KAU 2000 AD

PAPERS AND PROCEEDINGS OF THE SEMINAR
organised by the Kerala Agricultural University

DIRECTORATE OF EXTENSION
KERALA AGRICULTURAL UNIVERSITY
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PREFACE

With the passing years, an increasing proportion of the Agricultural Scientists in Kerala will be alumni of this University. This casts a great responsibility on us. We have necessarily to work against a sufficiently long perspective—at least the end of the Century—in order to discharge this responsibility. Soon after I took charge as the Vice-Chancellor, I circulated a letter to all the Professors canvassing their reactions to the changing character of agricultural activity in the State and how the University should gear itself up to meet these challenges. The response was comprehensive and heartening and has been the inspiration for this Seminar.

As in the life-history of an individual, so in the case of Institutions, we can differentiate stages of development. In the infancy of this University, strong administrative measures and strict discipline aided by the spell of Emergency ensured its survival amidst the perils of infant mortality. This was followed by a spell of rapid growth, somewhat unbalanced perhaps, until now the University is typically in an "adolescent" stage. We can recognise the analogue of "sibling jealousies" among the "older" and the "existing" Faculties and those in "gestation"! We have a "Narcissus complex" leading to complacency and self-admiration; there is an "Oedipus complex" in the form of a preference for its own offspring for job-placements and a corresponding predilection on the part of the alumni to seek jobs in the University in preference to anywhere else in the country, though not perhaps in the Wide World abroad!

I think that of these the worst is the tendency towards complacency and self-approval. Combined with it and re-inforcing it, we share with the rest of Kerala an "anti-work" attitude which cuts at the very roots of progress and frustrates all our movement in any direction what-so-ever. Any excuse is good enough to explain failure to work, particularly if blame can be cast on somebody else. A pathological fear of "unemployment" in the absence of a job in Government or quasi-Government service is the obverse of this anti-work attitude—employment which can be turned into a sinecure is the "Holy Grail"!

The result of these trends is to reduce the quality of work done in the University as elsewhere in Kerala. As an Institution which is devoted to Learning not only in an abstract sense but also committed to constantly concern itself in the welfare of the agricultural masses of the State, we have to maintain excellence through Research to find solutions to the problems facing them, to Educate the young students entrusted to our care to commit themselves to this cause instead of merely seeking the Degrees of competence to assure themselves of jobs in Government and simultaneously through Extension to ensure that the benefits of our activity for which the People of the State foot the Bill pass on concurrently and continuously to the farmers of this State.

All these we have to achieve in a world of rapidly changing technological and scientific advance and changing aspects of social relevance. A necessary and equally rapid modernisation of every aspect of our working, in the Offices and the Classrooms as much as in the Laboratories, has to be gone through if we are to justify the scientific base of what is claimed to be a Professional Service.

It is to these problems and prospects that the Proceedings of the Seminar draw attention in the following pages.

Mannuthy,
4th September, 1985.

T. MADHAVA MENON
Vice-Chancellor

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PART I

PROCEEDINGS

1

Organisation and Objectives of the Seminar

Making futurological predictions in a world of rapidly changing technological and scientific advances is rather an onerous exercise. This is especially so in the field of Agriculture in view of its myriad uncertainties. However, identifying thrust areas for future development, framing long-term policies and drawing a perspective plan of action for development would, perhaps, be rewarding.

The agricultural scene in Kerala presents many unique features and in the past few decades conditions in the farm front have changed so rapidly that many conventional solutions are no longer relevant. As the agency charged with the responsibility of leadership in teaching, research and extension in agricultural subjects, the Kerala Agricultural University has recognised the dynamics of Agricultural development in the State and is responding suitably for today as well as tomorrow.

It was against this backdrop, the University held the Seminar "KAU 2000 AD" from 22nd to 24th November, 1984 at its Main Campus at Vellanikkara, Trichur. The Seminar was organised and coordinated by the Directorate of Extension, Kerala Agricultural University.

The major objective of the Seminar was to give a long-term perspective to agricultural research, education, extension, administration and finance and social organisations and uplift of the underprivileged sections of the people. The Seminar also aimed to serve as the forum for a loud thinking to crystallise the modalities of the University's continued performance as an advanced centre integrating the aspects of research, education and extension in agriculture in its broadest sense

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Summary of Proceedings

The Seminar was inagurated by His Grace Mar Gregorios, Arch Bishop of Trivandrum on November 22. In his keynote address, His Grace underscored the need of orienting agricultural research help draw the greatest benefit from the resources, nature has placed at our disposal with a bounty beyond words. "The greatest of these resources", His Grace pointed out "is our abundant sunlight". He also emphasised the need for KAU to intensify research on low-cost farm practices in place of capital-intensive technology practised by the West.

Shri. T. Madhava Menon, Vice-Chancellor, Kerala Agricultural University, welcoming the gathering spelt out the objectives of the Seminar. Dr. N. Sadanandan, Dean, College of Agriculture, proposed a vote of thanks.

Lead Papers on Agricultural Education, Agricultural Research, Extension Education, Veterinary and Fisheries Education, Administration and Finance and on the Role of the University in the Welfare of the Underprivileged Sections of the people were presented by eminent scientists and administrators from both within and outside Kerala State. In all, about 70 Papers were presented during the Seminar.

Under the chairmanship of Dr. S. Vasudev, Chairman, State Committee on Science, Technology and Environment, Kerala, Prof. A. Abraham, Chairman, Tropical Botanical Gardens and Research Institute, Trivandrum; Dr. C. Prasad, Deputy Director General, I. C. A. R, New Delhi and Dr. K. V. Ahmed Bavappa. Director, C. P. C. R. I., Kasaragod, presented Lead Papers on 'New Horizons of Agricultural Education', 'Extension challenges 2000 AD', and 'Problems and perspectives of Agricultural Research', respectively.

On November 23, Lead Papers were presented under the chairmanship of Dr. M. N. Menon, Commissioner of Animal Husbandry (Retd.), Government of India. Shri. P. S. Habeeb Mohammed, IAS, Vice-Chancellor, Kerala University; Dr. P. K. Gopalakrishnan, Member, State Planning Board, Trivandrum; Shri. T. Madhava Menon, IAS., Vice-Chancellor, Kerala Agricultural University and Dr. M. N. Menon presented papers on 'Administration & Finance', 'Problems of Organisation and Management', 'The Role of the University in the Welfare of the Underprivileged Sections of the People', 'Animal Husbandry, Veterinary and Fisheries Education', respectively. This was followed by a session on Research under the chairmanship of Dr. S. Kedarnath, Director, K. F. R. I., Peechi.

The Theme Papers on Research, Education, Extension, Administration and Finance and Campus Planning were presented by the Officers of the University, followed by Satellite Papers on the above topics presented by the delegates. At the end, Thought Papers on the proposed faculties and centres of excellence such as

Horticulture, Co-operation, Rural Home Science, Forestry, Agricultural Engineering, Agricultural Economics, and Agricultural Statistics were presented on Nov. 24.

The Papers were presented in four major sessions covering Research Education, Extension and Administration and Finance, and Social Organisation and Uplift of Underprivileged Sections.

The Session on Research recommended that the University should gear up its research to cater to the needs of small and marginal farmers. Screening for photosynthetic efficiency and maximising the harvest index, plant improvement by genetic engineering, and exploitation of bio-fertilizers were recommended. In the plant sciences, studies should involve biological nitrogen fixation, mycorrhiza, biogas production, fermentation technology, molecular cloning and tissue culture.

In animal sciences, studies should include embryo transfer, deep freezing of embryos, development of new cross-bred types of animals and improved strains of poultry suitable for our agroclimatic condition, development of low-cost feed, utilisation of farm produce, farm waste, and agricultural by-products, and studying the etiology of diseases of livestock and poultry.

In fisheries research, KAU should give stress on culture fisheries with a view to increase production from reservoirs and other inland water sources. Mixed farming involving crop-fish-prawn culture techniques have to be standardised. To solve the problems in fish culture and processing faced by the weaker sections including fishermen, scheduled castes and tribes appropriate technology should be developed.

The session on Education recommended an evaluation of the present trimester system, separate faculty for post-graduate studies and internship for the different professional courses, periodical review and updating of curriculum and re-organization of the University library on the modern lines.

The session on Extension recommended establishing a Centre for Rural Development communication with a TV studio, sound recording studio, Press which can use advanced printing technology and other training facilities and starting a rural newspaper.

The session on Social Organizations and Uplift of Underprivileged Sections recommended that the University should take up steps to provide the expertise in various fields of rural development by imparting education and training to the people working in rural and social organizations free of cost. Attempts should be made to strengthen organisations like young farmers' clubs and women's clubs. The Seminar came to a close on Nov. 24 with a valedictory function presided over by Shri. T. Madhava Menon, Vice-Chancellor, KAU.

The Seminar was attended by about 300 delegates including teachers, supporting staff, and students of KAU, scientists from other research institutions, representatives of farmers, extension personnel from development departments in the state and personnel from input agencies, commodity boards and voluntary organisations.

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Recommendations

SESSION ON RESEARCH

General Recommendations

1 The organisational set up of research should be on a multidisciplinary basis wherein scientists belonging to different disciplines could work in close collaboration with sustained interaction at all levels. The centres of advanced studies/centres of excellence in important areas in the faculties may be established to promote such collaborative research activities.

2 Progressive replacement of sophisticated foreign items of equipment should be attempted wherever possible with indigenous ones. In some cases, research may involve high costs. This can be justified if the technologies developed in such research programmes have wide adaptability and very high cost-benefit ratios.

3 Organised and systematic exploration of the Western Ghats by joint teams of scientists from the Kerala Agricultural University, Kerala Forest Research Institute, NBPGR, the Kerala and Calicut Universities, etc., should be planned and conducted at periodic intervals to collect the fauna and flora of value. The materials thus collected should be systematically evaluated to groom the promising ones for commercial utilisation.

Agriculture Faculty

1 Screening for photosynthetic efficiency and maximising the harvest index, plant improvement by genetic engineering, breeding varieties for stress and resistance to diseases and pests.

2 Standardisation of agro-techniques for maximum utilisation of applied nutrients.

3 Exploitation of bio-fertilizers.

4 Bio-technology in plant, animal and fisheries sciences should receive adequate attention in the future. In the plant sciences, such studies should involve biological nitrogen fixation, mycorrhiza, biogas production, fermentation technology, molecular cloning, sky farming and tissue culture. In the animal sciences biotechnological studies should include embryo transfer, recombinent DNA technique, hydridomas and monoclonal techniques and deep freezing of embryos.

5 In crop protection, short-term warning services and long-range forecasting systems should be developed for pests and diseases. In a centre for plant protection, all aspects of pest and disease management and also the crop protection equipment including forecasting systems could be taken up. Further, this would provide strong interaction between scientists working in the related disciplines of crop protection.

6 Studies on land use pattern are essential in view of the rapid fragmentation of agricultural holdings.

7 The entire research should be on a cropping system approach. Varieties mainly required, microbiological studies, studies on soil factors, recycling of organic matter etc., should be undertaken on a system basis.

8 Standardisation of technology for different cropping systems for different size of holdings should be attempted.

Veterinary and Animal Sciences Faculty

1 Development of new cross-bred types of animals and improved strains of poultry. With regards to poultry, the main emphasis should be given for the development of promising strains suitable for the backyard rearing system.

2 Collecting and maintaining germplasm preserves of indigenous livestock and poultry for identifying promising types and for undertaking future improvement programmes.

3 Investigating the causes and suggest remedial measures for infertility and delayed maturity of cross-bred animals.

4 Standardisation of production technology of low-cost nutritive feed for cattle and poultry by utilising available farm produce, farm wastes and agricultural by-products.

5 Studying the etiology of important diseases of livestock and poultry and to find out preventive and curative measures.

6 Studies on the aflatoxins should be undertaken.

7 Development of economical and efficient management system for livestock and poultry for different agro-climatic and socio-economic conditions of the farmers of Kerala.

8 Standardisation of economic and hygienic production of livestock and poultry products.

Fisheries Faculty

In fisheries research, Kerala Agricultural University should give stress on culture fisheries with a view to increase production from reservoirs and other inland water sources. Mixed farming involving crop-fish-prawn culture techniques have to be standardised. With the above view, the following thrust areas can be considered for research in fisheries.

1 Development of viable technology for the commercial cultivation of fin fishes and shell fishes.

2 Development of composite culture of Indian and exotic major carps along with suitable local species.

3 Development of techniques of paddy-cum-fish and prawn culture.

4 Studies on fisheries biology, ecology and processing technologies and fisheries management should be undertaken.

5 Problems in fish culture and processing faced by the weaker sections including fishermen, and SC/ST persons should be studied and appropriate technologies for their economic betterment should be developed.

There is considerable scope for crop-livestock-fisheries integrated production systems particularly the rice-pig-duck-fish system. It is essential that the rice varieties with insect and disease resistance should be identified or developed to ensure that pesticidal applications are avoided or reduced to the bare minimum so as not to cause hazards to fishes.

SESSION ON EDUCATION

General Recommendations

1 The trimester system has its merits and drawbacks. Elimination of draw backs and retaining and enriching the merits are needed. Semester system may be a suitable substitute.

2 Basic science subjects and humanities related to the different applied sciences may be included.

3 A separate faculty for post-graduate studies may be established.

4 Internship for the different professional courses should be made compulsory.

5 Establishment of centres of advanced studies in specialised areas relevant to the economic prosperity of the State may be given top priority.

6 New post-graduate programmes may be instituted in subjects identified for the purpose.

7 Evaluation of teachers should be done periodically. Apply correctives wherever needed. Encourage deserving teachers.

8 Production of textbooks relevant to local conditions should be undertaken.

9 Organisation of a University library in the modern lines should be assigned top priority.

10 Facilities should be provided to enable students to undergo post-graduate programmes in other Universities in India.

11 Periodical review and updating of curriculum should be done.

12 Encourage teachers to participate in symposia, seminars, workshops etc. in other Universities.

13 University campuses should be developed as fully residential campuses with all necessary amenities for students and staff.

14 Aptitude and interest should be the criteria in selecting students to the various courses.

15 Practicals to be given more importance than theory to instil confidence in the graduates as fullfledged agricultural technicians.

16 Provisions should be made for the full development of the personality of the student. He/She should get facilities to develop inborn talents such as sports, arts, literature, music, histrionics, etc. Institution of character and personality building aids such as yoga and meditation may be considered.

17 Newer and more effective teaching methods, including use of sophisticated aids, may be introduced. Teachers who evolve such methods may be encouraged by giving awards.

Specific Recommendations

1 Post-graduate programmes in fisheries should be started and adequate equipment and infra-structure for teaching and research should be provided.

2 A National Commission to examine fisheries education in India and to reorganise on a national and regional perspective should be instituted.

3 Agricultural Engineering education should be organised at 4 levels:-

   1 Farmer's level
   2 Technicians/Mechanics level
   3 Graduate level
   4 Post-graduate level

4 Alternative energy sources, crop processing structures, dairy food engineering and bio-engineering should be given priority in Agricultural Engineering education.

5 Middle level courses should be diversified.

6 Formulation of short-term training courses in agriculture and related fields including processing technology for village youth and women. Training camps should be organised for imparting these trainings.

7 Agriculture and related subjects should be introduced at the school level.

8 The following Faculties may be started:

   a Horticulture Faculty
   b Forestry Faculty
   c Rural Home Science Faculty
   d Agricultural Engineering Faculty
   e Co-operation Faculty

9 Teaching of Agricultural Economics and Agricultural Statistics should be strengthened.

SESSION ON EXTENSION AND ADMINISTRATION AND FINANCE

1 Cluster/group/association/club approach superimposing group management over individual ownership and initiative coupled with system model for extension should be fostered.

2 A Centre for Rural Development Communication with a TV studio, Sound Recording Studio, Press which can use advanced printing technology and other training facilities should be established.

3 A rural newspaper should be started.

4 Adequate recognition should be given for extension work performed by scientists.

5 Regional Extension Units and District Extension Units should be established.

6 Extension Department may be strengthened for having a common P. G. Department for Extension Education for various faculties in the University.

7 Efforts should be made to increase the internal revenue of KAU.

8 Departments of Extension should be established in all the faculties where there are no departments at present.

9 A Continuing and Adult Education Centre with the help of national and international funding agencies should be established.

10 Advisory Centres at taluk level veterinary hospitals may be established.

11 The University should involve more in TV, Radio and Newspaper programmes.

12 Public Relations Unit and Information Centres of the University should be strengthened.

13 Appropriate selection, promotion and transfer policies for staff may be formulated.

14 Consultancy Services should be established.

SESSION ON SOCIAL ORGANISATIONS AND UPLIFT OF UNDERPRIVILEGED SECTIONS

1 The need to fill up the communication gap between farmers, producer organisations and research workers should be satisfied by farming a cell in the extension wing of the University.

2 The University should take up measures to provide the expertise in the various fields of rural development by imparting education and training to the people working in rural and social organisations free of cost.

3 The University should take up research projects to solve the problems faced by the voluntary and social organisations in the vast area of rural development especially in areas related with the underprivileged sections of the society.

4 To provide the necessary personnel for the management of rural organisations producers organisations and voluntary agencies the University may take up, steps to offer relevant courses in areas like rural sociology, rural organisations including co-operatives and rural home science and forestry.

5 Attempts should be made to strengthen organisations like young farmers' club, women's club etc.

PART II

INAUGURAL ADDRESS AND KEYNOTE ADDRESS

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Inaugural address and Keynote address

His Grace Benedict Mar Gregorios

Arch Bishop of Trivandrum

The 2nd millennium of the Anno Domini (era of grace) is drawing to a close and we are standing on the threshold of the 3rd millennium. Wise people, are everywhere taking stock and making plans. It is quite appropriate that, on this momentous occasion, the Kerala Agricultural University, in which so much hope is reposed for a better and meaningful life for the people of Kerala, should do the same.

Kerala has its own position—its strength and its weakness. Its past history may be summarised as a series of golden opportunities lost. The per capita income in Kerala is one of the lowest in the world.

At the same time, the expectations Kerala raises also are immense. In the eyes of social scientists, the world over, Kerala is an object of wonder. The Overseas Development Council, Washington, D. C. rates Kerala's Physical Quality of Life Index (P.Q.L.I.) rather close to the highest in the world. Among the Indian states, Kerala has no equal. If Kerala's P. Q. L. I. is 100, that of Tamil Nadu is rated 36. It is therefore in a spirit of optimism that we should face the theme before us: Kerala Agricultural University 2000 A. D. In order to have a clear vision of the KAU and to understand its proper role in the future, naturally we have to have first of all, an overview of the situation in India as a whole.

Gunnar Myrdal in his 'Asian Drama' says: "It is in the sector of agriculture that the battle for long-term economic development is won or lost". For any country, agriculture is the foundation of the economic edifice; industry, the walls and the professions, the superstructure. In India, where nearly 80% of the population live off the land, this comparison is all the more valid. We have at present a weak foundation supporting still weaker walls on which ultimately rests too heavy a roof. The whole economy is in a precarious situation; it may collapse any moment. It is therefore urgently needed to strengthen the foundation as well as the walls and to lighten the superstructure so that we have a viable and strong economic edifice.

In this process of reconstruction we have now reached a crucial moment. We are now at the end of the VI Five Year Plan. By the year 2000, if all goes well we will have completed 3 more Plans. Thinking about 2000 A. D. and beyond it would be profitable to give some thought to the rhythm of our development so far. In the first two Five Year Plans, the main concern was to harmonise public and private sectors without deliberately thinking of the harmony that should exist among the various sectors of the population. In the III Plan there was stagnation. The per capita availability of food (16 oz.) in 1966, was less than in 1950 (17 oz). It was in the IV Plan that emphasis began to be given to the weaker sections of society. A number of specific programmes were initiated for the small farmers and for the rural population as a whole. Elimination of poverty was the dominant aspect of the V Plan. Now it was clearly realised that unless deliberate attention was given to the problem of unemployment and income distribution, it would take thirty or fifty years for the poorest sections of the people to reach a minimum consumption level. Consequently a National Programme for Minimum Needs was devised. This objective dominated also in the VI Plan. Now when a national debate is going on regarding the VII Plan, it is advisable to pause and evaluate our achievements so that we could go ahead with confidence and with determination.

The fact that in the production of food grains, the country has made conspicuous progress should not make us complacent and we should not close our eyes to the fact that our potential is incomparably high. It was Daniel Moynihan who said that the Indo-Gangetic plane alone, if properly developed, could produce enough food grains not only for the whole of India but also for the entire world. India has more arable land than Russia. Our progress is remarkable only because our starting point was incredibly low. Even today in almost all commercial crops productivity in India is not only lower than in all developed countries but lower even than in some developing countries. In a report in the Hindu two days ago, we get a glimpse of what could be achieved with better planning and management. According to this report Thanjavur Delta had an all-time high production of rice—small and marginal farmers produced 5.5 tonnes a hectare. There is now, for the Government a serious storage problem. Over one lakh bags of paddy were kept in different temples and other buildings besides the large quantities stacked in the open.

The VII Five Year Plan is fortunately to give the highest importance to the rural population, among whom backwardness and poverty have become chronic and practically institutionalised. The fight against poverty has in practice to be carried on in the rural sphere. Production of food, rural employment and productivity are the main thrusts of the proposed VII Plan.

Against this background let us now consider KAU 2000 A.D. The primary duty of our University is agricultural education. In promoting agricultural education, we must strongly resist the temptation blindly to imitate or copy Western patterns. In the West, agriculture has taken on the nature of an industry–the ideal is to produce more and more goods from lesser and lesser area. There the rate of progress in agriculture is measured by the rate at which the human factor is eliminated from agricultural activities. In a typically advanced Western nation, five or six persons working on land could supply agricultural products sufficient for a hundred persons and even more.

The situation in India is quite different in most respects. For us agriculture is not just a means of eking out an existence, nor just a source of income. It is a way of life. It has a culture and a philosophy of its own intimately affecting the quality of human life. "The farmers live in close harmony with nature—the majestic temple of creation. Their work has to do with the life of plants and animals – a life inexhaustible in its expression, inflexible in its laws, rich in allusion to God, the Creater and the Provider. They produce food for the support of human life and the raw materials for industry in ever richer supply. Theirs is a work which carries with it a dignity and nobility all its own. It is a work which demands a capacity for orientation and adaptation, patient waiting, a sense of responsibility and a spirit of perseverance and adventure" (Pope John XXIII). Education and modernisation of agriculture in a developing country like India, with its own social traditions, should take this and similar facts into consideration.

At the same time there are many things which we could with great profit accept from developed countries. In general it may be said that in the world as a whole, in the last fifty years, more knowledge has been accumulated in agriculture than in all the previous ages from the time man began the art of cultivation. Unfortunately most of our people remain in complete ignorance of this great wealth of knowledge which is really the common property of mankind. Pandit Nehru said long ago: "We all know better implements, better ploughs, better seeds, more irrigation, more fertilizer, more manure etc. etc. Everyone knows what has to be done and where it has to be done. Yet when you spell it out the problem becomes big for there are sixty million farming families in India. It is not a question of lack of resources. We have to train up 60 million families and prepare them mentally to do the job as they should. That is the problem".

Added to this, in India and particularly in Kerala, there is the most pernicious attitude of considering idleness as more dignified than working with the hand. Gandhiji was convinced that India's main economic ailment was the widespread idleness of the labour force and the lack of intensity in work performance.

The role of the Agricultural University as a centre for teaching and as a medium of education consists in orienting and conscientising the people and thus getting them involved in the process of development. Attitudes have to be changed. The standard of literacy and general education in Kerala could play a catalytical role in such development..
(Miseducation: Myrdal, Ignorance and Confusion: Kusum Nair).

In my view, the University has to involve itself much more in the work of extension and in making available to the farmer the new knowledge in agriculture. As regards the good of the people, it does not matter in the least who does this process of communication, the University or the Government departments. The University seems to be more equipped and more suitable for this work than any department of the Government with its bureaucracy. This work has to be done and most urgently, and all human resources including voluntary agencies should be mobilised and should be actively and intensively involved.

The work of education and extension should be carried on thoroughly and effectively in the surroundings of the University as an integrated programme. The dedicated work of the staff and the students could bring about a significant change and alround improvement in the area around the University. Once this has been achieved this process will rapidly spread in still wider circles. Nothing succeeds like success. Words fly and example moves. This is all the more true in Kerala, where there is a lot of miseducation and consequently resistance to change. It would be possible in this way before long to transform the whole of Kerala and what Kerala could achieve tomorrow, would very strongly influence the rest of the country.

Given our initial backwardness, a serious effort on the part of the people will show rapid progress in the initial period and this would create greater confidence. "Without any innovation and even without any investment other than longer and more efficient work, agricultural yields could be raised very substantially. At present our agriculture is strictly not labour-intensive, but labour-extensive," (G. M.). Inverting the words of Christ, we could describe our present position: "The harvest is little, the labourers are many".

What has been said about imitating patterns of agricultural education in the West holds good all the more in the field of research. Since agriculture in the West is capital-intensive, research also has the same bias. Most of the research in the West is highly sophisticated and suit to the social and climatic conditions of the West, quite different from those of India. Only an infinitesimal part of the research in the West is made with the interest of the developing countries in view. The West has passed the stage of the first and the second agricultural revolutions. They have reached a state of permanent agricultural revolution. We are still practically taking the first faltering steps in agricultural revolution. In India, with its population more numerous than the total population of U.S.A. and U.S.S.R., and most of the people depending on land, for their living, agriculture and research should have a labour-intensive pattern in view. It is true that India needs industrialisation as fast as possible. However, in the special context in our country, we could ask how fast is fast enough? There are various restraints. First of all we lack captial. Secondly it is not possible from a primitive agricultural system, to gain entrance immediately into an industrial system, which requires a whole change of climate and temper for which we are not ready, either by temperament or by training. The ever increasing labour force in India will continue to press more heavily on the land, since alternative employment is simply non-existent nor possible in the near future. "In consequence, the larger part of modern agricultural technology is unadaptable to Indian conditions and a new technology has to be devised" (G. M.). Simply to adopt the findings of research in the West will, therefore, be counterproductive and the gap between the advanced countries and India would only increase rapidly. It is therefore necessary to devise a process of research and modernization strictly appropriate to our social, economic and climatic conditions.

For us the orientation of research should be to help us to draw the greatest benefit from the resources nature has placed at our disposal with a bounty beyond words. The greatest of these resources is our abundant sunlight. Sunlight (Photosynthesis) being the ultimate limiting factor in agricultural production, other things being equal, from a given area of land, we can produce four times as much crop as in the temperate zone, say in New York (Climate in England).

Among agricultural practices, the use of fertilizers is a major prerequisite. In this respect India ranks very low. In the 60's Japan used more fertilizer than India, although the cultivated land in Japan was only 4% of that in India. Actually India used 3.5 kg. per hectare as against 100 in Europe, 270 in Japan and 462 in New Zealand.

Since mineral fertilizers are extremely costly and they would be increasingly so in the future, we should make every attempt to identify crops which have very high nitrogen fixing qualities. The National Academy of Sciences in Washington, D. C. has made thorough and extensive research to identify leguminous crops suitable for the tropics. Of these Leucaena (recently named Subabul by the late Prime Minister Smt. Indira Gandhi) is the most important. There are also other trees almost equally beneficial and versatile—*Acacia mangium* and *Calliandra* for example. The Kerala Agricultural University could start from this point. They could also identify other crops suitable to conditions in India. NPK and all trace elements like calcium and magnesium could thus be produced in abundance with the added advantage of eliminating pollution.

Social forestry will help ordinary people to find the fuel they require for cooking. Planners consider that by 2000 A. D. the supply of grains could be adequate for all the people in the world. But the fuel for cooking food would become more and more scarce. It is now time for us to plan for such an eventuality. Social forestry is also a rich source for finding rural employment. Social scientists now strongly advocate that the movement of people from the rural areas to the cities should be effectively discouraged. Instead of uprooting people and taking them to new areas for work, they say that people should be left where their roots are and work should be taken to them there. Along with this, common amenities available in the cities should be made available also to the rural people.

Another important field for research is that of irrigation. For Kerala the problem is normally not the scarcity of water, but the management of water. The abundant precipitations that we have are confined to two periods in the year. Supply of moisture in the long period between December and April could greatly increase agricultural production. (Robert Bradfield on Intercropping cocoa under coconut, five different annual crops). (Ponnaiya on coconut trees dressing up in Kerala.)

By the year 2000 various disciplines will naturally become more integrated. In this respect I should like to make an important remark on processing of agricultural products.

Objective studies by social scientists under the auspices of the UNO show that normally a farmer gets only about 10% of the market value of the goods he produces. Ninety per cent of the value goes to those who process and sell these goods. In today's economic system, agriculture, divorced from processing, is almost the synonym for poverty. No country relying only on agriculture can come out of poverty and misery. For the Agricultural University, as a centre for education and an organ for social change and development, these subjects also should be of concern.

The Government on its part should encourage and enable the University to play its role effectively by helping it and by giving it full freedom in acquiring and defusing to the fullest extent, new knowledge and skills in the development of the economy and developing social life. If we are to catch up with other centres of learning elsewhere, very generous financial allocation must be made especially for research. In advanced countries where agriculture has comparatively only a secondary role, huge amounts are granted by the Governments and also by rich citizens for agicultural research.

I am fully convinced that, in the present context in Kerala (India) the most gainful and the most beneficial investment will be investment in agriculture and agricultural research.

PART III

PAPERS

A. Lead Papers

5

New Horizons of Agricultural Education

Prof. A. Abraham

Chairman, Executive Committee,

Tropical Botanic Garden and Research Institute, Trivandrum

I do not look on this Seminar as an exercise in futurology, because we are discussing what our Agricultural University should be in 2000 AD, just 15 years from now. This will cover 3 plan periods—7th, 8th and 9th plans, assuming that the basic span of our National Plans will continue to be 5 years each. Anyway, that is more an administrative matter rather than a scientific one, and in my short address I wish to restrict myself as far as possible to development of Science and Technology in relation to agriculture. By agriculture I mean all that this Institution now comprehends in its curricula, teaching, research and extension, as well as any other aspect that may be added to your responsibilities.

India is basically an agriculture oriented country, and the well-being of the 730 million people, which may be 900 million by 2000 AD, depends on agriculture. Even in the most advanced and prosperous country in the world, namely the United States, its prosperity is dependant on agriculture. The idea of Agricultural Universities came from United States. Originally they were called Land Grant Colleges as Government gave a large piece of land to develop colleges concerned with "agriculture and the mechanical arts". Naturally, as developments elsewhere took different shapes and USA itself was only a product of the old world, by which, I mean Europe, these Land Grant Colleges later became very advanced Universities catering to all the needs of advanced training and research, both fundamental and applied, and it is very difficult now to distinguish an American University from one of the more recent European Universities.

Fourty years ago when I was a graduate student at the famous University of Cornell in upper New York State, U. S. A., I had the opportunity to see how much an University can be involved in work outside its laboratories and libraries and gardens. I am referring to the 4-H clubs in many Universities in the United States, where young boys of the age group 9-14 are given fairly advanced training in horticulture and various aspects of growing plants, rearing chicken and pigs, and in many other ways inculcating in the young minds a love for the land and the environment. When these boys and girls grow up, and finish their formal education, be it in space science or higher mathematics or economics or any other area of human interest, they will still remain plant lovers, and this would mean a revolutionary change in the attitude of our people, whether they be priests or politicians or dedicated to any other profession.

The Agricultural University of 2000 AD will be the leader in ensuring that our growing millions are fed and properly nourished. Malnutrition at an young age, upto 5 years, can seriously hamper proper development of the brain. So it is not enough to appease hunger, but ensure proper nutrition.

Inspite of the many efforts made by the United Nations and many other agencies in the last two or three decades, even today it is estimated that 500 million people go to bed without a meal in the evening. Most of us who have never tasted starvation cannot understand what it really means to go hungry, and worse still not able to pacify a crying hungry child. This is a standing shame on our so-called civilisation.

If a portion of the money spent on ever increasing allotments for armaments is spent on food production of various types, plants as well as animals, we can totally prevent malnutrition. This statement is fully based on correct statistics gathered over a period of time.

As I mentioned already 2000 AD is only 15 years ahead ie., 3 plan periods. Can you in the Agricultural Universities dedicate yourselves to this most important task of harnessing newer and newer scientific discoveries to ensure that by the beginning of the 21 st century we are able to feed properly our immense population.

In the past three decades tremendous progress has been made in Biotechnology, particularly in Genetics. As that happens to be a field in which I had some advanced training, and I have been involved in plant breeding work for many years, I shall touch on that subject.

In a recent address delivered at Colombo, Dr. M. S. Swaminathan, our most outstanding Agricultural Scientist, who is currently Director-General of the International Rice Research Institute in the Phillippines underlined the role of genetic engineering has stated that in the short term, the following areas of biotechnology offer immense promise in Agriculture.

a) Tissue culture for clonal propagation and germplasm conservation.

b) Haploid culture techniques

c) Somaclonal variation and cell culture screening

d) Embryo culture

e) Protoplast fusion

f) Monoclonal antibodies and hybridoma techniques in disease diagnosis and control

g) Gene transfer

h) Regulation and control of gene expression

Depending on the nature of the problem, the appropriate technique will have to be chosen.

But if we have to succeed in this effort to make use of the immense possibilities opened up by genetical research we should initiate anticipatory action to ensure that we have the trained personnel of high calibre to meet any challenge, adjust to ever increasing flow of new knowledge and be ourselves leaders, and not mere camp–followers. Transfer of highly sophisticated technology takes time. In the United States almost any new discovery and its applications can be patented, just as a new Rose or Tomato hybrid can be patented. So let us take steps to get our bright students trained in the best laboratories in the world. This is a period of tremendous activity in genetic technology. Almost a third of the pages of Science and Nature carry new original papers on this and closely related subjects. When I was a graduate student there was hardly one or two pages on these subjects in these world famous journals.

I shall briefly touch on the significant landmarks in Genetics in the last 30 years.

1953	The double helix structure of DNA, its basic configuration was discovered by James D. Watson and Francis H. C. Crick
1962	First evidence for restriction enzymes, the chemical knives that help in splicing the genes was found
1966	The chemical make up–the sequence of amino acids that serve as the genetic instruction code—was revealed
1972–73	Techniques to clone genes, and re-design living organisms, bacteria in this case, were developed.
1975-77	Techniques for rapidly locating the sequence of sub-units in any piece of DNA enabled molecular biologists to read the message of the genes and thus use them more effectively.
1980-82	Commercial production of human insulin through engineered bacterial cells was achieved.
1983	First working man-made chromosome constructed, and in
1984	Dr. Barbara Mcclintock is awarded the Nobel prize in Medicine for her much earlier work in genetics which was then laughed at, but has since been accepted as valid—the so-called"jumping genes'—first presented in the early 1950s—almost at the same time as Watson & Crick's epoch making discovery.

Can we meet the new challenges facing us? It is my firm belief that we can do it. But how?

We have to adopt an entirely new approach to our whole system of education, research, training, and dissemination of knowledge. Today, thanks to the greater opportunities open to the really good young students, more and more of our talented youth are coming to agriculture. In my youth, by and large, it was only the student who could not get admission for anything he considered better who came to the Agricultural and Veterinary Colleges. In due course they come to senior positions in Government as Directors of Research and Education. You can well imagine what the consequence of having third rate people manning such Institutions. Government also treated the Departments of Agriculture as second rate or third rate departments.

Fortunately all that is undergoing rapid transformation, and today we find some of our most talented students going for the various branches of Agricultural sciences. The result of this will be felt in the coming years.

But I venture to say this is not enough. We must make the Agricultural services much more attractive,and be able to siphon atleast 10% of our best students to this area. How can this be done? We must give serious thought to this matter.

I would suggest that if the Kerala Agricultural Universty in 2000 AD is to be much better than it is today, we should plan now, not next year but this month onwards to take the necessary steps. I would make the following tentative suggestions for your consideration.

The Vice-Chancellor, who is a very able and distinguished administrator, should appoint a few Committees of experts, including some very outstanding men from outside Kerala and do the following.

1 Decide priorities for each 5 year plan.

2 Have experts decide what are the additional facilities needed to attain our targets of production, protection, marketing etc.

3 Have a well-planned training programme for promising young scientists at the M. Sc. level and see that they are placed in the best laboratories in India and outside and thus ensure we have a continuing stream of highly trained personnel. Atleast 10% of the staff should be away on such programmes each year.

4 Facilitate promising scientists to attend seminars, workshops etc. in other parts of India and in foreign countries.

5 Ensure promotion and such other encouragements based on merit.

6 Persuade Government to give adequate funding for all the above.

If we do these, and I expect during discussions other ideas will also come up, we will by 2000 A D have an Agricultural University which would be an Institution of excellence. We cannot have excellence without men and women of outstanding ability. We should avoid the dangers inherent in the process of inbreeding as far as our staff is concerned. I feel it is high time we have an Agricultural University Service so that transfers from one University to another would be possible.

I hope you will all rise to the challenge I have posed before you and will not be found wanting.

6

EXTENSION CHALLENGES—2000 A. D.

Dr. C. Prasad

Deputy Director General

(Transfer of Technology)

I. C. A. R.

GENERAL BACKGROUND

National Scene

Agriculture will continue to be the mainstay of Indian economy. The country has now about 730 million mouths to be fed as against 548.16 million in 1951—an increase of 181.84 million in 33 years. The birth rate continues to be 2.4 per cent during the Sixth Five Year Plan, whereas food grains production has been increasing at the rate of 2.32 per cent. The population is projected to be around 900 million by the turn of the century (935 million according to National Commission on Agriculture–NCA) and it may stabilise at around 1200 million by 2050 A. D.

The country has a highest record foodgrains production of 150.60 million tonnes in 1983–84—a substantial jump as against a target of 149 to 154 million tonnes for the Sixth Five Year Plan. According to N. C. A. (1976), the aggregate consumer demand for foodgrains for 1985 may range from 127.76 to 138.45 million tonnes; and for 2000 A. D. from 168.29 to 182.10 million tonnes. According to other estimates, the demand for foodgrains by 2000 A. D. may be 200–225 million tonnes. If the production target of foodgrains for the Seventh Five Year Plan of 188.0 million tonnes could be met, it may be possible to attain the target of 200-225 million tonnes by 2000 A. D. Our production scheme may also think of export potential and prospects for fine rice, coarse grains for animal feed, and improved seeds for neighbouring countries.

Our Agriculture has grown rapidly. From a growth rate of 0.3 per cent of agricultural production between 1900-01 and 1946–56, it has gone upto 2.7 per cent between 1950–51 and 1978–79. Table 1 gives a detailed picture.

A plan–wise review indicates that the growth performance in agriculture was 4.1 per cent in First Five Year Plan (1951-52 to 1955-56); 4.0 per cent in Second Plan (1955–56 to 1960-61); 1.4 per cent in Third Plan (1961-62 to 1965-66); 6.2 per cent in Annual Plans (1966-67 to 1968-69); 2.9 per cent in Fourth Plan (1969-70 to 1973-74); 4.2 per cent in Fifth Plan (1974-75 to 1978-79) and 2.7 per cent between 1950-51 and 1978-79. During Sixth Five Year Plan, a growth performance of 5.2 per cent is expected.

Table 1

Growth rate of area, production and yield

Item	Foodgrains		Non-foodgrains	
	1949-50 to 1964-65	1964-65 to 1978-79	1949-50 to 1964-65	1964-65 to 1978-79
Area	1.4	0.6	2.5	0.8
Production	3.0	3.4	3.5	2.6
Yield	1.4	2.3	1.0	1.3

Source: Sixth Five Year Plan 1980-85, Govt. of India.

The per capita availability of land comes to only 0.60 ha (60.20 ha in Australia and 0.35 ha in Japan)—one of the lowest in the world. The average size of farm holding is 2.0 ha (1976-77), but is fragmented in 5-6 parcels reducing the operating unit to 0.3 to 0.4 ha. There are 81.52 million farm holdings in the country of which 44.53 million are marginal (one hectare and below) (54.6%) and 14.70 million small (holding between 1 to 2 hectares) (18%). Thus a total of 72.6% farm holdings belong to marginal and small category. Presently, the area under cultivation is about 143 M ha of which 32 M ha are double cropped. Hence the gross area under cultivation becomes 175 M ha.

A lot of technological changes have taken place in the field of agriculture —in irrigated area, area under high yielding varieties, fertilizer consumption, land reclamation, yields of major crops etc. Nevertheless, there exists a wide gap between the potential of production and actual production in the country. Table 2 gives a more clear idea—the figures are the average of 9 years of results under National Demonstrations.

Table 2

Average Yields of Major Crops in q/ha between 1971-72 to 1979-80 under the National Demonstrations

Crops	Average of the country	Average of National Demonstrations	Average of Highest Yields of National Demonstrations.
Paddy	17.45	52.52	118.56
Wheat	13.77	36.66	81.95
Maize	10.28	34.16	80.49
Jowar	6.12	37.69	74.61
Bajra	4.35	25.18	49.66

There is a thin border between foodgrain requirement of the country and the production. Population pressure continues. Natural calamities and hazards—floods, drought etc. are frequent features. The distribution system further complicates the situation. While we are self-sufficient in foods, poor people cannot afford to have two square meals a day. In 1977-78, 51 per cent rural people were below the poverty line—48 per cent being the national picture.

The plantation crops are very important for the Kerala State. One would like to compare the yields of different plantation crops with the following table.

Table 3

Yield gap between national average and best managed gardens in plantation crops[1]

Crop	Yield (Kg/ha)		Gap	
	National average	Best managed garden	Actual	Percentage
Tea	1743	3100	1357	77.9
Coffee	750	1575	825	110.0
Rubber	790	2000	1210	153.2
Cardamom	48	200	152	316.7
Coconut	5249*	23100*	17851*	340.0
Arecanut	1037	4025	2988	288.1
Pepper	233	1100	867	372.1
Cashew	314	1000	686	218.5

* Number of coconut

Development in Kerala

The Kerala State has 1.03 per cent of the total area of the country and sustains 3.89 per cent of her population (over 22 million). The density of population is the highest in the country — 549 persons per sq. Kilometre. Kerala is agrarian in character—55 per cent population is engaged in agriculture including livestock, fishing and forestry. The total cultivable area is 30.40 lakh hectares with the intensity of cropping being 140.00. Of the total cropped area, 21.52 per cent is irrigated, 90 per cent of this is diverted for food crops specially paddy (80%).

The per capita cultivated land is only 0.10 hectare. The farm holdings continue to be fragmented as a result of pressure of population and the law of inheritance (unlike Japan). The total number of farm holdings is 28.23 lakhs of which 15.18 lakhs are below 0.04 hectare. Thus, most of the holdings have ceased to be economically viable. The crops grown in the State are: plantation crops—coconut, arecanut, cashewnut, pepper, coffee, tea and rubber; annual crops—paddy, tapioca, pulses, sesamum, cotton, groundnut, ragi and tobacco; and horticultural crops - mango, banana, cardamom. The major food crops are paddy and tapioca, oilseed crops are coconut, groundnut and sesamum, and pulse crops are cowpea, blackgram and redgram.

The special feature of Kerala agriculture is homestead system of cultivation with mixed cropping of perennial and annual crops and/or mixed farming of crops-livestock, crop-livestock-fish. The rice cultivation in areas of utmost adverse conditions viz. lands below sea level which is subjected to inundation by

1 M K. Muliyar, Transfer of Technology in Plantation crops, Journal of Plantation Crops, 11 (1):1-2 June, 1983.

sea water and extreme salinity (Kuttanad and Pokkali). The Sixth Five Year Plan targets envisaged are additional production of 20 per cent rice, 250 per cent pulses, 200 per cent cocoa, 50 per cent groundnut and sugarcane and 30 per cent coconut and sesamum.

The Kerala State leads all the States in the country in literacy–60.61 per cent.

The State Government has introduced the "Training & Visiting System" of Extension in all the 13 districts. The Directorate of Extension of the Kerala Agricultural University (KAU) with its (i) Training, (ii) Farm Advisory Service and (iii) Communication Units, organises the first-line extension programmes in the State, though, they are mainly localised around the main campuses. The Directorate also implements a number of ICAR sponsored Transfer of Technology Projects. For instance,there is a National Demonstration in Quilon district at Sadanandapuram; there are three Operational Research Projects on Watershed Management in Palghat district, on Agricultural Drainage in Alleppey district and Integrated Control of Rice Pests in Kuttanad; there are two KVKs at Pattambi (Palghat) and Ambalavayal (Wynad); there are two projects on Socio Economic Upliftment of Scheduled Castes (Nilambur) and Scheduled Tribes (Trivandrum); and there are 1100 farm families adopted by the University under the Lab-to–Land Programme.

In addition, there are ICAR sponsored Transfer of Technology Projects in Kerala which are being implemented by other Institutions / Agencies. For instance Central Plantation Crops Research Institute, Kasargod has 250 farm families under Lab-to-Land Programme, one Operational Research Project on Plantation Crops and another O. R. P. on Disease Management; the Central Tuber Crops Research Institute (Trivandrum) has 200 farm families under the Lab-to–Land Programme; the Central Marine Fisheries Research Institute (Cochin) has one Krishi Vigyan Kendra and one Trainers' Training Centre at Narakkal, 250 farm families under the Lab-to–Land Programme, and one O. R. P. on Blending Sea Farming with Traditional Capture Fisheries; the Central Institute of Fisheries Technology (Cochin) has 50 farm families under the Lab–to–Land Programme; and Mitraniketan (Vellanad) has one Krishi Vigyan Kendra and 250 farm families under the Lab-to-Land Programme.

The University spends only about 1.6% of its budget for extension purposes. The Vice-Chancellor is assisted by an Advisory Committee on Extension Education.

A comparison of growth rates of foodgrains production and population in the 70's indicate: in Kerala the growth rate of foodgrains is 0.21, growth rate of population is 1.75 and the difference between the two is 1.54 as against all-India figures of 2.32, 2.24 and 0.08 respectively.

Paddy and Tapioca are two major crops of the State. These crops figure in the National Demonstrations programmes prominently. The results are presented in Table 4. The rotations which gave better results were Paddy-Paddy-Pulse; Paddy-Paddy-Groundnut, and Pulse and Tapioca.

Table 4: Results of National Demonstrations during 1983-84 (q/ha)

Crops	N. D. Yield Average	District Yield Average	Ratio
Paddy	45.60	13.41	3.4
Tapioca	267.00	165.75	1.6

Through an ORP, integrated pest control has been successfully introduced in the project area through replacement of susceptible paddy varieties, Jaya and IR-8 by pest tolerant varieties like Jyothi, Bharathi and Triveni etc. Cultural methods like flood following of rice fields and early direct seeding/transplanting before September were recommended in the entire operational area to avoid the peak incidence of pests like brown plant hopper during February–March. New culture M-11–57-5-1 was identified through adaptive minikit trials. The concept of economic threshold of pest incidence was taken up as the control measures and was widely accepted by farmers in the region with the result that the number of sprays have been brought down from 6-7 to 1 or 2 even zero level, in some areas. Constraints analysis survey conducted earlier has proved the high cost of cultivation and low price of paddy as major constraints. The project has revealed that the net return in paddy from integrated pest management is Rs. 3300 as against Rs. 1600 from traditional methods.

EXTENSION SYSTEMS

The demand made upon transfer of technology for accelerating agricultural production is enormous and most formidable. This is a complex task—inter-disciplinary and multi-institutional in approach and content. This is why, integrated functioning of research, education and extension has been the cardinal principle of agricultural development system. The extension system involves (i) research institutions, (ii) educational institutions, (iii) training institutions/centres, (iv) marketing systems, (v) extension organisations / sub-systems, (vi) input agencies, (vii) village institutions and (viii) the farming communities. As a short as well as long-term strategy of development, a systems view of the extension organisation has to be taken for fostering functional linkages and creating synergistic effect.

In the Indian context, there are four major organisational streams devoted to extension work for agricultural and allied production: first, the ICAR Extension System; second, extension system of the Ministry of Agriculture; State Departments of Agriculture; third, extension system of the Ministry of Rural Development/State Development Departments; and four, development work by the non–government organisations, Business Houses, etc. The ICAR extension system comprises of mainly research institutes and the Agricultural Universities; the scientists and the extension personnel of these institutions are required to play "First–line" extension role through organising demonstrations, training, etc., on a limited scale, but forceful enough to have catalytic influence on other extension systems / sub–systems. The main agency for agricultural development work is the Ministry of Agriculture and the State Departments of Agriculture. The introduction of Training and Visit System (T & V) of extension by the Ministries is intended to strengthen the extension system considerably for rapid transfer of technology. The work of the Ministry of Rural Development embraces over 60 per cent agricultural activities. The Voluntary Organisations, Business Houses and other autonomous / non-government bodies have also been contributing to the rural development work including agricultural extension work. The Government has encouraged such development efforts by introducing section 35 cc/35 cc of the Income Tax under which Companies, Co-operative Societies, Associations, Institutions are entitled to a deduction in the computation of taxable profit of the expenditure incurred by them on any approved programme of rural development.

The Indian extension system has to deal with 81.5 million land holdings and about 500 million farmers, farm women, young farmers and agricultural labourers. Any extension system/sub-system, howsoever vast, cannot reach them quickly. Therefore, in Indian context, multiplicity of extension agencies, training institutions, input organisations, etc. and duplication of work by them is a misnomer. What is required is to develop and maintain strong functional relationship and play complimentary and supplementary roles influencing the total agricultural production in the country.

SOME BASIC ISSUES

Prelude to specific discussions on the strategy for transfer of technology for the Kerala agricultural University in 2000 A. D., some basic issues are being highlighted. They will have direct bearing on the University extension policy and programmes.

1. Professional commitment :

Contributions that one could make in one's profession and allied areas is directly related to his commitment to it. Fuller expression of individual's talent is only expressed in an environment which is charged with commitment. Under this state of mind one enjoys working rather than works under constraints and compulsion. Also an achieved professional sees all disciplines in their right relationship and perspectives—there is no decrying of any discipline. In an inter-disciplinary profession like agriculture, this becomes all the more important. But such values are being fast eroded and have adverse reflections on the academic world. Extension Education, being a relatively new discipline historically speaking has been a subject of less importance to many with the result its growth has been retarded. And the result is obvious—today the weakest link in agricultural production system is transfer of technology—an applied name of Extension Education.

The Universities should think of mechanism as to how such values could be restored and re-inforced among students and staff. Changing value system consistent to the need of the nation is one of the most important functions of the educational institutions.

2. Integration of Functions:

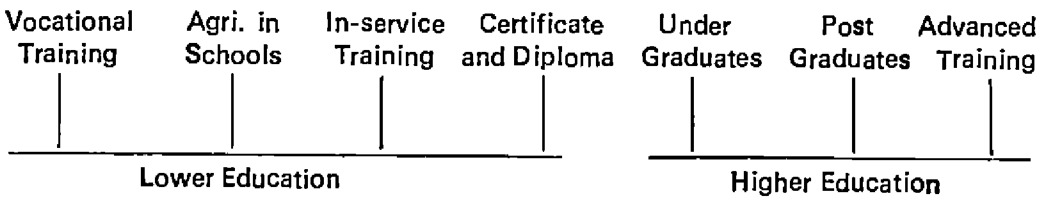
Integrated functioning of teaching, research and extension has been one of the basic premises on which Agricultural Universities were established. Initially these functions were to be handled by individual scientist on 1/3: 1/3: 1/3 basis. Later on it was changed to 2/3: 1/3 formulae and the provision for inter-change of functions at suitable intervals. How this formulae by and large has faired in our universities? Basically each of these three functions is a profession in its own right and one could justify working in one for whole of his life. One could be excellent in research, but not in teaching or extension work or vice-versa. One could be proficient in two, may be teaching and research, but rarely one could find one professional who is efficient and effective in all the three functions. But the basic inter-disciplinary character of agriculture leaves no room for isolated working; some interlinking has to be done. Therefore, the ideal way to achieve the integration of the related functions is to go by the interest and aptitude of the scientists, but with a caution that one must have some direct or indirect exposure to the function (s) which is/are not the main concern of the scientists. This approach alone could be productive in the long run.

But how the interest and aptitude are formed? or are they eternal? It could be, in fact, both. But this aspect could be titled from one area to another depending upon the motivation that we provide. For instance, more research papers means better opportunities for promotion. On this account both teaching and extension has suffered—the latter the most. Studies indicate that even extension professionals prefer research and teaching jobs vis-a-vis extension job. * It is essential, therefore, that all these functions get equal importance and then along there could be proper integration—there cannot be effective alignment between strong and weak. Besides, one must learn to appreciate the value of all these functions—first integration must take place in one's mind.

3. Educational Continuum:

Agricultural research and higher education have fairly advanced in this country, but not the agricultural education at the lower levels, below degree programmes. The lower education in agriculture will comprise certificate and diploma courses, in-service training programmes, agricultural education in school system, and vocational training programmes.

Fig. 1. Agricultural Education Continuum



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* Dr. V. K. Dubey, Integrated functioning of teaching, research and extension in Agricultural Universities, Ph. D. dissertation, IARI, New Delhi 1972.

At the first instance, it is very crucial to define the jobs where technicians (diploma and certificate holders) could fit in instead of utilizing surplus degree holders who are misfits in the technicians jobs. This also implies that education and training programmes must take a stock of our manpower requirements State-wise and device the educational strategy accordingly. This has been our weak link-production without a plan.

To strengthen the transfer of technology programmes, lower education in agriculture must be given due weightage. For instance, agricultural education has never fared well in school system in India, but it must be made to work. The school-drop-outs(65-70%)of rural schools or non-school goers really make the village population. If the school-drop outs go with some knowledge of rudiments of science and art in agriculture, this will go a long way in building our farming community for scientific farming.

The scope of vocational training in agriculture and allied areas has also to be provided in its right perspective. On an average in a district, according to 1971 census, there are 3.83 lakhs potential farmers and allied workers to be trained by short or long training courses. Taking a Krishi Vigyan Kendra as the latest mode of vocational training with better facilities and inputs and which trains about 3,000 farmers/farm women in a year, it will take 127 years to cover the entire district by one KVK with only one exposure of training. One could very well imagine the number of KVKs required in a district when vocational training is a continuous game. The National Commission on Agriculture (1976) recommended for three KVKs in each district to be established by 2,000 A. D and the ICAR High Level Evaluation Committee on KVK (1980) recommended for many more such vocational institutions in a district.

The University must define the role in lower education in agriculture.

4. Education content in Extension:

Extension literally means transferring an innovation, an idea or a thing from one person or place to another. Extension Education means an act of transferring the innovations with appropriate education so that the innovations are properly understood and related skills are acquired leading to conviction, action and adoption. Through this process, we build our traditional farmers to modern and enlightened farmers. But, by and large, the observations support that our transfer of technology efforts have been more of an extension effort in literal sense than as extension education effort. Thus, our farming community remained neglected as far as their proper education (non-formal) was concerned and hence they adopted innovations in sporadic manners with fluctuations in production. The lack of such educational effort also implies that our extension effort will continue to remain over-burdened for transmission of knowledge, because the farmers could not be prepared for seeking knowledge and information on their own from the extension agencies.

Since inception of extension work in India, people's participation in the programme has been emphasised. Through the extension work people were to be helped to help themselves. And in due course, it was expected that the process of seeking information on the part of the farmers will be a dominant feature instead of reaching their door-steps with information packages by the scientists and extension workers. But, even after three decades of extension work in this country, this process has been changed only to a limited extent and that too is localised with well-to-do progressive farmers (Fig. 2).

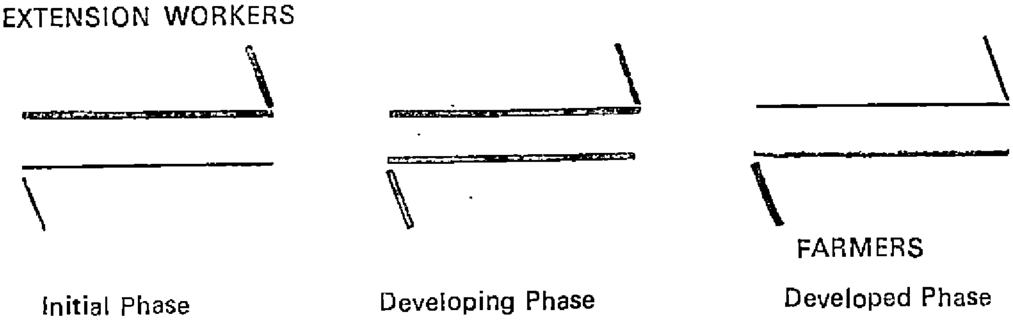

Fig. 2: Stages of interaction between farmers and extension workers.

An analysis to this effect would support that this process could not be reversed because the extension work could not become all in all educational in character.

5. Incentive to Field Workers:

There are frequent complaints that field positions are not easily filled-up, good workers do not stay in rural areas for a longer time, and those employees like village level workers (VLWs) hardly get due promotions. The living conditions in rural areas are hard in the absence of proper marketing, schooling for children, health centres, recreation etc. Many times, the field workers have to maintain double establishments and live separated from the family. The salary structure is not in favour of field workers *vis-a-vis* urban workers. How do we compensate for these? This is hightime that we look into this basic issue of providing adequate incentives so that field extension work could be made attractive and respectable.

6. Adoption Behaviour of Farmers:

There is a common saying that farmers are the receptive lot; give them the innovations, they will adopt them. This is rather over simplification of the issue. The fact is that the adoption behaviour of farmers follow a definite pattern—the normal curve; 15–20 per cent farmers are innovators/fast adopters, 35–40 per cent are early adopters, 35–40 per cent are late adopters and 15-20 per cent are laggards. Those who talk about the sharp receptivity of the farmers, they are really talking for the 15-20 per cent of the innovative farmers. This has a serious implication. Like the local specific technology, the communication technology has also to be oriented to the target groups.

7. Academic Programmes in Extension Education :

Extension Education is an applied field where there has to be a happy balance between agricultural technology and extension methodology. An examination of the curricula in extension education in the country would reveal that the courses have more leaning for sociological or psychological contents at the cost of the subject matter know-how. This is why we have not been able to produce field oriented graduates and post-graduates. This imbalance must be corrected soon by incorporating technology and extension methodology on a 50 : 50 basis.

8. Functional Linkages :

Creating proper environment for functional linkages and relationship between departments, institutions. State Department of Agriculture and allied extension agencies has become extremely important. In spite of coordinating bodies and linkage mechanism, because of their failure of effective functioning, the synergistic effect is not being harnessed. How could this be achieved ?

FUTURE EXTENSION STRATEGY

The first-line role of the Universities and research institutes has been emphasised in the earlier discussions. It is very essential that we realise the fact that there is a massive need for transfer of technology and all agencies and institutions should give their best to surmount this challenging task. The task is so huge that, in spite of multiplicity of institutions/agencies in addition to the State Department of Agriculture, there would not be any duplication. Therefore, the word dupli cation in extension is a misnomer; many times repetition is a requirement of extension education/adult education.

The report of the Review Committee on Agricultural Universities* (1978) studied the extension education systems in the Universities and has made definite recommendations for improving extension set-up so that the first-line extension work could be strengthened. In the words of the Committee: "One of the essential features of Agricultural University system is the acceptance of the philosophy of service to agriculture and the rural community. To fulfil this commitment, it is essential that each Agricultural University has an adequate and efficient extension set-up for the speedy and effective communication of knowledge and technology to the extension workers and to the farmers". The report further observes that, "only five Agricultural Universities could be said to have a vigorous and dynamic extension organisation capable of undertaking effective extension education programmes. In several Universities, the extension set-up is extremely weak, without adequate staff and facilities. It is generally under-financed; on an average the budget allocation for extension work forms only six per cent of the total budget of an Agricultural University".

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* Report of the Review Committee on Agricultural Universities, Indian Council of Agricultural Research, New Delhi, 1978.

The report has made a pin-pointed reference to Kerala Agricultural University in this respect: "In certain cases (For example the KAU), the role of the University specialists is severely limited and they are not allowed to even conduct a few front-line demonstrations". According to the report of the ICAR Review Committee for KAU under the National Agricultural Research Project (NARP)*, the University spent only 1.6 per cent of its total budget in 1980-81 for Extension Education. This basic weakness needs to be corrected and the University should spend at least one-third of its budget on extension education in view of its urgency and importance.

This is a crucial juncture when University is planning for its Seventh Five-Year Plan. It will be highly desirable to provide for adequate funds both for compensating for the past weakness as also for the additionality to create new infrastructures wherever necessary. The following specific suggestions are made as the future strategy of the University:

1 Provision of statutory Extension Education Council, like many other agricultural Universities, including representatives from all disciplines, State Development Departments, Voluntary Organization and progressive farmers. This will be an effective linkage point at the highest level in the University like the Extension Coordinating Committee of the State Department of Agriculture.

2 The Directorate of Extension may be strengthened by improving its three wings: (i) Farm Advisory Unit, (ii) Training Unit and (iii) Communication Unit. These Units may be manned by qualified staff coming from both extension education discipline as well as the subject-matter departments.

Besides main campuses and the regional research stations, the farm advisory unit may be extended upto regional/district level like other Agricultural Universities — PAU; HAU, etc. The strong training unit of the Directorate should have training nucleus with regional research stations. In addition to printing press and laboratory facilities for producing communication aids, the Communication Unit should have facilities for producing documentary films.

3 The Department of Extension Education, besides teaching and research, must involve its staff in field extension work with the Directorate of Extension. The Head of the Department should be responsible to both Dean of the Faculty and the Director of Extension. The academic and the research programmes need drastic changes to make them field-oriented, meaningful and productive.

4 All main campuses should have Farmers' Hostel as in PAU, HAU, Pantnagar, etc.

* Report of the ICAR Research Review Committee for Kerala Agricultural University, ICAR, Krishi Bhavan, New Delhi, September, 1980.

5 Mobility of staff for extension work has been a recurrent problem. Adequate number of vehicles must be provided directly under the charge of the Director of Extension.

6 All scientists must be encouraged to participate, to the extent possible, in extension programmes. This is not only essential for contribution to the farming community but also for first-hand feed-back information. The integration concept must work.

7 The role of the Agricultural University in relation to lower education in agriculture needs to be defined. For transfer of technology, strengthening lower education in agriculture—Certificate, Diploma, School Education (Specially rural schools),Vocational Training, in-service Training are extremely important. In the past, we have not paid adequate attention to this important aspect. It is also a policy issue as to what should be the scope and role of certificate and diploma level education and how they should be placed in comparison to degree holders.

8 The functional linkages and relationship at present is extremely weak, specially with the State Department of Agriculture. For boosting agricultural production, the University and the Development Departments of the State Govt. must work hand in hand. The Coordination Committees, which already exist in most of the cases, must be made to function. The introduction of T & V System of extension has been specially more demanding in this respect.

CONCLUSION

The 2000 AD is only 16 years away–a very crucial period for accelerating agricultural production including plantation crops. The provisions in the Seventh Five-Year Plan in Extension Education should be such as to (i) consolidate the existing programmes, and (ii) fill–up all the infrastructural gaps at the shortest possible time. Then alone we may cash on the scientific advances already made and being made, and bridge the continuing gap between the production potential and the production realised. Doubling the production in coming three decades does not look impossible, even raising 50% more production may lead our production to 225 million tonnes – the targetted goal for 2000 A. D.

The first-line extension programme should play a leadership role in influencing both farmers as well as the extension functionaries of the State Department of Agriculture and the allied extension agencies. This poses a great challenge to the University extension programme as also provides a golden opportunity to serve the agricultural communities.

7

Problems and perspectives of Agriculture Research–2000 A. D.

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By year 2000 the Indian population of about 1 billion will require an agricultural output 50-60% greater than what it is today. Though the thrust of agricultural research will continue to be directed to finding quality food in adequate quantities in the wake of fast dwindling non-renewable resources and damage to ecology greater burden will have to be shared by agriculture in the other two basic needs, clothing and shelter as well as in improving ecological conditions. Before planning for the 21st Century it is relevant that we assess the situation from now to 2000 A. D. as the initial exercise. It has already been recognised that agriculture today comprehends animal husbandry, fishery and forestry all interacting at micro and macro levels in a human–animal–plant eco–system. In the light of the fast changing social and economic conditions, for a long term planning of agriculture research it will be more realistic to understand that the three basic needs of food, clothing and shelter will centre round grains, tubers, fruits, vegetables, animal, fish and their products as the source of food, natural and synthetic fibres as the source of cloth and dry matter of varying qualities as the source of fuel (energy) and timber, the core components of shelter and for improving ecology social and agro-forestry systems all of which will have to be developed even in annual cropped areas. Thus, integrated research efforts are called for producing not only adequate food but also enough dry matter keeping the ecological balance at safe levels.

Research efforts upto 2000 AD

Most investigators and leaders in agriculture expect that a revolution through genetic engineering to occur in agriculture it may take longer than 10–20 years since several break–throughs are required. As such research on high yielding new varieties of plants with resistance to many of the environmental and nutrient problems, which face the present day agriculture, adopting new approaches and involving the expected break–throughs in some of the biological processes such as transfer of symbiotic nitrogen fixing capability, C_4 mechanism of photosynthesis, reduction of loss due to respiration etc. have to be our major concern upto 2000 A. D.

1. Basic change in research strategy

Research has little relevance unless the results obtained therefrom contribute to social benefit. It has to be admitted that the ongoing research efforts are isolated in nature and in many cases either not sufficiently important in relation to production or is not carried through to a stage of effective transfer to the field. This will mean that in future while planning research a variety of factors and their likely interactions should be taken into account. Computerised inventories of the following interacting factors are therefore a must.

1.1 Human resources—

a) Research for which section of society—landless labour, marginal, small and large farmer, tribals etc.

b) Research by whom — Disciplines to be involved, whether competent persons are available.

c) Transfer of technology mechanism—Agencies and type of manpower required.

If a total picture on the above are available it will be possible for deployment of man power, continued interactions and develop on appreciation among the researchers that their efforts are likely to benefit at least those sections of the society for whom the programmes have been planned. While this is too generalised a situation, it will be possible even for specific problems of the nature of pests and disease control, factors to be looked into before initiating research keeping in view the above factual situation.

1.2 Present level of understanding of different areas of production

For a productive research the starting point has to be based on what has already been done not only in that particular field but also in the related areas which should be critically analysed by the research group and the work planned. The available research results should, therefore, be summarised and appropriate retrieval systems developed.

1.3 Genetic resources of animals, plants and microbes

Since exploitation of genetic diversity will continue to play vital role in enhancing/stabilising production an inventory of the genetic resources of animals, plants and microbes indicating conservation and *in-situ* centres of both indigenous and introduced materials indicating the possible/potential use of each must be prepared urgently.

1.4 Input requirements and constraints

One of the major reasons for the limited flow of research results into the farmers' fields is the lack of understanding of the input needs and constraints that the farmer/extension agency will have to face if a given technology is to be adopted. These should be analysed and listed in advance and action initiated simultaneously.

The advantages of computerising such information are obvious. However, what is more important is whether answers/predictions can be obtained from a total analysis of the likely interacting factors that a research programme is likely to be socially beneficial and if so when and under what circumstances. If this answer could be provided, fixing priorities in research is bound to be much more meaningful.

2. Break yield barriers

2.1 Multi-disciplinary revolution

The green revolution achieved in wheat, rice and corn has been by and large the function of improved varieties cultivated under a set of limited conditions over specified areas. Still, the average yields of not only these crops but that of many others are far less than the averages realised by a number of farmers. A multi-disciplinary revolution in agriculture with greatly increased crop productivity is just around the corner. Multi-disciplinary revolution, as the name implies, is the efforts required to put all together into a unified or integrated system developed procedures which can improve crop yields. If we are to integrate the various independent pieces of know-how which already exist on how to improve crop yields, substantial increases in production are possible.

The following is the effect of management system on increasing crop yields.

	Yield in MT	
Crop	*Average*	*Best realised*
Wheat	2.5	20
Potato	3.7	100
Soyabean	2.0	7.5
Corn	6.8	22.5

The secrets of those who have attained the 20 MT per ha corn are inputs such as an appropriate hybrid seed, 90,000 plants, correct planting date, eliminating soil compaction, plenty of soil organic matter, 400 kg of nitrogen, 220 kg of phosphoric acid and 440 kg of potash, sufficient and continued availability of soil moisture, control of weeds without injury to plants and protection against pests and diseases. If soil moisture becomes limiting, then the computer says that some of the nitrogen fertilizer should be withheld.

The exciting aspect of simultaneously overcoming several limiting factors to crop production is that additive effects are experienced (Wallace, 1984). Correcting two limiting factors alone may result in a 20% yield increase for each. When both are corrected together the combined yield increase is more than 40%; it can be 44 or more per cent (1.20 x 1.20 = 1.44). When six, eight, ten or more limiting factors can be corrected simultaneously the total effect can be staggering. Often the combined effect of two corrected limiting factors is a synergism (Putnam and Penner, 1974). The combined effect then is much greater than the sum of the parts. Yields go up very rapidly with synergistic responses. An integrated approach to overcome limiting factors on sugar cane growth increased yield of the cane almost five times (Hussain, 1982). At this level inputs which normally give smaller incremental return will start giving higher responses.

Yields have not reached a plateau. Much improvement is still possible especially if the disciplines work together to eliminate more of the limiting factors. Examples of recent works to improve yields by overcoming multiple limiting factors have been reported by a number of workers (Anderson and Balser, 1983; Brann and Alley, 1983). This should therefore, become a great research goal. Integrated inter-disciplinary experiments to test the additive and synergistic effects of available production know-how and for obtaining information on critical areas of interaction for a computerised monitoring of the crop production will be greatly rewarding and should enable the easy accomplishment of human requirements of 2000 A.D.

2.2 *Tissue culture*

Genetic variability of a population while it is an advantage, sets limitation in obtaining higher yields in the population unless efficient clonal multiplication techniques are available for the large scale propagation of any outstanding high yielding or otherwise desirable naturally occurring or synthesized plants. In cocount while the average yield of WCT is 60 nuts/palm/ year, elite single palms yielding 470 nuts and single D x T hybrid palm giving 180 nuts year under rainfed conditions are available. There is no better method immediately available for breaking the yield barrier than adopting tissue culture technique under such situations provided adequate care is taken to include a wider genetic base in such materials used for multiplication. Where somaclonal variation is desired to be exploited a callus pathway and in cases where genetically uniform clonal populations are to be generated from elite selections direct embryogenesis and plant formation will be the useful tools. Research on the biochemical control of the process of somatic embryogenesis in crop plants where the technique is rewarding should be a priority area.

2.3 *Manipulation of physiologic parameters*

The overall conversion efficiency of crop plants depends to a great extent on the rates of dark respiration and photorespiration exhibited by them. Although a high rate of dark respiration reflects better growth of the plants some crops use large portion of the photosynthets for their maintenance through this mechanism. In C_3 plants intensive search for crop varieties/individual plants which have higher efficiency in dark respiration as well as low photorespiration should be made so that the net dry matter production level is enhanced. Considerable efforts should also be made to locate C_4 system in individual plants among perennial species since some of them show outstanding yields which could possibly be due to C_4 pathways.

3. Biomass pathway

Calculation based on theoretical concepts have shown that the potential productivity of a crop in tropics under conditions of optimum management is 770 kg dry matter/ha/day which is equivalent to an annual biological yield of 281.05 tons/ha (Loomis and Williams, 1973). As against this the following is the situation in terms of dry matter production (Hall 1976).

Yields of dry matter—T/ha/year

Tropical	
Napier grass	88
Sugarcane	66
Annual crops	30
Perennial crops	75-80
Rain forest	35–50
Temperate	
Perennial crops	29
Annual crops	22

The above yields are by and large from monocrops. There are definitely methods by which the total biomass production per unit area in unit time can be enhanced through high density cropping system approach. In such a system it was also possible to ensure that the basic needs of food, fibre, energy, timber etc. are also generated by an appropriate choice of the constituent crops. Considerable income generation also be ensured. Experiments conducted in Sri Lanka have shown that one such model involving over one dozen crops at a population density of 3606 plants/ha is capable of giving an income of over Rs. 46000 per annum in addition to giving a variety of home needs and fodder for animals (Bavappa & Jacob, 1982). Recently high density planting in coconut taken up at Kasaragod has over 13,000 plants/ha where the normal stand of coconut was only 175. The dry matter production in all these cases is yet to be estimated. All the same, it is expected that in view of the maximum harvest of solar energy through the crop canopies of different crops under multi-layered system and better utilisation of soil mass the productivity of biomass could be pushed higher. Such an approach has many advantages such as minimum requirement of tillage, continued returns and better economic stability, higher generation and recycling of organic matter and nutrients and better ecological balance. A highly multidisciplinary approach to understand crop compatibility, inter-plant competition, nutrient balance, moisture requirement, soil micro-biological changes, ecological advantages, energy input and output, biomass production and economics of the systems involving annuals, perennials and animals in varying combinations is highly worthwhile.

4. Low cost technology

Most of the currently available technologies are neutral to scale but not to resources there by compelling the farmers to spend more on the inputs. Research should be oriented to developing technologies that do not cost much to the farmers.

4.1 Utilisation and conversion efficiency

Photosynthesis

While photosynthetic efficiency of a particular crop is important, conversion of solar energy through the photosynthetic apparatus of a crop community is more relevant in a tropical situation where mixed cropping patterns are being followed. Understanding of this conversion capability is a primary need.

4.2 Nutrients

Recent researches have shown that the ability of D x T coconut to exploit the native fertility of the soil as well as to use the applied nutrients is much higher compared to West Coast Tall.

Utilisation efficiency of nutrients

		WCT	DxT	TxD
		Nuts Yield/palm		
	M0	23	31	17
	M1	51	75	60
	M2	67	76	61
		Nutrients (gms)		
Qty. of fertilizers to be applied to get 75% Max. yield	N	1025	140	170
	P	1025	140	170
	K	1050	280	345

Research to unearth this capability of the plants will be most rewarding.

4 3 Moisture

The fact that no crop production worth the name is possible without moisture, has shifted the search for drought resistant plants to those capable of doing well under stress (low moisture availability). Since moisture and nutrients have high interaction and also in view of the fact that moisture availability becomes limiting at least during certain periods of the year, search for stress tolerant varieties should receive priority.

4 4 Pests and disease resistance

In low cost technology research in this area is the most rewarding since the end result is a no cost technology. While search for resistance in the available populations should form part of any crop improvement programme, induction of resistance and transfer of resistant genes adopting DNA recombinant technique should be taken up.

4.5 Better adaptation to environment

An analysis of major U. S. crops shows that there is a large genetic potential for yield that is unrealized because of the need for better adaptation of the plants to the environments in which they are growm. Evidence from native populations suggests that high productivity can occur in these environments and that opportunities for improving production in unfavourable environments are substantial. Genotype selection for adaptation to such environments has already played an important role in agriculture, but the fundamental mechanisms are poorly understood. Recent scientific advances make exploration of these mechanisms more feasible and could result in large gains in productivity.

4.6 Biological fertilizers, nitrogen fixation and nutrient systems

Though the possibility of cheaper sources of nutrients through biological fertilizers and nitrogen fixation have been indicated this is yet to come to a level of commercial exploitation. While the pace of research in this area should be accelerated using modern biotechnology tools, a more relevant area of immediate interest is the nutrient addition and conservation through cropping systems. Research on relay and mixed cropping systems for improving their self generating and conservation capability with regard to nutrients is a high priority area. Cocoa mix cropped with coconut in double hedge system has been observed to add 50 kg N, 11 kg P_2O_5 and 35 K_2O/ha/year. Much higher efficiency may be possible by appropriate choice of crops and supporting them further with proper biological agents such as arbuscular vesicular mycorrhizae, Rhizobium, free living fixers for nitrogen etc.

4.7 Slow release fertilizers

Recent research has shown that in coconut grown in sandy and sandy loam soils, up to 80% of the applied nitrogen is lost by leaching. Importance of slow release fertilizers in this context is most relevant for reducing the fertilizer input.

4.8 By-product utilisation

A number of agricultural byproducts if used in appropriate places can considerably bring down the cost of production. Coconut husk pith is ideal soil amendment for sandy soils. Rice bran and brewery waste in cattle feed could substitute wheat bran reducing the cost of production of milk by 35 paise/litre.

The research towards 2000 A.D. therefore, should not be simple trials but large experiments involving genotypes with variables for nutrients and moisture under an appropriate cropping system with a '0' control and a large interdisciplinary team working on at least the more important parameters of production and their interactions.

INNOVATIONS FOR 21st CENTURY

1. Biotechnology research

Though considerable optimism is evinced in this area as a tool for enhancing production, it is evident that massive investment and expertise are required to achieve meaningful gains. Since very many easier approaches are still available at lesser cost for increasing production it is only logical that these should be first researched. All the same when a plateau in yields is to come by the turn of the century, methods for breaking this barrier should be available. It is in this context that biotechnology research particularly becomes relevant.

1.1 Root nodule symbiosis

The property of atmospheric nitrogen fixation is now limited to leguminous plants, among higher plant species. Monocotyledonous plants provide no confirmed instances of nodule symbiosis. Although some of these may be induced to participate in rhizosphere, nitrogen fixation which leads to large gains in nitrogen, nodule symbiosis is considered to be the most efficient. Recently some workers have considered the possibility of imparting a faculty for nitrogen fixation to higher plants themselves. Rhizobia have been successfully fused with tobacco protoplasts and these cells, when cultured on a suitable medium are expected to give a whole plant with nitrogen fixing ability. These findings open up new and exciting possibilities of obtaining hybrids between legumes and perennial monocots which will eventually lead to enormous saving in nitrogen fertilizers.

1.2 C-3 C-4 hybridisation

C-4 plants in general are the most productive capable of producing high biomass and yield. Transferring a number of characters from C-4 to C-3 plants adopting normal breeding techniques has been done. However, transfer of the most important characteristic viz, C-4 pathway has not been achieved. Cellular hybridisation and monocular transformation should enable the transfer of C-4 mechanism to C-3 background.

1.3 Other areas of interest

Screening for resistance: in perennial crops screening for resistance especially to virus mycoplasma etc. is an exceedingly time consuming process today. *In vitro* culturing of pathogenic agents like mycoplasma and *in vitro* screening of the callus/embryoids obtained through tissue culturing technique should enable locating resistance much faster. In the case of disease problems like Root (wilt) and Thatipaka diseases of coconut, Yellow Leaf Disease of arecanut, research to standardise the basic technique should be undertaken. In this context, the possibility of developing a vaccine for the plant mycoplasma on a cross protection technique may not be viewed as stretching the imagination too far. As a long term practical measure of immunising millions of coconut palms this is worth heavy investment.

2. Breeding new strains of bacteria

Single cell protein

Whilst agricultural research world-wide pursues yield improvement in food and forage crops in an attempt to keep pace with growing demand, alternative 'non-crop' protein sources have also been sought. Bacteria and yeasts have been shown to have the characteristics necessary for large-scale production of what has come to be known as single-cell protein. ICI's 'Pruteen', using a unique continuous fermentation system, compares favourably with conventional protein feedstuffs (Waterworth, 1981). Improving the quality of these bacteria adopting modern biotechnology techniques should enable massive production of edible protein for human consumption.

Biomass degradation

When biomass production pathway becomes a reality, the surplus dry matter can profitably be used only if the same is separated into fractions based on lignin, cellulose, hemicellulose etc. for further exploitation. Search for bacteria capable of such functions will have to be made and if required even evolved.

3. Hyponica

A recent report from Japan shows that plants giving exceptionally high yield can be grown without soil by placing a vinyl sheet in a water tank where ordinary seeds are put along with water and fertiliser running constantly and evenly. One tomato plant raised in this method is reported to have yielded 12,000 fruits. Nozawa, an agricultural engineer who is the father of this innovation has already attracted the attention of agricultural experts from different parts of the world. Research to convent thousands of Km^2 of backwater, tanks, canals and rivers of Kerala into "vegetable factories" merits attention.

4. Sky farming

During the twentyfirst century, at least in urban areas and in some of the thickly populated tracts the pressure on land will necessitate farming in the air space, roof tops and for that matter any area available for growing plants without directly coming in contact with land mass. This calls for research on production technology for farming without soil in media which are light and which can keep moisture and nutrients in a continuously available form, structures to support such media in space, mechanisms to feed them and breed plants, with canopies and root systems fitting into this. Air space factories should be virtually possible for many crops. Research in this area has to make some beginning.

Research in 2000 A.D while is challenging should also be novel and ingenious.

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8

Administration and Finance in 2000 A. D.

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To speak on 'administration and finance in 2000 A. D' is a difficult task since the pace of scientific and technological advancement is very fast, which makes any ideas that we have at present obsolete in no time. Therefore, it will be ridiculous to speak about any futuristic plans towards 2000 A. D. This is what Galbraith meant when he said that conventional wisdom will be broken up by the march of events. However, with all the ideas we have at present we are still children of our times and it is only very few people who will make any valid predictions for the future. Perhaps, political writers like Alex de Tocqueville, the French magistrate who wrote the famous book 'Democracy in America', visualised years hence what shape democracies would take in future. This is particularly so in a vast community like India where the philosophy of Administration and Finance was instilled in a flash of thought or a series of connected flashes of thought as in Arthasastra and the great epics Ramayana and Mahabharata. We should think of what is our heritage and not get swayed by transcient phenomena. There is sufficient evidence in our great epics that our old administrative system should be the frame work for us to move ahead though suitable changes will have to be incorporated in line with the requirements of modern times. In one of the earlier State Administrative Committee Reports, it was stated that what Kerala requires is not administrative reforms but administration. This is particularly true not only in the case of Kerala, but in India as a whole and for the Universities it is very relevant, whether it is in the methods of selection of teachers and non-teaching staff, promotion and so on. There are some basic things which one should not forget. It is mentioned in the Arthasastra that the objective of administration should be to do good things to the people. The methods of misappropriation of public funds mentioned in the Arthasastra have not been improved upon, either in numbers or in quality, during all these centuries. When we think of a new system of administration, we have to keep this in mind. If we make an analysis of the administrative systems during this century, we will be able to make necessary changes in the system and it will be possible to do some good to the people. In France, the founder of positivism, St. Simon observed that a stage has been reached when administration has become management of things. He pointed to the organisational changes which nullified the role of human relations in administration. Mention should be made about the concept of reflections as in Kierkegaard. Reflection does not mean here the reflection of thoughts but the reflection as in a mirror, a case of image building, the image replacing the real thing. What you write down may not be reflecting what you thought. Care should be taken to understand the inner things. One should not go only by the rules and regulations formulated by an administrator, but should understand the inner implications of it, which would prevent mere subservience to the people in power. This is the age of quantification, according to Whitehead. It does not mean statistical manipulation or detached thinking. However, gradually the human factor is taken away from administration. This is one reason why in the case of structuralist thinkers in social anthropology, the point of view has been propounded, that it is when the lineaments of a society are not clear, one is best able to grasp the inner coherence of things and not when rules and regulations make for a seeming clarity, which clarity is only an inverted form of obscurity. Instances of considering human groups according to status, caste etc. by the Governments and administration are plenty though the rules and regulations serve to camouflage this.

While designing modern administrative systems, one has to take into consideration the basic things and objectives that govern the administration. Conflicting ideas in an organisation would not make it a dead one. But in Rome, it was considered that the best time in terms of republican administration was when the rulers were divided as when Plutarch describes divisions in Rome. In a democratic country conflicts are the very essence of the progress of the society. The conflicts, however, should not lead to the destruction of the parent structure.

In democractic administration the advantage is that you can question the rulers, decisions etc. and go to the roots of the things. However, people or the public need privacy in public matters and too much exposure of the decisions is also hurtful. Ultimately, as Shakespeare said, if you take authority away, you are taking out responsibility also away and chaos results, as he said in one of his plays. Administration is not to be equated with stage management. Instances of employing 'tactics of power' are found in the history of Argentina and Chile.

I am sure that the systems of administration and finance in India could be modified to suit the changing times. Developments in the Electronics Industry such as the computors, micro computors, ete. have made it possible to predict about the shape of things to come by 2000 A. D. However, the pace of changes in the society could interfere to a great extent and shatter this prediction into pieces. My suggestion is that the scientists who plan for the future should make this plans functional, readable and decipherable. The very concept of property is changing. It is no longer land and buildings but in a highly bureaucratised society, the service rights of individuals constitute real property. Hence the plethora of service cases in the highest courts of the land.

9

Problems of Organisation and Management

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There is a built-in sense of discreetness in Indian social structure with its unique historicity and fragmentation each with a tradition and self-identification and awareness. This situation is highly oriented against development and social change. The endemic internal conflict of the fragmented caste system leads to political instability of a very inferior order in its origin and quality. Loyalties of large groups of citizens are very often to fuedal associations and symbols. The segmentation of this endemic symbolic type inhibits the transfer of loyalties from small to large units; political and economic decisions invariably cannot be taken on rational grounds and the tallest of the group leaders are particularistic catering largely to one's own group. Thus fragmentation and consequent discontinuities in social structure create difficulties of an insoluble nature in the way of initiating and directing social change. A diseased social organisation thus breaks the lines of communication preventing the flow of impulses for social change and development. Such a situation contributes substantially to uneven rates of change and disproportionate development of the various sectors of the traditional society resulting in political instability and economic stagnation.

The exposition of growing caste, communal, linguistic and regional rivalries has reached a wide audience through the facilities provided by a modern technologically oriented propaganda system of the press, loud-speakers and radio and thus the "primordial loyalties" to use the words of Shils, are on the ascendent. The basic elements of the group conflict born of this plethora of social tensions are the search for a new status accommodation by increasingly organised caste groups infiltrating modern rational political associations eroding the content of rationality and modernity out of them. The planners in India cannot isolate their scientific responsibilities and tasks from this highly segmented society of non-rational loyalities and ritualised pattern of conflict. Questions of economic policy cannot thus be separated from questions of political philosophy, social organisation and administrative commitments.

At the highest level of intensity every caste segment in our society regards as sacred certain rules of conduct and thought and certain arrangements of social and political action. A certain degree of herd mentality is implicity in this explicitness and agreement which is inimical to growth of the modern concept of liberty because it is hostile in substance and in form to innovation and adaptation as well as to adjustments which are inevitable in a system of liberty. This finds vivid expression in the unwritten expectations which govern the general conduct of the members of this group and the values, implicity in a growing tradition of belief, become endowed with the property of sacredness.

These sacred values are usually vague and less concrete as much as they are unreflectingly accepted by those who belong to this group. Their vagueness is the secret of their strength; they allow a considerable amount of freedom of interpretation and application.

The unchallenged acceptance of these rules and regulations in family, economic and religious life and even in personal relationship limits the freedom of individuals and groups as we would like to understand this concept today. They not only restrict freedom but also confine it so much as to suffocate it. In all avenues of collective behaviour like political organisations, private limited companies and other business organisations, these traditions only strangle the fundamental human impulse to be free and prevent the emergence of the civic sense. The traditions of family and caste loyalty are so strong that the rights of other families or other castes are regarded as relatively unimportant. Tradition is sacred and, therefore, dogmatic and doctrinaire and insists on uniformity of individual behaviour in the caste society. It insists a complete adherence to the accepted norm. It does not make any distinction between the necessary and the unnecessary and it insists that all elements of the tradition are equally essential. Its insistance on totality permeating all spheres—political, economic, cultural and religious – leads to rigidity in the social structure which they regulate. The custodians of the sacred law always insist on the purity of traditions implying exact and thorough confirmity. Variations are not tolerated and the caste chiefs or leaders who regard themselves as the properly qualified standard bearers cannot stand rival claimants. Obedience is due to the personal authority of the individual which he enjoys by virtue of his traditional standards. This leaves the chief even in such a rigid system with some sphere for personal decision free of any specific rules. Thus each caste segment is an administrative organisation run by sanctions and group ties uniting people of different and opposed private interests. At all levels, common ritual values and traditions constitute the ideology of this political organisation. Most members feel their unity and see their common interests in their attachment to the traditional symbols and these symbols, therefore, make the social system intellectually tangible to the individual, rendering it easier for the acceptance of the social order.

The new rationalism of the present century has severely criticised tradition for its conservatism. Political thought, the world over asserts that liberty is antagonistic to tradition. Repetition of inherited lines of conduct is very often a substitute for thinking on the individual's part. Thus traditions impose barriers and restraints on the individual's capacity for innovation and development. In the modern Indian Society the antagonism between tradition and liberty is accentuated by the traditional holders of authority and privilege. They depend on archaic and fuedal forms of property and social institutions and in general oppose any socialist pattern of government and invariably appeal to tradition and ancient Indian culture in support of their position. In the context of planning for a democratic and socialist form of society, over-emphasis of our caste traditions is not conducive to our political and economic evolution.

Until recently human relations within a geographically contiguous village in India were not democratic by modern standards; they are no doubt undergoing very rapid changes. Caste had very great significance in the old order and it retains in a large measure the same hold today. Many of these relations and their traditional importance are decreasing rapidly. Economic changes are a primary cause for this transformation. While subsistence agriculture and a few simple crafts made up the economy of the Indian village in the past, the economy of the modern Indian village has become part of an organised internal and international market and there is no longer any self-sufficiency. Foreign trade as well as trade between newly grown cities and the villages have developed. Railways and metalled roads have annihilated distance. In consequence a highly differentiated, interdependent and acquisitive society is developing fast. In this context the hold of the tradition and caste order is putting up a persistent struggle to stem this process of transformation. The role of planning, therefore, assumes added significance in that it is the duty of the planning organ to recognise the traditional blocks to change and deal with them accordingly. Planning at the state and village level should be conscious that its main function is one of social engineering. Any failure to identify these blocks to change and a slackening in the fight against them will by itself constitute another serious block to change. An example may be cited. Property relations are sought to be changed by land reforms and tax machinery in India; but equal compensation and, therefore, the necessary means for perpetuation of the old order is placed in the hands of the erstwhile property owners. The reason is that the socialist state does not follow the implications of social change. Welfare values are still dominated by fedonistic values. The whole force of quickening the tempo of change is lacking; the fear of change is working instead.

The nature of the Indian society and the segmented basis of our economic organisation have to be clearly recognised in any schematisation of our future programmes. The main economic features of our underdevelopment are the following:

i) The surplus of national income over what is needed for the reproduction of the labour force is small.

ii) Such economic surplus as is available is not wholly utilised for capital accumulation. The feudal mode of production, mainly in agriculture, results in low productivity and hence a low economic surplus. Moreover, the small ownership class used a large part of this small surplus for conspicuous consumption, ie. for unproductive purposes.

iii) The unproductive drain of the economic surplus through profit taking by foreign monopoly capital is retarding the growth of the economy.

iv) There is lack of sufficiently broad and wealthy class of domestic industrial entrepreneurs who would command the resources for substantial investments in industrial development.

v) Under these conditions balanced economic development can take place only on the basis of public investment ie. by the State, Municipalities, Panchayats and Co-operatives. The physical resources for public investment exist in the form of employed or under employed labour power and natural resources.

vi) Since the physical resources for such public investments are available, the financial resources to set them in motion could be provided through a channelisation of (1) Profits of the nationalised industries; (2) contributions of the peasants in the form of the delivery to the State of part of their products at reduced prices; (3) nationalisation of large industries and plantations (largely foreign owned) and the banking system; (4) increased taxation and state loans subscribed by the population and (5) deficit financing.

The development of a large public sector and its more rapid growth than that of the private sector is a necessary condition of the industrialisation of the country. But one possibility has to be guarded against. The nationalised (Public) Sector can either be made a nucleus and starting point of the development of socialist economy or made subservient to the existing concentrations of private economic power. In one case it can lead directly to socialism; in the other it may serve as a powerful instrument for the promotion of capitalist interest. Since India has opted for a socialistic pattern of society there is no reason why perspective planning cannot set clear and definite socialist goals.

In planning a new socialist order, the planning machinery and other executive organs of the Government have to make a scientific appraisal and a proper approach in relation to the different fields of social and economic activity. The distribution, control and responsibility in State managed industries, incentives in the new industrial order and the role of trade unions in industry need close study. There are other problems of social reconstruction like problems of social change, caste system and social hierarchy, measures for facilitating social mobility and problems of dehumanisation and social isolation in our social and administrative system which need constant attention. The supervision and direction of welfare has to be organised with built-in provisions for hearing public complaints and helping the people to obtain quick remedies and for special work among the scheduled castes with a comprehensive programme of action for raising their social and economic status.

The social purpose of education has to be clearly defined in relation to the needs of economic plans. Secondary education and industrialisation have to be in unions; university education has to be clearly oriented for the development of scientific research and scientific talents. One would imagine that problems of contemporary life should form the basis of curriculum-making in educational institutions. An institute of educational planning has to be specially designed whose work should be to plan education with special reference to economic theory and proper occupational distribution and to watch the social and educational progress. The social significance of academic freedom and autonomy of operation has to be amply recognised in this area of planning.

Problems of town and country planning will assume more and more importance with industrial development. The conflict between city and country has to be worked out in individual area context. Urbanism as a way of life will have to co-exist with the factors of permanence and change in Indian village life. New housing estates and their social problems will have to take into consideration the problems of family in the new social order. Problems of social ownership and social control will create new problems for legal institutions. The crisis of the middle class and the property-less classes will necessitate new legislation. Thus law and property as a means of social technique will have to be given a definite socialist orientation. The socialist principle of law is based upon the change in the nature of ownership of the means of production. Socialism which is a drive for conscious social relations needs a new jurisprudence which is functional as well as historical, which goes to show that Indian legal system should be deeply conditioned by the developments in the Indian economy through the different Five Year Plans. Law, instead of being merely an instrument of policy, should be conceived as a moulder of social policy.

The organisation of the youth of the country and their training will by its very nature assume importance in this context. Problems of leadership and problems of recruitment will lead to a new sociology of prestige and fame. Leadership in group-work and the professional training of rural leaders will have within its fold problems of age-group conflict consequent on a changing culture. The need for community centres for youth in community project areas has to be recognised.

A most important problem of growth for which there is no provision in our social and political organisation is in relation to the use of leisure. The problems of leisure (a) in village houses; (b) in urban households; (c) in schools and other educational institutions; (d) in factories and other administrative offices have to be attended to with the seriousness it deserves and on a scientific basis. The social cohesion and the social purpose of any institution will very much depend on the content and quality of the cultural pursuits of the people who comprise them. As we have seen in a segmented caste ridden society of the type we have inherited from the past, problems of national integration boil down to the question of our ability to visualise and implement a wide media of education oriented towards the creation of the new society in these institutions. Thus the economic problem of unemployment and under-employment has a counterpart in that it leads to larger amounts of leisure. Therefore, one has to have a plan for the fruitful utilisation of this leisure. Reading materials will have to be so designed to suit the various reading public and provided for in ample quantities. The motion picture can play a very important part in imparting new education if it is properly conceived to cater to the economic and social aspects of development. Sports and games should receive the momentum of a mass movement which alone can create a sense of discipline and *esprit de corps* in the people. The guidance of public opinion through the press and the radio assumes added importance viewed in this context. Socialisation of the major levels of economic power should logically mean great discipline and purposiveness in deciding on newspaper content. The setting up of an institute for propaganda analysis and for the co-ordination of the various means of social control at the disposal of the Government may be considered.

In planning a new social order, because it has to emerge from the old order, the old values such as the 'economic man' the 'market economy', the 'invisible hand' and 'individualism'' persist. They are inherited and in the process of growth and development, new values come up and we should be guarded against mixing these two sets of values. Since planning is a problem of growth which has developed out of history, it cannot be partial. It has to be integral. This explains why problems of planning are problems of transformation and social revolution as against slow and disorganised evolution. In short, it is a problem of transvaluation and of tempo in time.

In a changing society there is need for a purposive transmutation of social energy into each and every one of its parts. This largely is a question of decentralisation and enlivening of bureaucracy. Impersonalisation and transfer of personal services from primary groups to well-knit organisations are involved in this. The growth of objectivity in bureaucracy and rise in the standard of its efficiency has to be aimed at through the process of blending attitudes to the needs of new institutions. A new conception of bureaucrcy has to be evolved carefully with a view to continuing the two principles of efficient administration and competition. Special bodies are to be set up to represent authority and to apply sanctions at all strategic points of our social and economic life. A special machinery for controlling controls has to be invented. Planning is in short the emergence of the idea of controlling all the controls. The bureaucrat of this new type should be different from his counterpart today who does not make decisions. The latter executes orders and is only an agent. He does not belong to the power group either. This anamolous position has to be rectified. The new bureaucrat has to be immediately connected with decision-making. The process of decision-making must be the result of a cross-fertilisation of different levels of administrative and political intelligentsia. Bold criticism and group leadership should inform this process which alone can eliminate waste, speed up work and produce innovations. The bureaucracy which necessarily should form the backbone of the growing administrative system will have to overcome enormous difficulties connected with the necessity of simultaneously solving the problems of creating a heavy industrial base of developing light industries, of reconstructing agriculture and of improving the material conditions of the masses of people in the towns and countryside. He cannot perform this task unless he enjoys great prestige among the people. But today 'it is alleged that the effectiveness of the bureaucrat has been materially reduced because he does not any longer enjoy a position of prestige and respect as before. In season and out of season, as it suits political exigencies, he has been decried for his alleged failures to adapt himself to altered circumstances.

There is a tendency in the political leadership to disown its responsibility. In the process there is rarely any appreciation of good work done and even more rare is punishment for inefficiency and slackness. Thus a whole series of sociological, political and economic factors has combined to produce a steady deterioration in the quality of administration. Inevitably a majority of civil servants just "carry on" waiting for some one higher up to give the word for action. The result is the slowing down of the administrative machinery and a total loss of all sense of urgency. Such a situation definitely is not conducive to learning and doing, nor for integrity and thoroughness. The willingness to assume responsibility which is "the most crucial single qualification" of a good administrator is the first casuality in the present system. Sociologically this courage to face facts oneself to find solutions for problems and to breed self confidence has to be attributed, among other things to a deep and informed involvement of the individual to the social psychological context in which he operates. Hence it will not be far wrong if we say that the success of the administrative machinery will largely depend on the historical correctness of the organisational pattern and ideology directing out path towards a democratic and socialist society.

Wanted in India is a relevant social philosophy. There is no explicit doctrine or theory behind Indian development strategy today. Time was when India could borrow ideas on economic matters from abroad. We will have to develop a growing sense of pride and self-confidence. The habit of looking abroad for authority and ideology will have to be given up for good.

10

The Role of the University in the Welfare of Under-Privileged Sections of the People

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Article 46 of our Constitution lays it down as the duty of the State to ensure the welfare of Members of the Scheduled Castes and the Scheduled Tribes. This has been re-emphasised in the 20-Point Programme adopted by the Nation. Thus, it is incumbent on all agencies in the Nation, including its Universities and Centres of Learning, to strive especially to bring about improvement in the condition of these under-privileged sections of our people.

While Members of the SCs/STs may be identified as the decidedly poorest sections of our country, there are many more under-privileged sections and persons living "Below the Poverty Line" whose development is also an equally important National Priority. Even among the relatively well-to-do, women in many communities suffer various indignities and can be considered as under-privileged. In the spirit of egalitarian justice which inspires our Constitution, all these sections are entitled to special consideration by all agencies charged with spear-heading the economic and social progress of our people.

The ultimate test of success in these endeavours is obviously that by the turn of the Century, there should be no under-privileged sections! In order to do this the University has to concentrate on solving their problems on a priority basis. This applies to all the three main thrusts of the University's activities, viz., Teaching, Research and Extension. In fact, it will be shown in this paper that this three-fold division may lose meaning in many situations and all of them have to be combined in helping them solve their problems. This is particularly true of Tribal communities in whose case all the problems faced by the rest of the people in parts are combined together and compounded by that of the distance at which they are from the rest.

As the decidedly poorest, I shall consider the case of the ST populations of our State first. We have more than 40 communities who come under this category marked by differences in culture, habitation and occupation, but uniformly characterised by their vulnerability to various forms of exploitation and economic deprivation. They may be broady classified into those who live in Reserve Forests and those living outside them. The former have the right of the possession to land but the latter have had their land to a large extent grabbed by immigrants from the plains.

Our University has developed some action plans for the former groups. Our knowledge of their conditions is not thorough for the obvious reason that they have been so 'far away' from us both physically and culturally. Their habitat in deep forests and on steeply slopping hill sides is so different from the farm-lands where we have been conducting research and studies. Many of the infrastructural facilities which we have taken for granted in dealing with the majority of farm problems in the State are not available in the Tribal home-lands. Without a knowledge of the forest and its complex balance, our prescriptions designed for a more normal cultivable area are likely to cause more damage than progress. Thus, our starting efforts among them have to serve the purpose as much of educating the scientist and researcher as to improve the conditions of the tribal people.

In other words, research and extension have to be simultaneously attempted. The training programmes we devise for them pose special challenges because we have to develop, if we are intellectually honest, a feeling of humility and willingness to learn, as well as, if we are sincere, an ability to empathise and get over the cultural divide that separates the lucky few among whom we are from these the poorest of our people.

Thus our immediate task in the perspective of 2000 AD in this respect is to develop a necessary humbleness of approach and a willingness to learn so that we may identify what we have to study and do research on. We have to recognise that these people who have survived in these hostile surroundings for the past so many centuries do know far more about their circumstances than we do and that the conventional solutions whose validity we have established so laboriously elsewhere may have no relevance to the problems in the forest location. We should also realise that by deep study of their lore and their survival technologies, we may learn something of value for general application.

After so having a deeper understanding of their circumstances, we have to continuously research and simultaneously extend our findings among them. I believe that what we have started doing at Champakkad and Amboori are right beginnings. I envisage in the near future further efforts of a similar nature among other tribal communities in forest locations as well. We shall develop expertise in various frontiers of agriculture and forestry, as well as gain deeper insights into ecological balances and the preservation of edaphic and biotic conditions in the process.

I anticipate that within the next ten years, we should have sufficient expertise in these branches of agricultural learning as to be able to significantly improve the productivity of tribal agriculture as well as tribal earnings, without disturbing the harmony they have established in the forest and with Nature. By extending our leadership and helping them to organise and successfully run co-operative institutions of their own, we shall also have achieved a Constitutional purpose, viz., of safeguarding them from all forms of exploitation.

Our role among the tribal communities who live outside the forests is more complicated. For those who have not yet lost their lands substantially or wholly, we have been conducting training programmes in how to manage their farms better. We may have to support them in the structuring of their organisations for better farming and co-operative endeavour. We have to further refine our researches into the technology of the minuscule farmer whose land holding may be limited to the small homestead plot he has got as a result of the Land Reforms. We have to recognise that such a farmer may be more of a landless labourer whose engagement as a wage earner may be more remunerative than the full-time cultivation on his small holding. We have to develop activity schedules so that he may be able to achieve some greater degree of economic independence by optimising the time spent and production achieved from his plot of land with the non-denial of employment opportunities during periods of maximum demand for agricultural labour. The Krishi Vigyan Kendra we have at Ambalavayal will have to increasingly devote itself to such studies. We may even have to diversify our studies to a consideration of off-farm occupations for such tribal communities including the imparting of training in non-agricultural but closely allied skills, eg., processing of agricultural produce. I foresee a specialisation emerging for professional competence in tackling these complicated socio-economic problems at the periphery of agriculture as a purely biological profession restrained to the raising of crops.

The Scheduled Castes present a different set of problems altogether. They are mostly landless and do not have the wherewithal to acquire the ownership of the means of production. Basically their problem consists in improving the status of capitalist accumulation. A short term palliative is to provide them with increased employment opportunities in the tertiary sectors so that their rate of savings improves. In spite of inadequacies and short falls, this is being gradually achieved through their access to the educational progress. Our task will thus be more orientated to programmes of Rural Home Science training with the emphasis on better financial management of their house-hold budgets, improving their capability as students, and in the process, helping them to improve nutritional and personal hygienic standards so that their earning capacities may improve and they may be enabled to take the full advantage of the many facilities that Government are providing them. Our University in its efforts at Nilambur has found that the best recipients of such training are the women of the communities and hope for the future lies in our ability to help them to innovate and internalise improvements.

We have already experience in tackling the problems of the small and marginal farmers. Our commitment in this area already has resulted in our gradual shifting away from crop-wise approaches to agricultural development and in the direction of systems approaches. We are gradually habituating ourselves to look at the small homestead farm as a system—We shall increasingly have to realise that agricultural (including horticultural) programmes of development are only a part of an overall optimisation of resources and opportunities open to the small farmer who will progressively have a choice of alternatives to economic improvement including absorption in tertiary employment and upward social mobility. He may even migrate abroad to make more money than our average professional can. I envisage that our University will take up more studies in social organisation as it applies to the very small farmer. We may also have an opportunity to turn our attention more towards ornamental gardening techniques to meet a demand from the affluent returning from abroad.

Rural women in Kerala are already on the march to equality and perhaps even more than equality if the performance of rural girl students in the various examinations are any indication. However, pockets of backwardness exist among them and greater attention to occupations for them in the farming sector have to be found. Traditionally, processing of agricultural produce was mainly a job for them; with the gradual disappearance of such activity, we have to find an alternative. Thus I foresee increasing scope and relevance for Rural Home Science among them, implying that we should strengthen our efforts in teaching it, researching its problems and extending our findings.

To summarise, just as Agricultural Education in its early stages emphasised that the Agriculturist as a scientist had to leave the "ivory tower" of academic research, in its involvement with the problems of the very poor, our University will have to leave the known and well-researched fields of conventional agricultural wisdom. It will have to innovate on the areas on which it should research, expand its activities to the very frontiers of conventional agricultural expertise and internalise the peculiar challenges of the under-privileged situation and the under-privileged people. By the turn of the Century, the relevance of our University will be to a large extent a function of the success and earnestness with which we attend to these people and help in abolishing the under-privileged.

11

Animal Husbandry, Veterinary & Fisheries Education

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When I was invited to present a lead paper on Animal Husbundry, Veterinary and Fisheries Education, I had readily agreed to comply without, I fear, a clear understanding of the magnitude of the mandate. Nevertheless this presentation is the result of a sincere effort made to put together my thoughts on paper, touching upon the various aspects of education, research and extension in general, keeping the faculties concerned in mind and the specific purpose of the Seminar 'KAU 2000 A.D.', in particular.

In this, I was fortunate to have had on hand a copy of the Souvenir released on the occasion of the Sixth Annual Convention of the Kerala branch of the Indian Veterinary Association, which met in July this year. From it, I have gathered an authoritative version of thinking on the subjects of Veterinary Education and Research presented by the Dean of the Faculty, Dr. M. Krishnan Nair and National priorities in Veterinary Research, contributed by the Deputy Director General, (Animal Sciences,) of the Indian Council of Agricultural Research, Dr.R.M. Acharya.

Reproduced herein are abstracts, first from the Dean's paper and next, from that of the Deputy Director General.

The Dean has, with emphasis, stated that what we need is good quality Veterinary aid and not an increasing number of Veterinary graduates being posted to work in departmental institutions of Government. In the place of institutionalised services, which can be availed of only by few farmer-owners, the suggestion made is that expert assistance with assured mobility be provided at reasonable cost. The Dean also desires that there should be proper liaison and interaction, between the field staff and the faculty members concerned on a continuing basis. Besides he has also pinpointed the necessity to appoint only those with postgraduate qualification in the different disciplines, for field and farm production functions. over and above a cadre of professionals for the work of inspection of meat and other foods of animal origin and above all for slaughter house management duties.

These are matters which have received priority of attention of all concerned in a welfare state, where public good availing of the benefits of science and technology in a rural centered economy permitting growth with social justice, is the aim.

The Dean wants that the State should be one of the important milksheds in the country, in consideration of the fact that it has the largest number of cross-bred cattle, while at the same time he has taken into cognisance the lack of a proper breeding plan and the acute shortage in the state, of all items of animal feed which are first essentials for sustaining viability of the venture. Also no State can fall into a national milk-grid unless it forms part of a commercially viable line of communication, notwithstanding the fact that the State is the most developed in the matter of cross-breeding indigenous cattle with exotic dairy-type European breeds. His plea is also that the State should in fact be a stronghold of buffaloes and that a well planned project should be undertaken for buffaloe breeding.

These two areas of development activity would no doubt provide for a considerable amount of basic research studies on the feeding, housing and management of dairy type cattle, since the State is chronically deficit in feeds and fodder resources. It being a heavy rainfall area in the equatorial belt, where the high annual precipitation level is also intensely seasonal, with high humidity and heat, the State is agro-climatically and ecologically unsuitable for buffaloe breeding of any scale.

In his presentation Dr. Acharya, the Deputy Director General, has similarly highlighted the need for more intensive studies on all the three aspects of animal production, health and products-technology, laying added emphasis on the engineering and technological aspects of housing and provision of animal shelters, using locally available materials and resources on an economic basis. Need for innovation in construction of slaughter houses and slaughter technology, have also been stressed upon by him.

Another aspect he has dealt with is regarding the need for creating specialised manpower resources on "Veterinary, Animal Sciences and Dairy Education" at the first degree level itself, in the Universities of Agricultural Sciences, allegedly on the basis of the recommendations made by the National Commission on Agriculture in its report (1979). In reality the Commission's report refers only to the need for separate courses of study within a single faculty in all these branches, on the ground that the course content and curriculum cannot possibly be stretched any further. Specialisation at the first degree level, it will be agreed, is neither relevant nor conceivable, whatever may be the character of the Universities. What will be worth consideration is the question of electives being introduced in the curriculum.

In retrospect, I had occasion to look into more of my old papers, one of which was some 25 years old, published under the caption "Principal's Dairy" in the 1960-61 issue of the magazine of the Kerala Veterinary College, of which I was the Principal and, the Dean of the Faculty of the Kerala University.

The main theme of this publication was the level of non-utilisation of the alumni of the College. The Dean of the Faculty now, Dr. Nair, is one of the most distinguished in the alumni list, having qualified most creditably, as one of the first 28 graduates of Mannuthy.

In this paper I had indicated various possibilities for useful employment of all the graduates produced on a continuing basis with more and more graduates with special skills and higher qualifications in support, being required.

The position as stated by the Dean of the Faculty and the D. D. G. (ICAR) in 1984 are in essence identical with what I had stated, way back in 1961.

Kerala State has 03.50 million operational land holdings of which above 03.00 million are below one hectare in size, the average holding size being 0.22 ha plots only. On the face of it, specialised farming-crop or animal based can only be a dream-land fantasy. The situation thus calls for considerable ingenuity, in the matter of generating man-power with different skills and grades of specialisation, for successful implementation of plans and programmes. In this process the participation of the development departments of Government should be in the manner of providing common facilities, to support people's projects, effectively utilising volunteer groups and organisations, in the field.

What the K A U has to take note of, is that it has to provide not only training opportunities but also adequate innovative skills of high calibre.

From the first step and at each step thereafter, whether be it in the matter of selection of candidates for undergoing basic courses of study or for employment as public servants, the need for stress is on proper attitudes in regard to dignity of labour and pride of participation in activities which are decisively in favour of the philosophy of the 'dirty-hand'.

The KAU is still young. It had many teething troubles including its multi-campus problems. It has infinite resilience. It has now more faculties added to it like the fishery faculty. The state has abundant marine and inland water resources. It has a long coastal belt of some 600 km and it would have been only logical to establish a full-fledged University of Fisheries in Kerala, the present semi-rural location of the College of Fisheries, about 100 km away from the main campus also being ideally suited for the purpose. What remains to be done is to induce the Government to act with determination, in matters such as this. The state's contribution to knowledge in aquatic biology and marine life has been significant. Ichthiology is important, even more important is fishery engineering and technology. As in fisheries so also in dairy science, the University should lay stress on the engineering and technological aspects, rather than on routine functions of teaching basic degree-level subjects, which are often repetitive and theoretical in nature. If the holders of the Indian Dairy Diploma have been found to be fully capable of dairy plant management and such other functions like butter and cheese making even under improvised conditions, the credit goes to the purposeful nature of their training. Similar has been the case with the first diploma holders in Veterinary medicine and surgery.

In meat processing and handling of meat and meat products for marketing, considerable ingenuity will be involved in tropical conditions, where engineering skills can be on test. Science without technology, in such specialities will be unproductive and wasteful.

I was a full member of the quinquennial review team of the ICAR which went into the achievements or otherwise of the I. V. R. I., between 1971-1982. This team took special note of the 'Deemed University Status' granted only very recently to the Institute under the U. G. C. Act and recorded its hope that this step taken at long last, would lead to the fruition of the long cherished hope and need for the establishment of a Central University of Animal Sciences. Sri. Rao Birendra Singh, the Minister for Agriculture and the President of the I.C.A.R., had also independently said in his inaugural address at the Institute that the real need is for a University of Veterinary and Animal Sciences and not just a deemed university status. This was despite the resistance of the ICAR's management, to all such changes.

I believe 'KAU 2000 A. D' will also take stock of the position and act appropriately. It is often said that what Kerala does today, the rest of India thinks of tomorrow.

They say in Krishi Bhavan, Delhi that fish speak Malayalam, in due tribute to our fishery experts. If so, language cannot be a bar in the matter of setting up our own University of Fisheries hopefully, in the not too distant future.

In truly co-operative dairy enterprises as well, our scientists have attained international recognition. We have our experts in poultry science too. The KAU may take note that sexing day-old chicken is an art and a science where technology is also very much involved. The University must enter this field of training too, to raise efficiency levels to 99.99 per cent recurring, in field level performance.

In animal health, Kerala has made considerable headway, not only in the matter of prevention and control of infectious/contagious diseases, but also in animal insurance, as an essential part of a package of economic inputs for securing from losses the scarce economic resources of several thousands and thousands of small and marginal farmers. We have to ensure that our graduates are not lured by unfair practices in this important nation building activity. The KAU has already done much to strengthen its animal science faculty, which, in the words of its present Vice-Chancellor, is the University's show piece, in many respects. But it has to be admitted that far too little has been accomplished by the University yet in the matter of diagnostic and curative aspects of animal diseases. There is need for a dedicated team of experts in this sector of activity too, who would act as the eyes and the ears of the State Department of Animal Husbandry by proper liaison.

The University's adopted villages and its field stations which are more symbolic than real at present, could provide the nucleus for such extension education oriented activities in Veterinary and Animal Sciences. These have to be energised and the result of work done reflected fully, at least from the commencement of the VII Plan.

The Kerala Agricultural University must also encourage the preparation of text-book material in all aspects of scientific growth. In these days when single authors may produce good monographs, text-books of value for teaching to the basic degree level, have to be of a different class.

The University must, above all, encourage faculty level basic research studies, apart from the maze of research exercises assigned to students at the M. Sc. and Ph. D. level. Our scientists will be judged by the level of our contributions to world knowledge. Once this capability is reached in however small a measure, within the limits of available resources, fund mobilisation should no longer be difficult.

It is true that higher degrees are awarded only as a mark of research competence. But, research degrees are proof of work done and are only of the nature of a licence to pursue further studies, on useful lines.

"KAU 2000 AD" should aim at excellence in its every action. Reaching peaks of excellence in place of mediocrity, should be its motto. Our specialists in this country should prepare the ground for superspecialisation which will be the stamp of the 21st Century in an age of ever advancing frontiers of science and technology, which knows no national barriers.

The University administration must be such as will promote these requirements. Science and research management is different from the management of industrial enterprises, as much as it also is different from the type of management required for matters such as law and order, administration of justice and so on. These are views which (late) H. J. Bhabha had made known, when he said that it is incorrect to believe that we are backward in science and technology while we are reasonably advanced in administration. He said that the administration, we have inherited is suitable to serve only the purpose of a static and undeveloped country.

Let *"KAU 2000 AD"* beware and, let its scientists and technologists equip themselves with that sense of integrity and honesty, which is the hallmark of a progressive and forward looking society, where merit alone can count.

B. Theme Papers

12

Research in Kerala Agricultural University— A Perspective for 2000 A. D.

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1. History of Agriculture in India

History of agricultural development in India during this century can be grouped into 3 phases. The first phase, covering the first half of the century, was marked by stagnation in agricultural growth (average growth rate 0.3 per cent per annum). But foundation for agricultural education and research was laid during this period. During 1907, five agricultural colleges were established. The establishment of ICAR in 1929 and the establishment of IARI and IVRI was important land mark in the history of agriculture research and education. During this period educated people often turned away from agriculture and it was considered that only the 'brawn' is required for agriculture.

1.1 During the second phase covering a period of 30 years (1950 to 1980) the agricultural production increased by 2.7 per cent annum. In the different Five Year Plans, more and more research and development programmes were initiated. The additional production achieved from 50 million tonnes to 132 million tonnes during this phase exceeds the production of the proceeding 10,000 years. The combined effect of the 'brain' and the 'brawn was responsible for this significant increase.

1.2 The third phase covering the remaining period (1980-2000), requires substantial growth rate in the agricultural sector. If we have to sustain the the existing rate of food availability by 2000 A. D., at least 210 million tonnes of grains have to be produced, considering the increase in population and possible higher consumption due to increase in the standard of living. We have to aim atleast a production increase of 4 per cent per annum to attain the minimum requirement (210 million tonnes) by 2000 A. D. This requires not only 'brain' and 'brawn' but also the "bank".

2. Agriculture in Kerala

The primary objective of agricultural research in the State is to maximise production per unit area. The per capita cultivated land holding in Kerala is only 0.10 ha. The land holdings are small and tend to be smaller (Table-1). The holding size in the country was 2.66 ha in 1961. The holding size has not affected the productivity in the countries like Japan (1.18 ha); Egypt (1.89 ha); Taiwan (1.27ha) or Republic of Korea (0.85 ha). Even this holding will be in more than one bit resulting in loss of more land as ridges and boundaries. The population and literacy in the State are high. The labour in the agricultural sector is becoming scarce and costly. Yet the agricultural labour is also under employed. The average number of work days comes to only 100–150 per year depending upon the location since agricultural activities are seasonal in nature. The above factors indicate the necessity for increasing the production and productivity, for maximising the income per unit area and for the creation of more employment The irregular fluctuations in the market rate of most of the agricultural produce of Kerala substantiate the necessity for diversification of crops.

2.1 *Trend in area, production and productivity*

The trend in area, production and productivity for major crops of Kerala is given in Table-2. In the case of rice, the area and production increased from 1955–56 to 1974–75. The area increased from 7.59 lakh ha to 8.81 lakh ha and thereafter it decreased to 7.93 lakh ha in 1979–80, with a marginal increase to 8.01 lakh ha in 1980–81. The production showed an increasing trend from 8.83 lakh tonnes in 1955-56 to 13.31 lakh tonnes in 1975-76. Gradually, the production came down to 12.57 lakh tonnes in 1980–81 and increased to 13.4 lakh tonnes in 1981-82. Thus, the production increased by about 50 per cent in 25 years registering an annual growth rate of 2.0 per cent per annum, while the population increased by about 1.9 pet cent per annum (1971–81 only). The productivity of rice (husked) increased from 1164 kg/ha to 1660 kg/ha during the same period (by 43 per cent).

A season-wise analysis shows (Table-3) an increase in production and productivity in *Virippu* and a decrease in *Punja* and *Mundakan* (only production). The *Mundakan*, which covers 44 per cent of the area, contributed 44 per cent of the production while *Virippu* contributed to 43 per cent of the area and 41.5 per cent of the production in 1981–82. The coverage of high yielding varieties is only 21 per cent in the *Mundakan* as against 40 per cent in *Virippu*. The chances of increasing production and productivity in these two seasons are quite high, even based on our present level of knowledge. The increase in yield due to high yielding varieties is only 250 to 350 kg/ha which is quite low, considering the experimental yield of 5 to 6 tonnes/ha as against 2 to 2.5 tonnes/ha in the case of conventional varieties. Table 4 indicates that we are producing only 1.88 tonnes/ha while Japan, Korea and China are producing 6.16, 6.78 and 3.51 tonnes/ha, respectively. This points out to the tremendous possibilities of increasing our production level. Even at present, our potential yield is estimated as 4.91 tonnes/ha while the achievement is only 46.1 per cent, leaving a gap of 53.9 per cent (Table-5). The production and productivity have recorded an increase in the case of rice, tapioca, rubber, tea, coffee and cardamom since 1955. But only in the case of rubber, the increase is substantial. In the case of coconut, there was drastic reduction. Pepper production was almost static around reduction. Pepper production was almost static around 27,000 to 28,000 tonnes, although the productivity has gone down. Although 2/3 of total cropped area in Kerala is under perennial crops, the fertilizer consumption in this sector is only 17 per cent of the 97,200 tonnes of which major share is consumed by plantationcrops such as rubber, coffee, tea and cardamom. In other words, the consumption of fertilizer by crops like coconut and arecanut etc., is rather negligible. It has been established that one ha of coconut garden having 173 plants yielding 40 nuts per tree per year removes 96 kg of N, 48 kg of P_2O_5, 144 kg of K_2O, 87 kg of CaO and 36 kg MgO. Often we fail to replenish the above quantity to the soil which will naturally be resulted in low yield. The presence of a large proportion of unproductive genotypes, lack of proper selection of planting materials, imbalanced manuring, under-manuring or non-manuring, non-adoption of optimum cultural practices, lack of proper moisture conservation and drainage, lack of proper plant protection measures are the important causes for the yield decline in coconut, apart from the malady of root (wilt) disease. Experimental results from Kerala (CPCRI & KAU) have shown that the response to fertilizer would be about 38 nuts and that to irrigation, about 35 nuts per palm per year. The combined effect would be 73 nuts per palm per year thereby increasing the yield to 100 nuts/year/palm, if the plants are properly fertilized and irrigated.

The above factors are also true in the case of pepper. A survey utilizing 13 million standards of pepper by the Indian Institute of Statistical Research, New Delhi indicated that by proper fertilization alone, the yield of pepper can be increased by 66 per cent. Research results are available to prove that the yield of pepper can be increased to 2.0 kg/standard/year from the present level of 264 gm/standard/year, if the available technology is adopted.

From the above examples it is clear that the yield gap (the gap between the farm yield and the experimental yield) is quite wide and the immediate task will be to bridge the gap by utilising the available appropriate technology. The experimental yields now available are also far below the potential yield. Hence the research gap (gap between the potential yield and the experimental yield) may also be bridged by proper and well planned location-specific research.

3. Agricultural Engineering

The major areas that come under agricultural engineering are (1) Farm machinery and power, (2) Soil and water conservation, (3) Irrigation and drainage, (4) Post-harvest technology (5) Dairy and food engineering and (6) Agro-industries and energy. There is considerable scope in Kerala for research and extension activities in agricultural engineering because of its distinctive farming practices, topographical features, small size of holdings, diversity of crops, pressure of population on land and the large contingent of organised agriculture labour.

3.1 Farm machinery

In other parts of the country or elsewhere in the world, machinery and equipment are developed with the objective of saving labour. They are mostly big machines intended for large scale operation. The situation in Kerala is different.

Here, the holdings are small and the number of under-employed labourers is large. Any attempt to introduce large scale labour saving devices will be strongly resisted by the organised labour force. As conditions in Kerala are distinctly different, we have to develop our own package of small equipment, tools and implements which will perform the work better and reduce the human drudgery to earn more for the labour and to develop agriculture as an economically viable venture.

However, from the recent trends, it appears that this can only be the short term objective. Of late, it is becoming increasingly difficult to get labour during the peak seasons. A few years back, the labourers strongly resisted the use of tractors and power tillers for ploughing and other tillage operations. There were many voilent clashes between the land owners and the labourers on this account. There is practically no resistance today to the use of tractors and power tillers for tillage operations.

It is argued that since there is unemployment in Kerala, the use of equipment and machinery which displace labour should be discouraged. It is true that there is unemployment in Kerala, but it is more among the educated class than among the working class. The wages of manual workers are increasing steadily and the farmers are finding it difficult to engage labour at the high rates of wages without reasonable out-turn. The only solution for this is to increase the labour productivity by selective mechanization. The research, education and extension activities of the State should be geared to meet the future needs in this field.

3.2 Water Management

So far, the policy of the State has been to convey irrigation water only upto the distributory outlet points. Each distributory outlet point commanded an area varying from 10 to 40 ha. It was left to the cultivators to convey the water to their own holdings. It was then expected that the cultivators would construct field channels to convey the water. But the experience has shown that the cultivators did not construct the channels, but conveyed water to their holdings by makeshift arrangements and during the process large quantities of water were lost in deep percolation. The tail-enders in the outlet command often received no water. Not even 50 per cent of the total potential created, is now utilised. Realising the importance of efficient water management, the State has now constituted the Command Area Development Authority for looking after the water management aspects.

Annual rainfall in Kerala is very high; but it is not evenly distributed. Nearly 80 per cent of the total rain occurs during the six months from June to November. The months of January, February and March are the driest months, receiving less than 3.0 per cent of the total rain. The soils are comparatively shallow, usually less than 1 to 2 meters deep and as such, only a limited quantity of water can be stored in the soils. Supplementary irrigation becomes necessary during these months.

But in large areas, water is not available as the shallow wells and tanks dry up. The only potential source is groundwater which has to be harvested. In areas where groundwater cannot be tapped, we may have to adopt dry farming techniques developed recently or evolve new techniques to raise a successful crop during these months.

Technology also has to be developed for irrigating rice fallows during summer for raising remunerative crops like sesamum, groundnut and pulses with the limited water supply during the season.

Drainage problems in Kuttanad in the peat and muck soils (kari) which have unique physical, chemical and biological properties require careful study. The ordinary drainage practices that are used in mineral soils are not suitable here. The peat and muck soils which have been developed from the residue of trees and shrubs deposited there thousands of years back contain partly decomposed organic matter. As the field level is below the surrounding water level, there is always an upward movement of water from the sub-soil to the surface. This brings along with it, harmful byproducts of decomposition of organic matter which on coming into contact with the roots of plants adversely affect them. Yield has been consistently poor in these lands. Development of suitable drainage practices which will prevent the rise of toxic salts into the rootzone is of prime importance, because 'kari lands' occupy a substantial area.

'Petti & Para' are used in large numbers in Kuttanad and 'Kole lands' for dewatering. These machines have very low efficiency. The efficiency of 'Petti & Para' is as low as 20 to 25 per cent, while that of manufactured axial flow pumps is as high as 75 per cent. It means that a 15 HP manufactured pump will deliver as much or even more water than a 50 HP 'Petti & Para'. There is considerable scope for improving the efficiency of the 'Petti & Para'. But 'Petti and Para' has some advantages over the manufactured pumps. They are cheap and are fabricated with materials available locally. Their repair and maintenance can be attended to by local artisans. Improvement in the design of 'Petti and Para', retaining its present advantages, is one of the important items requiring immediate attention.

3.3 Soil conservation

At present, the soil conservation activities of the State are restricted to the construction of contour bunds. In order to be effective, the soil conservation activities will have to be taken up on a water-shed basis. The different aspects to be covered in this field are the water-shed hydrology, flood forecast and flood control, stream bank protection and river training, run off and sediment control.

Collection of hydrological data is another important work that calls for immediate action. Hydrological data, especially, for small agricultural water-sheds, are not available. Such data for a period of 25 years or more are available for many important locations in India. As we are lagging behind we will have to initiate this work without any further delay.

Kerala has a very undulating rolling topography with hills, hillocks and valleys. The valleys are mostly paddy fields. In the rainy season, surface and sub-surface run off from the surrounding hills drain into the paddy fields making these fields waterlogged. During this season, drainage is the main problem in the paddy fields while soil erosion is the most serious problem on the hills which have very steep slopes. Cultivation on slopes over 50 per cent is not uncommon in Kerala, eventhough all the conventional text books on soil conservation recommend that lands having more than 40 per cent slope should be put permanently under afforestation and natural vegetation should not be disturbed. The pressure of population on land is so much that this recommendation cannot be followed. The recommended practice is to construct California or Puerto Rico type terraces and pitch the down-hill side with stones for stability. This method is effective, but the cost of pitching is becoming prohibitive. Now it has become necessary to find out alternative cheaper but effective methods of construction of the bunds. Taking advantage of the high infiltration rate of most of the hill soils in Kerala, it may be possible to develop a combination of mechanical and agronomic methods for checking soil erosion.

Indiscriminate felling of trees and shift cultivation practices adopted by the encroachers in the forest area are causing severe erosion on the hillsides of Kerala. The eroded soil is carried by small streams and revulets into the reservoirs of multi-purpose projects. The useful life of a reservoir depends upon the prevention of silting. It is estimated that unless remedial measures are taken, our reservoirs will become virtually useless in less than a hundred years. Dr. M. S. Swaminathan has cited some grim statistics in this regard. The storage capacity of Nizam-sagar Lake in AP has been reduced by 63 per cent in 44 years; of Mayurakshi and Maithen reservoirs by 10 per cent in 20 years; of Bhakra by 6 per cent in 16 years. Thus not only the rich soil is getting depleted, but also our capacity to store water and use it for power generation and irrigation will decline. As we do not have any known deposits of coal or petroleum in Kerala, our only dependable source of energy is hydroelectric projects. We have to devise ways and means to protect these reservoirs from sedimentation and enjoy the benefits of this annually renewable source of energy for years to come or look forward to a time of utter ruin which is caused by our own follies. To avoid such an eventuality, we have to undertake soil conservation measures on watershed basis in the catchment of reservoirs on a war footing.

3.4 Post-harvest technology

Post-harvest technology and processing of agricultural produce have hitherto received only very little attention. Small-scale processing of agricultural produce into directly consumable items, both for internal consumption and export, can greatly benefit the farmers and the country. For example, at present there is no effective method for extraction of cocoa butter and production of cocoa powder on a small scale. If a successful method can be developed, it will break the monopoly of the big manufacturers, who are at present exploiting the farmers.

3.5 Employment generation

Another compulsive necessity of the day is to generate employment. The most potential source for this is the agro-based cottage and small industries. Agricultural Engineering Research Centres can identify industries suitable for each area and prepare production blueprints for each of these industries by developing requisite technology or by acquiring it from elsewhere in India or abroad.

3.6 Energy

The amount of energy available per unit area has significant effect on the crop yields and the cropping intensity. At present in India, 43.6 per cent of the total power used in Agriculture is contributed by draft animals. The contribution of human power is 10.9 per cent. The share of electric motors and diesel engines is 32.9 per cent. Tractors and power tillers contribute about 11.7 per cent. Since the maintenance cost of animals are increasing, it is becoming uneconomic to maintain them for providing the draft power for agriculture. If this trend continues, the share of animal power in agriculture may go down considerably.

Though, there is not much scope for increasing the net cultivated area, the gross cropped area will continue to increase in the years to come by multiple cropping. The additional requirements of energy cannot be met from animal power as it is not likely to increase and will have to come from other sources. Electrical energy and energy from fossil fuels are the conventional sources of energy and their share in the total energy used for agriculture will go up.

The scope for development of non-conventional sources of energy like bio-gas, wind and sun are enormous, which at present remain untapped. If energy from these sources are harnessed economically, they would provide alternative and cheaper sources of energy for agriculture in the coming years.

These are some of the major problems facing the State in the field of agricultural engineering. Unless the agricultural engineering activities in the State (which have been hitherto neglected) are strengthened, we may fail to achieve the targets fixed for agricultural production.

4. Approach in Research

The farm holdings are being fragmented and they are likely to become smaller and smaller by the end of the century. Hence, the main approach should be towards increasing the net return per unit area per unit time, so that the standard of living of small and marginal farmers is increased substantially. Although the medium farmers are few in number, the area cultivated by them is substantial. Hence neglect of the development of technology suited for the medium sized farms will be suicidal in respect of total production and marketable surplus. Unless and until post harvesting processing centres are established on co-operative basis at Panchayat level, the availability of quality produce for export will likely to be a limitation. A check has to be made in the further fragmentation of holdings to make the farms economically viable. Economically viable units have to be worked out. A form of voluntary co-operation in the farm operation will be necessary in the case of uneconomical small holdings if they have to become viable units, otherwise, such units will go out of cultivation. Similarly we often demand evolution of low cost technology. The low cost should not be in terms of the cost of inputs. On the other hand, technology resulting in higher cost: benefit ratio should be considered better on economic terms. In other words, it may be considered better to maximise output with the use of optimum inputs. There are countries which use 450 kg of N and corresponding quantities of P_2O_5 and K_2O per ha of vegetable cultivation getting huge profits, while we recommend 40 to 80 kg/ha.

Considering the above facts, our thrust on research should be on the following:

4.1 Identification of location spacific constraints for the yield gap and adoption of remedial measures.

4.2 Identification of research gaps on the basis of a system approach and taking into account the land under specific situation as a unit. A system of Agriculture has to be developed which will meet the goals of increasing production, income and employment.

4.3 Production of technology for small, marginal and medium farmers with a view to maximising the net return per unit area per unit time. A number of models suitable for holdings ranging from a few cents to a few hectares should be developed, based on scientific data. Development of technology for the eoonomic use of the natural resources such as land, water, light and air.

4.4 Protection and maintenance of soil and soil fertility.

4.5 Development of agro-forestry to maintain 1/3 of the land mass as forest for food, fodder and energy, for the development of healthy environment and for the maintenance of natural eco-system to avoid erosion of soil and water.

4.6 Development of small scale machinery, equipment and tools to increase the labour output and to decrease the drudgery.

4.7 Development of technology for agro-based industries at the village level.

4.8 Avoiding the environmental pollution.

5. Research Priorities

Based on the above priority, problem oriented applied research and fundamental research of relevance to the applied aspects on the following require immediate attention:

5.1 Increasing the photosynthetic efficiency and maximising the harvest index. The research so far done was not able to increase the biomass production. It enabled only to change the ratio. Unless we are able to increase the total biomass production by increasing the photosynthetic efficiency the total yield will not be increased substantially.

5.2 Plant improvement by introduction, selection and by other genetic methods including genetic engineering.

5.3.1 Breeding varieties for disease and pest resistance/tolerance by utilising wider genetical base. The discovery of "Dee-gee-Woogen", a spontaneous dwarf mutant gave a new direction to the improvement of typical *indica* varieties. About 140 varieties have been released by 1981, most of them having the dwarfing gene of "Dee-gee-Woogen". This narrow genetical base was responsible for the uniformity among these varieties as well as their susceptibility to pest and diseases.

5.3.2 So far mainly single gene resistance (vertical resistance) was contemplated in breeding in rice. Although this technique was effective against certain insect pests and diseases (eg. green leaf hopper, grassy stunt virus), this method was not found useful for insects which form biotypes (eg. BPH) and diseases that develop physiological races (eg. rice blast). Three principle approaches available ie. *gene pyramiding* (combining in each variety a complex of both major genes for resistance to a given pest or pathogen) *multiline* varieties (a series of genetic lines having similar external characters, but which differ in their reaction to specific biotypes or physiological races) and *creating horizontal resistance* (poly-genic resistance) (incorporating many minor genes that provide moderate level resistance) which are worth trying in rice to tackle the most important problem of the incidence of pests and diseases.

5.3.3 Breeding for drought resistance and tolerance to varying water depths. In Kerala nearly 50 per cent rice is cultivated under rainfed conditions and about 10–15 per cent is under deep water paddy. It is, therefore, necessary to evolve varieties which can tolerate water stagnation for about 30 cm for shorter periods to avoid the damage due to flood.

5.3.4 Breeding varieties of paddy suitable for saline and acid saline conditions. Varieties should be selected for different agroclimatic zones and also for specific situations even within zones.

5.4 Standardise agro-techniques for maximum utilization of the applied nutrients. Hardly 30 per cent of the applied nitrogen and 24 to 25 per cent of P_2O_5 and K_2O is available to the rice plant. The remaining are being lost by different means. Nitrogen is generally lost (1) by ammonification (2) by direct volatilization of ammonia from the flood water (3) by immobilisation of soil organic matter (4) by leaching and (5) by de-nitrification. Although technology is available to increase the nitrogen efficiency by coating the fertilizer with neem cake and coal tar, still substantial loss occurs. The availability of applied nutrients can be increased atleast to 60 per cent. The availability of P_2O_5 can be increased by different bacterial cultures(*Bacteriam magatheriam)*. Further increasing the availability of P_2O_5 may be aimed at and the necessary technology may have to be standardised.

5.4.1 Standardisation of the production and utilisation of bio-fertilisation like Azolla, blue green algae, etc. will be useful to reduce the cost of fertilization and also to improve the soil structure.

5.4.2 Standardisation of the technology for the economic utilisation of farm waste.

5.5 Standardisation of technically feasible and economically viable methods of mixed farming and integrated farming systems (crop-cattle-fish/prawn culture).

5.6 Standardisation of economically viable technology for maximising the production per unit area per unit time, for different types of holdings.

5.7 Utilisation of hormonal mechanism for yield enhancement, enhancement or slowing down of ripening, etc.

5.8 Research to find out material suitable for plant protection based on biological materials in place of harmful chemicals which create environmental pollution and health hazards. An integrated system of pest and disease management should be standardised for each crop and cropping system.

5.9 Standardisation of the best method of soil and water management, economising the available water.

5.10 Providing small and medium agricultural based industries. Agriculture being seasonal in nature there will not be adequate work through-out the year. Supplementary avocations can be provided by establishing small and medium agriculture based industries like processing of spices for oleoresin, grading and packing of spices, production of vitamin A from lemongrass oil, manufacture of toys, matress etc. from rubber, preparation of cocoa chocolates, tapioca based industries etc. These industries will also generate substantial employment in the State.

5.11 Germplasm assemblage of important medicinal plants and standardising their propagation, cultivation, extraction etc. Medicinal plants are important wealth of Kerala. The collection of the same from the wild habitat is found to be extremely difficult because of several factors. Therefore, detailed studies of the same is required to cultivate the same in the homesteads for getting genuine materials. They can also earn foreign exchange.

5.12 Establishment of a 'genetic sanctuary' of important crop plants . It is found that valuable genetic materials are being depleted from the forest area. As and when new types and varieties are evolved, we forget about the old varieties. It is not advisable to limit the cultivation of certain varieties alone due to several reasons. Genetic resources of plant materials, if allowed to deplete will have disastrous consequences in the next generation. Therefore it is necessary to have a gene sanctuary where wild types of different species and the old and present cultivated varieties can be assembled and systematic study of the same undertaken for utilising the useful genetic materials in the future breeding programmes and for economical exploitation.

In several important crops of Kerala, such as rice, coconut, pepper, etc., technology is available which can increase the yields by two or three folds, but the yield gap is still remaining. To bridge this gap, I feel, large-scale adaptive trials in the cultivators' fields and operational research programmes in selected areas are necessary. These will go a long way to demonstrate to the farmers the feasibility and economic viability of the technology. Agricultural research will have no meaning unless the research results are made use of by the farmers for increasing their income. Therefore, in addition to generation of economically viable technology, services which can enable all farmers to take up naw technology are absolutely essential. For agricultural improvement and adoption of the new technology, it is also necessary to provide public policies which will stimulate production and consumption. While formulating such policies, land use, institutional changes, creation of village level leadership, providing support price in the case of export oriented crops, insurance against marketing loss are some of the important factors to be considered. Unless these changes are brought about, the research result will only serve as an addition to the knowledge. Now-a-days in Kerala the cultivators are ready to accept any technology that is economically viable. But crops which are mainly export oriented are often neglected when market rate goes down substantially. A minimum price level can be fixed as a safeguard against wide fluctuations in the market price. When the World market price goes beyond a particular level, excise duty can be levied assuring an optimum profit to the cultivator. The amount received by way of such excise duty may be ploughed back to the cultivator when the international price goes down to the extent of non-profitable value.

Research will have meaning only if it is backed by proper extension service, organisation of efficient input supply system, providing institutional support for efficient storage and marketing, providing price policy which will generate consumption and assure reasonable profit to the cultivators.

7. Veterinary & Animal Sciences

The major thrust on Veterinary & Animal Science research will be to increase production of milk, egg and meat not only to cater the needs of the growing population but also to increase the net income of the farmers especially that of marginal and small farmers. The thrust area for research is as follows:

7.1 To develop new cross-bred types of animals and improved strains of poultry. With regards to poultry the main emphasis will be given for the development of promising strains suitable for the backyard rearing system.

7.2 To collect and maintain germplasm preserve of indegenous livestock and poultry for identifying promising types and for undertaking future improvement programmes.

7.3 To investigate the causes and suggest remedial measures for infertility and delayed maturity of crossbred animals.

7.4 To standardise production technology of low cost nutritive feed for cattle and poultry by utilising available farm produce, farm wastes and agricultural by-products.

7.5 To study the etiology of important diseases of livestock and poultry and to find out preventive and curative measures.

7.6 To study on the aflatoxin and suggest remedial measures.

7.7 Development of economical and efficient management system for livestock and poultry for different agroclimatic and socio-economic conditions of the farmers of Kerala.

7.8 To standardise economic and hygienic production of livestock and poultry products.

8. Fisheries Research

In fisheries research Kerala Agricultural University will give stress on culture fisheries with a view to increase production from reservoirs and other inland water sources. Mixed farming involving crop-fish-prawn culture techniques have to be standardised. With the above view, the following thrust area can be considered for research in fisheries.

8.1 To develop viable technology for the commercial cultivation of fin fishes and shell fishes.

8.2 To develop composit culture of Indian and exotic major carps along with suitable local species.

8.3 To develop techniques of paddy-cum-fish and prawn culture.

8.4 To conduct studies on fisheries biology, ecology and processing technologies and fisheries management.

8.5 To study the problem in fish culture and processing faced by the weaker sections including fishermen, SC/ST persons and identify and develop appropriate technology for their economic betterment.

Table 1

Operational holdings—Number and area of Kerala 1976-77

Sl. no.	Size class	No.of operational holdings	Area of operational holdings
1	0.02—0.99	28,66,518	6,78,250
2	1.00—1.99	2,76,917	3,79,930
3	2.00—3.99	1,12,195	3,03,139
4	4.00—4.99	33,047	1,81,427
5	10.00 & above	3,494	65,612
	Total	32,92,171	16,09,358

Source: Agrl. Census 1976-77, Directorate of Economics & Statistics

Table 2

Area, Production and Average yield of important crops of Kerala

Name of crops	1955–56			1960-61			1965-66		
	Area (000 ha)	Produ-ction (000 tons)	Average yield (kg/ha)	Area (000 ha)	Produ–ction (000 ton)	Average yield (kg/ha)	Area (000 ha)	Produ-ction (000 ton)	Average yield (kg/ha)
	1	2	3	1	2	3	1	2	3
Rice	759.35	883.92	1164	778.91	1067.53	1371	802.33	997.49	1243
Coconut	447.94	3099.00 (mil. nuts)	6919 (nuts/ha)	500.76	3220.00 (mil. nuts)	6430 (nuts/ha)	586.31	3293.00 (mil. nuts)	5616 (nuts/ha)
Tapioca	222.13	1594.10	7061	242.20	1683.00	6949	229.68	3095.66	13478
Pepper	86.49	27.68 (black)	321	99.75	27.03 (black)	271	99.70	21.69 (black)	218
Rubber	64.71	21.17	327	122.87	23.04	187	149.63	46.95	314
Arecanut	58.10	6460.00 (mil. nuts)	111195 (nuts/ha)	54.26	7737.00 (mil. nuts)	142601 (nuts/ha)	64.48	9681.00 (mil. nuts)	150360 (nuts/ha)
Banana & Plantains	47.07	—	6737	44.42	327.85	7381	47.78	361.12	7558
Tea	39.88	30.40	762	37.63	40.37	1073	39.47	39.15	992
Cashewnut	37.46	58.79 (raw)	1569	54.32	84.63 (raw)	1558	87.37	98.03 (raw)	1122
Cardamom	28.07	1.26 (processed)	45	28.61	1.28 (processed)	45	28.68	1.61 (processed)	56
Coffee	14.29	6.25	372	16.80	7.41	442	23.60	9.88	418

Name of crops	1966-67			1967-68			1968-69		
	1	2	3	1	2	3	1	2	3
Rice	799.44	1084.06	1356	809.54	1123.90	1388	873.87	1251.35	1432
Coconut	609.58	3425.00 (mil. nuts)	5618 (nuts/ha)	638.72	3593.00 (mil. unts)	5625 (nuts/ha)	686.06	3834.00 (mil. nuts)	5588 (nuts/ha)
Tapioca	224.65	3409.67	13937	297.65	4198.36	14105	296.66	4081.12	13759
Pepper	99.70	21.41 (black)	215 (black)	99.70	21.06 (black)	211 (black)	98.83	20.44 (black)	207
Rubber	153.36	50.50	329	162.93	59.98	368	168.53	66.47	394
Arecanut	71.23	10683.00 (mil. nuts)	149976 (nuts/ha)	76.04	11473.00 (mil. nuts)	150873 (nuts/ha)	81.18	12289.00 (mil. nuts)	151376 (nuts/ha)
Banana & Plantain	45.59	344.90	7665	49.42	374.28	7573	51.59	390.48	7569
Tea	39.80	44.13	1109	39.28	43.19	1099	41.16	44.78	1088
Cashewnut	90.56	101.61 (raw)	1122	94.99	106.58 (raw)	1122	96.02	107.73 (raw)	1122
Cardamom	47.03	1.61 (processed)	34 (processed)	47.03	1.61 (processed)	34 (processed)	47.03	1.06 (processed)	22 (processed)
Coffee	25.15	10.51	418	26.47	11.46	433	27.68	11.98	433

Name of crops	1969–70			1970–71			1971–72		
	1	2	3	1	2	3	1	2	3
Rice	874.06	1226.41	1403	874.83	1298.01	1483	875.16	1351.74	1544
Coconut	707.84	3956.00 (mil. nuts)	5589 (nuts/ha)	719.14	3981.00 (mil. nuts)	5536 (nuts/ha)	730.26	4054.00 (mil. nuts)	5539 (nuts/ha)
Tapioca	295.58	4665.76	15785	293.55	4617.19	15729	303.26	5429.28	17902
Pepper	118.04	24.40 (black)	207 (black)	117.54	25.03 (black)	213	116.34	25.10 (black)	216 (black)
Rubber	175.19	76.90	439	179.26	78.73	439	188.61	88.93	472
Arecanut	83.68	12861.00 (mil. nuts)	151303 (nuts/ha)	85.82	12738.00 (mil. nuts)	148430 (nuts/ha)	86.66	12832.00 (mil. nuts)	148074 (nuts/ha)
Banana & Plantains	53.50	404.94	7570	48.76	368.98	7568	47.89	362.27	7565
Tea	38.30	40.20	1050	37.59	41.45	1103	37.08	42.80	1154
Cashewnut	98.96	111.03 (raw)	1122	102.71	115.24 (raw)	1122	100.66	112.94	1122
Cardamom	47.03	1.07 (processed)	23 (processed)	47.49	1.25 (processed)	26	47.49	1.52 (processed)	32 (processed)
Coffee	28.87	12.47	132	31.56	12.57	430	32.86	14.11	429

Name of crops	1972–73			1973–74			1974–75		
	1	2	3	1	2	3	1	2	3
Rice	873.70	1376.87	1575	874.68	1257.07	1437	881.47	1333.83	1513
Coconut	745.43	3921.00 (mil. nuts)	5260 (nuts/ha)	744.83	3703.00 (mil. nuts)	4972 (nuts/ha)	748.17	3719.00 (mil. nuts)	4971 (nuts/ha)
Tapioca	304.83	5692.36	18674	306.45	5669.52	18468	317.88	5625.12	17696
Pepper	116.35	25.15 (black)	216	118.25	27.75 (black)	235 (black)	118.41	27.23 (black)	230
Rubber	195.60	91.95	470	199.60	118.02	591	202.32	121.56	601
Arecanut	88.63	13136.00 (mil. nuts)	148207 (nuts/ha)	90.70	13459.00 (mil. nuts)	148389 (nuts/ha)	93.04	13777.00 (mil. nuts)	148073 (nuts/ha)
Banana & plantains	47.29	357.88	7568	46.72	353.62	7569	47.14	356.58	7564
Tea	48.38	43.68	1138	37.69	48.36	1283	37.57	48.90	1301
Cashew nut	101.49	113.88 (raw)	1122	103.16	115.75 (raw)	1122	104.88	117.68 (raw)	1122
Cardamom	47.49	1.25 (processed)	26	47.49	1.50 (processed)	32	46.63	2.05 (processed)	44
Coffee	34.65	14.92	430	35.81	15.46	432	36.59	15.78	431

Name of crop	1975-76 1	2	3	1976-77 1	2	3	1977-78 1	2	3
Rice	876.02	1331.19	1520	854.37	1254.00	1468	840.37	1294.64	1541
Coconut	692.95	3439.00 (mil. nuts)	4963 (nuts/ha)	694.99	3348.00 (mil. nuts)	4817 (nuts/ha)	673.48	3053.00 (mil. nuts)	4533 (nuts/ha)
Tapioca	326.87	5390.22	16491	323.28	5125.52	18855	289.72	4188.57	14457
Pepper	109.25	24.58 (black)	227 (black)	108.67	24.50 (black)	225 (black)	101.05	20.15 (black)	199 (black)
Rubber	206.69	128.77	623	209.72	139.35	664	212.27	135.91	640
Arecanut	76.62	11387.00 (mil. nuts)	148620 (nuts/ha)	68.36	11303.00 (mil. nuts)	165354 (nuts/ha)	62.43	10548.00 (mil. nuts)	168965 (nuts/ha)
Banana & Plantain	52.28	356.71	7556	51.70	390.61	7556	50.10	615.23	5430
Tea	37.70	43.26	1148	36.16	41.64	1152	36.11	51.98	1440
Cashewnut	109.06	122.36 (raw)	1122	113.33	87.26 (raw)	770	126.96	84.73 (raw)	667
Cardamom	54.00	2.05 (processed)	38	51.68	1.42 (processed)	27	52.01	2.90 (processed)	56
Coffee	41.78	14.40	345	40.50	15.03	371	52.64	27.65	525

Name of crops	1978–79			1979–80		
	1	2	3	1	2	3
Rice	799.24	1272.74	1592	793.27	1299.70	1638
Coconut	660.63	3211.00 (mil. nuts)	4060 (nuts/ha)	662.66	3032.88 (mil. nuts)	4576 (nuts/ha)
Tapioca	273.48	4044.05	14787	243.76	4088.91	16774
Pepper	106.73	27.33 (black)	247 (black)	105.82	28.90 (black)	273 (black)
Rubber	214.42	123.68	579	214.42	123.68	577
Arecanut	62.32	10919.00 (mil. nuts)	175217 (nuts/ha)	60.86	10829.00 (mil. nuts)	177939 (nuts/ha)
Banana & Plantains	53.34	—	6054	49.59	—	6254
Tea	36.09	47.37	1202	36.70	47.37	1291
Cashewnut	136.55	81.18 (raw)	617	139.92	82.76 (raw)	592
Cardamom	55.18	2.90 (processed)	53	55.18	2.90 (processed)	53
Coffee	53.35	28.01	525	57.95	30.18	521

Name of crops	1980-81			1981-82		
	1	2	3	1	2	3
Rice	801.70	1271.96	1587	806.9	1339	1660
Coconut	651.37	3008.00 (mil. nuts)	4618 (nuts/ha)	652.8	10.73 (mil. nuts)	4632 (nuts/ha)
Tapioca	244.99	4060.91	16576	49.26	317.8	16592
Pepper	108.07	28.52 (black)	264 (black)	108.07	28.5 (black)	264 (black)
Rubber	237.77*	140.33	590	248.00	139.45	562
Arecanut	61.24	10805.00 (mil. nuts)	176431 (nuts/ha)	61.54	10.73 (mil. nuts)	174474 (nuts/ha)
Banana & Plantains	49.26	317.41	6443	49.26	317.87	6453
Tea	36.16*	50.72	1402	36.16	50.71	466
Cashewnut	141.28	81.90 (raw)	580	141.27	79.82	561
Cardamom	54.04	3.24 (processed)	55	56.376	2.8 (processed)	50
Coffee	57.95*	23.54	634	57.94	26.97	466

* Commodity board estimates

1 = Area (00 ha)
2 = Production (000 tonnes)
3 = Average yield (kg/ha)
Source: Bureau of Economics and Statistics, Kerala, Trivandrum

Table 3

High yielding varieties—Area and productivity in 1978-79, 1979–80, 1980-81 and 1981-82

Season	1978-79	79-80	80-81	81-82	Proportion of HYV to Total Rice (%)			
					1978–79	79-80	80-81	81–82
Area in Hectare								
Virippu	144909	142537	136236	138942	41.78	42.01	39	40
Mundakan	77909	84565	92391	73579	22.53	24.73	26	21
Punja	56416	55112	51098	47183	52.88	52.07	52	45
Total	279234	282214	279725	259703	34.94	35.86	35	32
Production in tonnes								
Virippu	291604	324534	282070	288486	53.59	57.95	51	52
Mundakan	135303	168939	175238	141563	25.53	31.95	32	24
Punja	126544	118059	101753	100940	63.73	60.90	60	52
Total	553451	611532	559061	530989	43.48	47.68	44	40
Average yield in kg/ha								
Virippu	2012	2277	2070	2076				
Mundakan	1737	1998	1897	1924				
Punja	2243	2142	1991	2139				
Total	1982	2167	1999	2045				

Note: Figures for 1981–82 are provisional

Source: Directorate of Economics and Statistics, Trivandrum

Table 4

Paddy Production in Tropical and Temperate Countries (1977)

Country	Area ha x 10^6	Production ton x 10^6	Yield/ha
India	39.50	74.00	1.88
Indonesia	8.40	23.23	2.76
Philippines	3.60	7.15	1.96
Sri Lanka	0.75	1.70	2.27
Japan	2.76	17.00	6.16
Korea	1.23	8.34	6.78
Australia	0.09	0.53	5.76
China	37.07	131.47	3.51

Source: FAO Monthly bulletin of Statistics

Table 5

Potential yield, Indices of Potential Realisation and yield gap of Rice (Unhusked) in different States (Averaged over 1974-75 to 1977–78)

State	Proportion of total rice area (in percentage)	Potential yield (tonnes/ha)	Index of potential realisation	Index of yield gap
Assam	5.92	4.70	31.7	68.3
Andhra Pradesh	9.45	6.27	36.7	63.3
Bihar	13.78	5.08	27.1	72.9
Gujarat	1.21	6.91	27.3	72.7
Haryana	0.86	6.60	48.6	51.4
Himachal Pradesh	0.23	4.06	44.0	56.0
Jammu & Kashmir	0.66	4.70	53.0	47.0
Kerala	2.18	4.91	46.1	53.9
Karnataka	2.49	5.68	46.9	53.1
Madhya Pradesh	11.84	4.19	26.2	73.8
Maharashtra	3.84	4.11	50.8	49.2
Orissa	11.84	4.72	27.0	73.0
Punjab	1.75	6.81	56.0	44.4
Rajasthan	0.41	4.82	37.7	62.3
Tamil Nadu	6.09	5.57	55.6	44.4
Uttar Pradesh	12.18	5.18	26.7	73.3
West Bengal	13.47	3.45	54.3	45.7
All India	100.00	5.07	34.5	65.5

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Agricultural Education in 2000 A. D

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The Background

Agricultural education encompasses all types of formal as well as informal education. The ultimate aim of agricultural education is to develop the farming community through interaction of teaching, research and extension. The activities in agriculture in India received formal attention by 1871, when the Department of Revenue, Agriculture and Commerce was set up by the Government of India. Similar departments were formed later on in many provinces. The country has gone through two distinct phases of development in agricultural education; (i) pre-Agricultural University period and (ii) the post-Agricultural University period, after 1960. Organised education in agriculture was started in 1907 when five Agricultural Colleges were established in five different places of the Country. At first they were offering diploma courses which were afterwards upgraded to impart degree courses. In 1929 the Imperial Council of Agricultural Research was formed based on the recommendations of the Royal Commission on Agriculture. Post-Graduate education in agriculture was started around 1930. The Imperial Agricultural Research Institute and Imperial Veterinary Research Institute have also started post-graduate training during this time. The number of Agricultural Colleges rose to 17 by 1947 with about 1500 students.

The Government of India appointed a joint Indo-American Team in 1954 to compare the Agricultural Institutions in U. S. A and India and in the report submitted by that Team in 1955, it was recommended to adopt in India the pattern of higher education of the Land Grant Colleges of American Universities. As a result of this recommendation in 1955, the then existing Agricultural and Veterinary Colleges in India were brought into sisterhood relationship with five Land Grant Institutions of U. S. A. for technical assistance. The first Agricultural University in India modelled after the Land Grant Colleges of U. S. A. was set up at Pantnagar in 1960.

The second joint Indo-American Team which was set up to review the work done as a result of the recommendations of the first Team, submitted its recommendations in 1960. Its recommendations included the development of the pattern of agricultural education from vocational schools, multi-purpose high schools on through the Colleges and Universities. The Agricultural Research Review Team set up in 1963 recommended the reconstitution of ICAR into an effective central agency for co-ordinating, directing and promoting agricultural research and education in India.

Agriculture is being taught in many schools in India at the primary and secondary levels. In many places nonformal programmes to educate the farmers are also being conducted. The agricultural education at the pre-University level is much less developed than that at the University level. The proportion of agricultural graduates to agricultural technicians in India is too low when compared with that in Japan and Taiwan. But this proportion is dependent on the stage of agricultural development in a country.

Higher agricultural education is concerned with the education of qualified persons to occupy leading positions in scientific farming shaping agricultural policy, agricultural research, in teaching, administration and many other agricultural services and in industries based on agriculture. At present there are 23 Agricultural Universities including IARI. The Agricultural Universities support agricultural development through the three-fold functions of teaching, research and extension. The Agricultural Universities have a more or less uniform organisational pattern. The National Commission on Agriculture pointed out in 1976 that the duration of study of agriculture should be equivalent to four years of academic work after 10+2 school education. There must be a central agency to co-ordinate the education at the national level and a uniform pattern is to be followed. The central agency should look into the question of entrance requirements, periods required for study, internship and practical training, to evolve a uniform system of agricultural education throughout the country. This has to be done because now it is generally accepted that the education and training of people for agriculture is as important (or even more important) as the education and training of people for business and industry in a country like India. Since the development of our nation will be largely dependent on the developments of agriculture, the future programmes in agricultural education have to be aimed at improving all phases of development of agriculture. The following aspects are to be emphasised while planning the future programmes in agricultural education in India.

Aims by 2000 A. D.

There will not be any basic change in the accepted fact that food remains the most basic of all human needs and that the food and agricultural sector will continue to provide the basis for a large part of the industrial production and export. Unless the agriculture sector raises to the occasion it will be difficult to meet the above requirements by 2000 AD. Any improvement in the agricultural production starts with a well laid out system of agricultural education. The basic concept of U. G. and P. G. education in Agricultural Universities is to prepare our young men and women to fill the role of practitioners and disseminators of up-to-date technologies of production and associated functions and while doing so to equip them with the knowledge of scientific methods and also a measure of imagination and innovative ability to deal with the future problems which might arise in the years to come. As pointed out in a recent workshop organised under the auspices of UNESCO, the expectations of our products from agricultural universities be summarised as follows:

1 Acquisition of job related knowledge and skills.

2 Broad understanding of related basic sciences and scientific methodology applicable to that.

3 Personality development with capability for logical thinking and effective self expression.

4 Understanding of techno-economic and political environment.

5 Capability for management and communication of ideas effectively.

6 Innovation and self study to continuously improve self;

7 Capability of assessing job requirements in spatial and functional requirements.

These requirements can be illustrated as per their relative merits.(see Fig. 1)

Let us examine how best we can achieve the above objectives by 2000 A. D. by reorienting our teaching programmes in agriculture.

1 A high level body to be constituted to continuously review the curriculum and to suggest the improvements; according to the principles of educational technology. The term curriculum is used here in the broadest sense of the term. It is a written document meant to specify the orientation of the courses at the macro level and the course at the micro level, towards achieving the goals of the programme and the specific content of knowledge, skills, abilities and attitudes. There must be regular workshops and training courses for teachers. This Unit can be termed as Instructional Technology Ceil which will help in the improvement of curriculae and courses.

2 To make teaching to be more meaningful it is necessary that the subject specialist should interact with experts in the science which specially deals with education technology.

3 The teaching and research programme in basic sciences and humanities are to be organised in such a way that it acts as a companion for applied sciences. P. G. programmes in all branches of agriculture are greatly dependent upon advanced course in basic sciences and humanities.

4 A separate faculty for post-graduate studies is necessary since the concept, structure and organisation of post-graduate programmes of studies are distinctly different from under-graduate programmes.

5 The students of agriculture should undergo an internship or apprenticeship programme after their final year B. Sc. (Ag.) courses are over. This training should impart them practical knowledge on all aspects of crop raising and also the fundamentals of Management.

6 It is essential to establish centres of advanced studies in specialised areas. The specialised areas should be chosen on the basis of the availability of qualified, talented people, the work already done in the University and according to the special needs.

7 New post-graduate programmes and or new courses are to be developed in those areas proposed by the different centres of advanced studies. Some of the areas to be considered on a priority basis are the following.

(a) Remote sensing as applied to agriculture.
(b) Energy management in agriculture.
(c) Agro-forestry and natural resources.
(d) Uses and manipulation of solar energy.
(e) Agricultural business management.
(f) Post-harvest technology.
(g) Problem soils and soil reclamation.
(h) Homestead management.
(i) Genetic engineering.
(j) Environmental pollution.
(k) Deficiency and toxicity diseases.
(l) Biological control of pests and diseases.
(m) Organic recycling.

8 In the Trimester/Semester system of education the most important element in maintaining the standard is the teacher. In order to make this system most effective there must be a system to continuously evaluate the teacher. All necessary encouragements have to be given to deserving teachers.

9 It is highly essential to produce text books as well as reference material based on local expertise and knowledge since agriculture is highly location-specific. For this, proper planning is necessary and all encouragements to be given to authors phased programme for the of text books from our University and we must have a production of standard text books in agriculture in accordance with our curriculum.

10 All efforts have to be made to equip our library and laboratory to fully meet the requirements for which a detailed development plan has to be worked out.

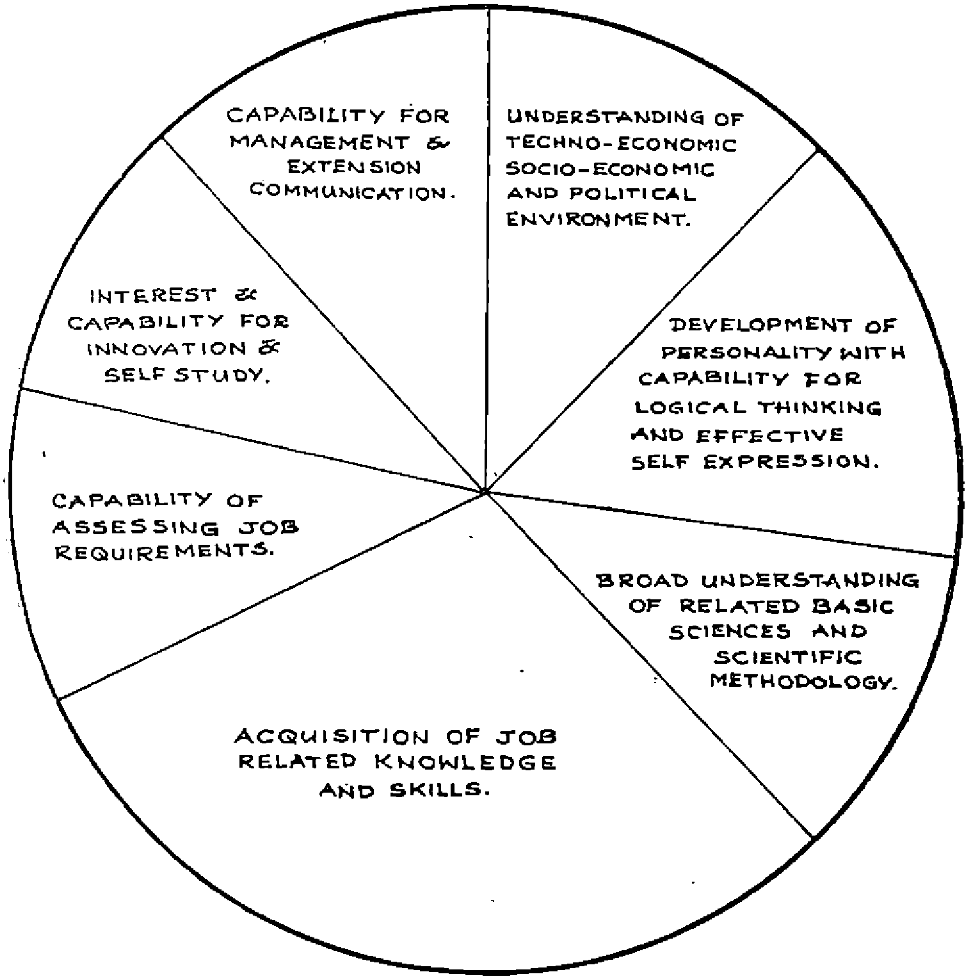

FIG. 1. EXPECTATIONS FROM PRODUCTS OF AGRICULTURAL UNIVERSITIES

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Veterinary Education

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"Education systems are built for a time and not for all times" (Dr. S. Radhakrishnan). In a broad sense the philosophy of education embodies the purpose of stimulating activities of human personality for integration into the present set up of the society, for service to the society and for preparation for the future requirement of the society. So when considering the educational pattern and perspectives for the future the important aspect to be considered is the methodology —pedagogic and scientific— to be employed to equip the students to face the challenges of the future. For this the main consideration is the expansion, strengthening and upgrading the institutional framework so that it can meet the man power requirements for sustained development along with promoting the quality and relevance of education through application of science and technology. The capability of an organization to carry out sustained and productive research is measured by its scientific and technological potential which in turn depends on the quality and not merely the quantity of trained personnel.

The demands that are made of Veterinarians by the State departments in diagnosis, control and eradication of diseases, and meat inspection and wild life and zoo animal management by the Universities for teaching and research, by the industry for maintenance of health and care of animals in intensive livestock production and animal lovers for treatment of their pets, are so great that the veterinary course should equip those who undertake it to participate efficiently in the economic development of the country.

It is necessary to forecast the possible scientific advances that would be made at the turn of the century to visualise the academic programmes that have to be tailored to fit into the system. Animal production system is found to undergo rapid changes, especially with the advent and practice of biotechnology. Livestock and birds with capacity for better production and resistance would be produced with genetic engineering. Embryo transfer from proven superior seed stock would become the proven breeding practice along with *in vitro* fertilisation and sex selection. Monoclonol antibody and hybridoma and other genetic engineering techniques would have ushered in new methodologies for production of biologicals which are very necessary for diagnosis and control of animal diseases. Molecular biology and cytochemistry would have yielded many new information on the biomechanics of cellular function in health and disease. With the movement of exotic germ plasm from other countries to India and with the movement of animals within, a spate of diseases would have emerged which would require newer diagnostic tools and newer chemo-therapeutic and biologic agents to contain and combat these diseases. Ecological pollution with chemicals and other physical agents would result in the contamination of animal products, resulting in interference in the somatic and cellular functions. With the constant pressure on land from man for food, it would become imperative to evolve alternate strategies to feed livestock with biologically or synthetically modulated feeds and fodder. In this connection, production of single cell proteins for animal feeding, which at the present stage is mainly yeasts cultured on a variety of substrates, would assume greater attention along with biologically degraded/altered feed stuff employing genetically programmed organism. Animal draught power and biogas generation would receive greater attention.

It would become necessary to exploit the vast potential of sea for cultivation of animal feeds and fodder. An integrated and intensive system of three dimension utilisation of land, water and air would become absolutely essential. Intensive and semi-intensive units of smaller livestock like rabbits, quail, snail, guinea pigs, earth worm etc. would be the order of the day along with other livestock and poultry. With the increase of milk production, due to improvement in the production capability of animals, newer, low input technology has to be developed for the adoption by the rural people for conversion of perishable products for either marketing or for subsequent use.

The goal in the animal production systems should not necessarily be to maximise animal production in terms of quantity or efficiency, but rather to utilise a combination of products in the ecosystem for a balanced return of diversified products. To exploit animal food resources to the optimum more attention should be developed to the adaptation of the genetic material to the potential of the environment and its logical place in the ecosystems. Genetic and nongenetic parameters should be closely integrated to establish the optimal breeding and husbandry strategy for specific ecosystems.

Experimental veterinary medicine and surgery would have greater significance for application in human medicine and surgery. Newer tools, and equipments employing computerised techniques would be available for application in the diagnosis, treatment of animal diseases and in research and production systems. It may be possible to use computer in many experimental models, so that heavy expenditure necessary for maintenance of animals can be avoided.

With this background of possible technological advancement, the following steps have to constantly taken:

1 Regular review of curricula and teaching methods
2 Improvement of teaching and other infrastructural facilities
3 Production of relevant instructional materials and aids
4 Upgradation of faculty capability

It has to be admitted that our teaching facilities are well below international standards. It is a fact quality suffers when infrastructural development does not take place commensurate with increased numbers. An ideal undergraduate class would consist of not more than 40 students, which would be divided for practical classes into atleast 3 batches.

This is not a forum to analyze the merits and demerits of the course system with internal evaluation, but I feel, a component of external evaluation is necessary for proper maintenance of standards. Our experience has been that the trimester system with all possible theoretical advantages has many weaknesses which ultimately had resulted in the devaluation of the final product. Personally, I would welcome a shift to the semester which would help to plan the courses, more methodically and systematically.

It is also necessary to bring in new communication technology in veterinary education. This would enable high quality teaching and sophisticated demonstrations to be brought into any class-room and make it possible to gear the pace of teaching to the ability of the individual student. The various technologies available can be divided into two broad categories.

1 Those that operate in 'Real time'
- Open transmissions by television or radio
- Direct broadcasting by satellite
- Cable

2 Those that are available in packages
- Correspondence courses
- Audiotape/slide programmes
- Videotape
- Videodiscs

The "real time" technologies have great potential but are expensive. They require large audience to justify the cost. Package materials, whilst less expensive to disseminate are sometimes more limited in impact atleast in their simpler forms. An effective system is the audiotape-slide education programmes. The video disc would greatly increase the potential of packaged distance learning. The videodisc combines all the advantages of television with the flexibility of access of a book and interaction with the teacher. Distance-learning materials are more effective when there is the opportunity for interaction with the learning programme and the teacher. Closed Circuit T. V. and computers would be regularly employed for teaching and research.

Along with the improvement of teaching techniques, it is also necessary that the faculty members are adequately exposed to modern developments and techniques. A system by which faculty members are sent for training to acquire specific techniques and for general exposure in renowned laboratories in India and outside is essential for improving faculty competency. Post-graduate teaching should result in interaction between the teacher and student rather than giving pedantic lectures. While research at the Masters level should be to acquire the necessary skills for inquiry on a selected topic, the thesis for a doctorate degree should definitely embody new ideas and new knowledge.

Higher Centres of Excellence and Schools in specific disciplines and areas would become necessary for indepth studies and for qualitatively improving teaching and for accelerated research. Scientific vigilance and vision would be needed to maximise the beneficial effects and minimise the negative consequences of new technology.

The ultimate success in achieving a balanced rural-urban growth will depend much upon the nature of our educational system and its integration with other development inputs. A clear national ideology and leadership committed to this ideology are necessary to make this synthesis. Success would be assured where education, formal or non–formal, is developed as an ingredient in a package where economic initiatives are central.

Though lip service is often paid to the ideals of social commitment, our system of selection, training and evaluation of scientific personnel at all levels, or of the teaching profession, does not provide for it. For instance, selection and later promotion are mainly based on academic records and attainments and publication of papers. Job requirements rarely include such elements as participation in developmental activities.

The Veterinary graduate of the 2000 A. D. should be equipped not only to handle sophisticated tools and to assimilate newer technology, but he should also possess the spirit to absorb the changing social responsibility. Technically he would be a 'system analyst', in the biological sense, synthesising the health care of animals with the production systems in a social context.

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Fisheries Education

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Making futurological predictions in the realm of fisheries is rather a difficult excercise, especially in view of the uncertainities in the field of marine fisheries and the export markets. However, identifying the thrust areas for future development, framing our long term policies and drawing a perspective plan of action for development would be perhaps rewarding. As education, research and extension form part and parcel of the overall development process, it will be difficult to discuss at length one aspect without reference to the others.

The world Fisheries Conference held at Rome in June–July, 1984 recommended that 1985 should be declared as international year for fisheries. There was a general support that there should be a strong education and training component in respect of programmes aimed at producing operatives and managers. It was mentioned at the Conference that India would set up a Fisheries University soon. This shows the growing awareness in India regarding professional education in fisheries.

India has recently earned the distinction of becoming the biggest producer of fish in the Common Wealth. She is also the second biggest producer of fish in the inland sector and the eighth largest producer of fish in the world. The export of marine products from India has grown in a spectacular manner over the last two decades. While the export has grown nearly five times in quantity, its growth in terms of value has been nearly sixty–two times over the last two decades. In 1982–83 the foreign exchange earned through export of marine products touched the peak of Rs. 362 crores. India is endowed with considerable inland fishery resources and has a large coastline with an Exclusive Economic Zone by the different countries has brought about 95% of the world marine fisheries under national jurisdiction. This reshaping of the marine fisheries regime with extended national jurisdiction, embodied in the United Nations Convention on the Law of the Sea, is perhaps the most important political event that has occurred in world fisheries. India, with its vast coastline is one of these few countries which have gained substantial fishery resources under the new regime, but are not yet adequately equipped to handle them. There are several alternatives before us. We can build up our own distant water fishing capacity or engage in joint ventures with foreign enterprises or else can earn income by the sale of fishing licences to foreign fishing fleets. Conservation of the exploited marine fishery resources, expecially when common fish stocks are shared with neighbouring countries, will be an integral part of the management of resources under the extended national jurisdiction. Regional, International Co-operation is warranted in such situations. Cost of production of fish has increased considerably especially due to the spiralling cost of fuel. Conse–

quently, the price of fish has also increased significantly faster than that of most other forms of meat. We have to diversify our fishing effort and look for newer resources and their exploitation. Mean while, all the species, including the so-called trash fish have to be used one way or the other either for direct human consumption or as animal feed. The developing nations are increasing their fishery production in recent years by 3.4% per annum. The importance of fisheries in alleviating protein under-nutrition has to be taken into account. World wide, fish account for about a quarter of the total supply of animal protein. Consumption of meat, fish and eggs in India is about 6 Kg per head per year, more than half of which is contributed by fish alone. India registered a quantum jump during the decade 1961-71 when the decadal growth rate was as high as 92.6 per cent against the corresponding overall growth rate of the world fish production of 51.6 per cent. This quantum jump in India was mainly because of mechanisation programme. In the following decade from 1971 to 1981, India maintained her lead with a decadal growth rate of 32 per cent when the world growth rate was only 13.2 per cent. Having reached an optional level in the exploitation of nearshore waters, efforts are being made to exploit the deep sea resources beyond a depth of about 23 fathoms. About 60 larger vessles are commissioned to fish in the offshore waters beyond 20 fathoms deep.

The technical manpower requirement of fisheries personnel in the coming years in Kerala is dependent on the research, extension and development programmes envisaged to be implemented in the near future. A study has just been initiated to assess the technical manpower requirement in the fisheries sector in Kerala during the Seventh Five Year Plan Period and the results are being awaited. A previous assessment made by the Department of Fisheries has estimated that for implementation of its developmental programmes during a period of 20 years, the number of technically qualified supervisory and administrative staff and research and extension workers that would be required would be around one thousand. In the coming years the different fisheries institutes in Kerala propose to take up several programmes for fisheries education, research, extension and development. Some of the important areas to be covered are starting M. F. Sc. and Ph. D programmes in different disciplines of fisheries by the Agrl. University, research on hatchery production of seed of *Macrobrachium rosenbergii, Penacus monodon* and *Mugil Cephalus*, culture of airbreathing fishes, starting paddy-cum-fish culture in the Kuttanad and Kole lands, organising aquarium fish export trade, organising a fish seed trade, organising strong extension unit under the different research and developmental institutes, starting of Fish Farmers' Development Agencies in the different districts, running Krishi Vignan Kendra for Inland Fisheries, establishment of a Research and Extension Advisory Cell, a Communication Cell and Fishery Information and Forecasting Bureau under the Fisheries Department, Development of Deep-Sea fishing and tuna long-lining, exploratory and experimental fishing, collection of fishery statistics, utilisation of fishery by-products, designing fishing gears and crafts, taking up welfare and developmental activities under the Kerala Fishery Welfare Society, developing an internal market for fish and fishery products etc. We require well-qualified and trained personnel for undertaking these works. Mere Zoologists-turned-fishery scientists are ill-equipped to provide the required know-how and leadership for development in this sector. Properly educated and trained personnel should form the backborne of any developing industry. It is against this background that it is proposed to strengthen and to develop the College of Fisheries into a Centre of Excellence in Fisheries Education.

The required research and extension education support could be provided by strengthening research on the high priority areas already identified and by establishing a separate Department of Extension under the Faculty of Fisheries.

Fisheries education in this country requires further streamlining and standardisation. At present the Agricultural Universities offer a Bachelors' Degree in Fisheries after 4 years of undergraduate education. A post-graduate with M. F. Sc. Degree would have been exposed to at least six years of education and training in fisheries and supporting subjects. As against this, a post-graduate in Fisheries from a conventional University would be exposed to only 2 years education in Fisheries subjects. It will be difficult for an employer to educate these two sets of Post-graduates in Fisheries.

B. F. Sc. degree programmes started by the Agricultural Universities of maritime States are of the duration of 4 years and include courses on inland and marine fisheries. But when the inland States start fisheries courses, it may not be relevant or possible to include courses on marine fisheries and hence the total duration of the course may also be less than 4 years. That means collegiate education in fisheries in the future will have two streams, one comprising the subjects related to inland fisheries alone, and the other related to both inland and marine fisheries. There are other institutes which offer Degree, Diploma and Certificate Courses in fisheries in general, or in special branches of fisheries. It is therefore suggested that a National Commission of experts in fisheries may study the problems of fisheries education at College level and make suitable recommendations for adoption by all.

It would be interesting to examine as to what physical facilities the college should acquire before the turn of the century. At the Panangad Campus an ice plant-cold storage-freezing plant-frozen storage-canning plant-fish handling hall complex would be commissioned on a priority basis. A gear technology laboratory and oceanographic laboratory would also be established soon. Action for the construction of the main academic blocks and a hatchery complex is under way. The whole low-lying land will be converted into fish ponds and little area will be set apart for mixed farming of crops, livestock and fish. A fisheries museum will be established which will be the first of its kind in the country. Playground, auditorium, guest house, swimming pool etc. will be completed before the end of the 8th Plan period. The number of fishing boats will be increased to 5. The instructional farm at Puthuveypu will be provided with sufficient number of fish ponds for conducting statistically designed experiments on aquaculture. A marine prawn hatchery will be established there. Berthing facilities for the research vessels would be provided near Murikkumpadam and a small vessel for transportation of staff and students from Panangad to Puthuveypu and back would be provided. The anticipated expenditure for providing all these facilities including cost of acquisition of land is expected to be of the order of Rs. 3 crores.

On the academic side the syllabi will be reviewed and revised every 4 to 5 years. Programmes for exchanging staff and students with other universities both in India and outside will be taken up. Compulsory sea-going experience on board commercial fishing boats will be insisted upon; each trip of a deep-sea fishing vessel will have to be of about 30 days duration in order to be economical. The trimester system of education will be reviewed as it poses several difficulties in implementation of the field programmes. Step will be taken for linking fisheries education at regional technical high schools with professional education at the College level. The admission policy at present followed requires modification and attitude of the students for a professional carrier in fisheries should be taken into consideration.

Fisheries education to be more useful should be diversified and tailored to suit different job situations and requirements. Fisheries involves apart from scientific knowledge of the subject a great deal of practical skill that could be acquired only through aptitude and on-the-job experience. For example, for acquiring expertise in the fields of tuna long lining, squid jigging or purse-seining it is not a doctorate degree that is essentially required but years of on-the-field experience. In such cases, opportunities should be offered for acquisition of skill through on-the-job training, often on board commercial vessels. Such programmes should be supported by theoretical knowledge imparted through supporting courses and final recognition by award of certificates after proper assessment.

If the B.F.Sc. Degree is taken as the basic degree in fisheries and advanced training at M. Sc. and Ph. D. levels is offered by the different universities and research institutes only to these graduates, then a new cadre of fisheries scientists with somewhat comparable standard of education in fisheries could be produced. This will also pave the way, in the not too distant future, for the integration or affiliation of all institutions offering education in fisheries in order to form a new University of Fisheries in Kerala. The post-graduate courses in Marine Biology, Oceanography, Marine Geology, Marine Meteorology, Industrial Fisheries, Mariculture etc. and the M. F. Sc. programmes majoring in aquaculture. Fishery Biology, Fishing Technology, Fish Processing, Fishery Engineering, Fisheries Management etc. and all the doctorate degree programmes in Fisheries could be offered by the proposed new University of Fisheries.

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Changing Perspectives in Extension and the Challenges Before KAU 2000 A. D.

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Introduction:

Transfer of viable technology to the farmers holds the key for augmenting agricultural production. This function is largely performed by the extension personnel of the State Development Departments of Agriculture, Animal Husbandry, Dairy Development, Fisheries, etc. To consider transfer of technology as the sole function of extension will be an oversimplification of the functions of the extension personnel. The extension personnel will have to perform the 'enabler' role of helping the farmers adopt new technology. Their role of delivering the right mix of technology to the farmers and feeback to the researchers is basic to the 'enabler' role. Similarly, for effective transfer of technology, strong inter-organisational linkage is of vital significance since many organisations–social, voluntary, credit and other input organisations–are involved in the process. This 'linker' role must also be performed by the extension personnel.

Changing perspectives in extension:

The transformation of farm extension efforts from Community Development approach of the 1950's to the Training and Visit (T & V) System approach of the 1980's is phenomenal. Yet, the T & V approach is not a panacea for all agricultural and rural problems. It has a number of limitations when it is viewed in the overall perspective of rural development. How this system could be improved upon to deliver the goods and how similar approaches could be conceived and implemented in other fields of rural development such as animal husbandry, dairying, fisheries, forestry etc. are issues of great concern before those involved in rural development work.

The University's task:

Viewed in this perspective, the University's task is herculian. Besides providing the extension personnel with sound technical backstop, the University has to shoulder the responsibility of devising appropriate methodologies for technology–transfer so as to reduce the time lag between development of new technology and its large scale adoption. The extension approach in Kerala has to take into cognizance the peculiar agricultural situation obtaining in the State. The size of operational holding in the State is dwindling fast due to the social, political and economic reasons. These small farmsteads are unable to support the farm families dependent on them. By 2000 A. D. the per capita availability of cultivated land in the State, which at present stands at a precarious 0.11 ha, would steep down further leading to the preponderance of microscopic and miniscule operational holdings. It will then be exigent to exploit fully the production potentialities of these holdings so that the net income derived from the farmstead as a whole would enable its dependents to eke out a reasonable level of living. The efficiency with which this onerous task is achieved, will justify the relevance of all those engaged in agricultural research, education and extension in the State. The Kerala Agricultural University, charged with the prime responsibility of providing the leadership in these fields in the State, will have to devise suitable strategies to meet these challenges.

In view of the statutory limitations of Kerala Agricultural University, that the field extension activities of the University should be confined to limited areas and that the University should not compete with the extension departments of the State and duplicate their efforts, the University's extension contribution should be judged on qualitative terms only. The University's task should be to design and implement novel and innovative extension approaches for the development departments to imitate and imbibe. This could be facilitated by adopting 'integrated research oriented development approach in our extension programmes.

Superimposing Community Management over individual initiative and land ownership

As briefly mentioned earlier, the present trend in the pattern and size of land holdings unmistakably indicates to the increasing number of small peasant holdings in the years to come. The "regime of the small peasant will hold the fort well through the next Century". Coupled with this the increasing intricacies of farming enterprise will make the survival of individual small peasant at economic level rather impossible. Groups of farmers and community/group management of farming operations will become a necessity by then. The community or group approach envisions the superimposing of community or group management of key farm operations over individual initiative and land ownership. Key farm operations such as raising community nursery, pesticide and fertilizer application, water management, livestock feed production and supply, livestock health care, processing, marketing etc., can be carried out profitably by group management benefitting even the smallest farmer in the group. The specific pathways will be crop intensification with animal husbandry, fisheries, forestry etc., and post-harvest processing and crop residue utilisation for preparation of value-added products. To achieve this, a number of clusters of farm families can be identified and organised into non-political-non religious Associations or Clubs in each adopted village of the University. Each Association may be considered as a productive system. A series of agricultural operations that an individual family as a productive system cannot undertake will now become possible. Families with least on-farm income in the Association could be given some off-farm occupation to facilitate a fairly balanced generation of income among the members of an Association Primary level post-harvest processing, marketing of produce etc. are examples in this area. To cite another example a division of different stages of production of broiler chicken among the members of a group of broiler farmers. Rearing of chicks upto two weeks can be taken up by few farmers in the group while few others can take up rearing two week old chicks upto four weeks. These farmer members of the group who have less number of chicks can be entrusted with marketing, distribution of feed etc. A certain amount of communal and social integration will also take place among the members of the Association. Local initiative and leadership will also emerge from each Association. The Associations should functionally serve as a link between the individual farmer and the Rural Co-operatives and other village organisations. This will facilitate better utilisation of funds in solving location-specific supply and service problems of farmers.

Proper training and education on Community Management, including training in managerial skill, should be given to the land owners, particularly small holding operators, to carry through the approach. One of the latent but important benefits of this approach will be that it would generate substantial employment opportunities to the rural youth and rural women. Fostering cluster/group/association/club approach and superimposing group management over individual ownership coupled with a system model, should convincingly demonstrate to the people that holistic and egalitarian development will be possible.

Extension Programmes of Kerala Agricultural University—A perspective:

The developmental challengcs in communication lie in opening up possibilities, which exist in principle, to extend communication from a minority to all of the people. Our Communication networks should help in reaching the goal of communication ie., communion. Appropriate communication strategies involving a blend of mass, group and interpersonal channels would have to be devised. The communication satellites have the potential to revolutionalise technology-transfer process and to bring to reality the McLuhan's concept of 'Global Village'. By 2000 AD, the coverage under Radio and Television programmes in Kerala will be near-total. Electronic communication gadgets like Video Cassettes, Video discs, laservision, cable, computer, videotext and the advances in Printing Technology would unfold great opportunities for our information support programmes. The Universiiy should establish TV studio and Sound Recording Studio to produce and supply agricultural programmes for TV, Video and Radio. With INSAT – 1 B, and 1 – C and INSAT - II series, it should be possible for the University to get State, National and even International coverage.

However, need for location-specific communication requirements will become more and more clear by the turn of the century, particularly because of the possibility of generating location-specific technology. Taluk level Radio and T V Stations are a possibility. Even private agencies entering in these fields of communication cannot be ruled out. The University will be required to equip itself to meet the challenge emerging out of these situations.

With a very high literacy rate in Kerala, the communication abilities at the threshold are almost limitless. Educational innovations such as Distance Education and Vocational Education courses have immense possibilities in Kerala. To meet the information requirements for ushering in an era of rural integration and transformation, community based media have to be developed. A robust rural press will, obviously, become inevitable in the near future. The pious hope of a 'Rural' Newspaper' should become a reality by then. In all these fields, there is a rich, untapped potential for effective communication research and service to support these varied functions. A 'Centre for Rural Development Communication' under Kerala Agricultural University, catering to all these development–support–communication requirements, will be the organisational frame-work under which all these potentialities could be realised. Necessary infrastructural facilities and trained man power have to be developed in a phased manner to achieve this objective.

In a dynamic and fast changing technological World, the extension worker will assume the role of a spark plug. In updating the techniracy of the extension personnel in the State, the Kerala Agricultural University will have the most significant role. We have to design innovative and appropriate training strategies to help in human resource development needed in the agricultural sector. The training programmes of the University should facilitate an intensive dialogue and the sharing of experiences and skills between field extension workers and researchers. They should be helped in evaluating their work, approach and ideology on the basis of case studies and field visits and in learning the social skills, which are necessary for initiating a participatory development process.

Extension organisation—A perspective:

With the idea of developing technologies appropriate to the rural situations, the University integrated the Research, Teaching and Extension functions at the individual scientist's level. The objective was that every scientist will have an opportunity to do research, to teach and to involve in extension work actively. But with the experience gained so far, it is obvious that each scientist will not be able to put his best efforts in each of these three functions. The most to suffer, on account of this inadequacy, was the extension work of the University due to the nature of the work involved and inadequate recognition given to extension work performed by the scientists, in the absence of standardised norms.

This trend cannot be allowed to continue. The University's extension approach is increasingly becoming inter-disciplinary with many more disciplines to join us in future.

There are proposals to establish Regional Extension Units in the immediate future to coordinate the extension programmes of the University on a regional basis. As a long term perspective, District Extension Units of Kerala Agricultural University will also have to be established.

Organisational Development Strategies, such as the modern management techniques for motivating the personnel to contribute fully to reach the organisational goals, will become increasingly relevant in the future.

The possibilities and potentialities of extension education programmes of the University are enormous, but equally time consuming. To match this great responsibility, adequate recognition, on the basis of standardised norms, has also to be given to the Scientists, so that the University's extension programmes will stand out in quality for the simple reason that they have to generate and sustain the much needed 'multiplier–effect'.

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Administration and Finance

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Unlike a conventional University, Kerala Agricultural University has several complex administrative and financial problems to tackle. Spread over the entire State, in five teaching campuses and 23 research stations, KAU has tremendous administrative and financial tasks to perform too. There is no doubt that these responsibilities and tasks will multiply, many times over in the next fifteen years.

The University has to look after several categories of teaching staff, non-teaching staff and labourers. The academic matters pertaining to the students in various disciplines are to be attended to also. The University has to do liaison work with the public, the Govt., and other agencies in India and abroad.

In the University, the top policy decisions are taken by the various statutory authorities. The General Council is the supreme authority of the University and the Executive Committee is the Chief Executive Body. The Academic Council, the Boards of Studies of Faculties and the Finance Committee are the other statutory bodies of the University.

Certain assumptions are essential when we try to predict the nature of responsibilities and tasks—both administrative and financial-that the University will encounter in 2000 AD. At present, the most dominant Faculty is the Faculty of Agriculture. The relevant University Act of 1971, however, contemplates the formation of more faculties in Co-operation, Home Science, Agricultural Engineering and Basic Sciences & Humanities in addition to the existing Faculties in Agriculture, Fisheries and Veterinary and Animal Sciences. If these new Faculties come into existence in the next fifteen years and achieve the same growth as that of Faculty of Agriculture, then there will be certain drastic developments. There will be a rapid increase in the number of employees and the number of students. The amount under various heads in the budget also will, therefore, increase.

Another assumption that we will have to make is that the University will remain the same monolithic structure in 2000 AD, and it will not be split up, into two or three. In this context, it is relevant to point out that this possibility exists, because, in our State, already 3 additional conventional Universities had been constituted in the past one decade or so, splitting the original University of Kerala.

In several aspects, KAU, as an organisation is similar to an industrial undertaking. This comparison is important especially with reference to administration and finance. Infact, many of the management techniques used in industrial concerns can be adopted with considerable impact, in our University also, so as to improve efficiency and productivity.

By trying to visualise the problems to be tackled in 2000 AD, an exercise is being done by us in corporate planning as practiced in industrial concerns. We are making certain guesses based on certain assumptions. Now, like the other Agricultural Universities in the country, the KAU performs the triple functions, namely, teaching, research and extension. In making appropriate policy decisions in this regard and in implementing these the Departments of Administration and Finance have got significant supportive roles to play. However, the tasks to be performed are mainly dependent on the thrust of the activities in other fields. Thus, it is obvious that the constraints which circumscribe the activities of administration and finance will be

(a) The expansion in activites in other field; namely, teaching, research and extension.

(b) Major policy decisions taken by various statutory authorities.

(c) Pressures brought on the organisation by Government, Public and other Agencies.

The following important functions are performed by Administration at present.

1 Recruitment

2 Service conditions of employees, teachers, non-teachers and labourers.

3 Assistance to various statutory authorities in policy formulation and implementation.

4 Liaison work with the Public, the Government and other institutions in India and abroad.

5 Academic matters like selection, publishing of results of students.

6 Administrative support to various Faculties and Research Stations.

7 Management of Estate in Main Campus.

8 Welfare activities like managing the school, Co-operative Society etc.

In the next fifteen years, there is bound to be significant expansion in the above mentioned fields and therefore the work load on Administration will be correspondingly higher.

In the realm of Finance, an indication of the burdens and responsibilities, is evident if the two past budgets for 1973-74 and 1983-84 are perused. The quantum of receipts and expenditure has increased considerably. However, the crucial point to note is that the University is even now heavily dependent on grants from the Government and ICAR. For instance, in 1973-74, the receipts were Rs. 4.7 crores. Out of this, the income from colleges and University properties accounted for Rs. 43 lakhs, and the rest came from Government and ICAR. The expenditure was Rs. 1.8 crore. In 1983-84, the receipts were Rs. 10.2 crores whereas the expenditure accounted for was Rs. 9.92 crores. However, the income from colleges and University properties accounted for Rs.50 lakhs only and the rest came from ICAR and Government.

Thus the dependence on outside agencies is increasing year by year and naturally in 2000 AD it may not be incorrect to presume that the major source of our income will be the Government and ICAR.

The University has plenty of resources—both men and material—which can be effectively used to augment the receipts. For instance, proper replanting and tapping of our Rubber Estate in Vellanikkara alone will bring roughly 2 crores to our coffers. Another possibility is the proper utilisation of our paddy fields in Vellayani Campus. If coconut cultivation is done there scientifically, within a few years, this scheme can provide additional income to the University, within a short period. Similarly the potential of other farms can also be fully exploited.

Thus, a concerted effect on all fronts can certainly increase the internal resources of the University. An attempt can be made to make the University self sufficient, without heavy dependence on grants from outside agencies. It may be too ambitious to attempt self sufficiency by 2000 AD. However, we can attempt a rapid increase in the income from internal resources of the University. This will make the University a truly autonomous institution, in the proper sense of the word.

Considerable reforms are required in the formulation of annual budgets and the monitoring of expenditure and receipts indicated therein. At present an annual budget is only an 'intention' to do certain items of work. Subsequently a post-mortem is done by the Auditor. By 2000 AD certainly the quantum of receipts and expenditure will increase. More significantly, the number of transactions will multiply manifold. All these transactions will have to be done in the proper sequence and without delay. Otherwise, naturally, the activities in the field of teaching and extension and research will suffer.

Obviously these tremendous tasks and responsibilities call for systemic appraisal and periodic revision. The concept of Performance Budgetting in this context is relevant and can be introduced.

Moreover, in the next 15 years very important capital investment decisions will have to be taken especially when new faculties are to be formed, and buildings have to be constructed and equipments will have to be purchased and installed. 'Finance', in this field has to give considered expert opinion as to how to utilise the scarce resources available to the University in the most profitable manner. At the same time, 'Finance' can and must advise the University with regard to the benefit/cost aspect of the current patterns of expenditure and capital investment decisions.

Coming back to the field of 'Man' management, it is needless to point out that this field is the most sensitive one. The objective of the administration must be to utilise the strengths of employees and make their weaknesses irrelevant. Our greatest asset is our employees. The purpose of an organisation is to enable ordinary human beings to do extraordinary things. This requires specific practices rather than lofty sermons.

By 2000 AD, due to the expansion of activities in other fields, there will be considerable increase in the total number as well as in the number of categories of employees. There is considerable scope for improving the service conditions of the employees as well as for job enrichment.

We have got constraints in improving salary structure since we are heavily dependent on Government grants and in the next 15 years, the same pattern is likely to continue.

However, it is possible to provide additional conforts and perquisites. For instance, better lighting in office, better canteen facilities, transport, quarters for all, who desire to live in campus etc. are certain infrastructural facilities, which will improve their working conditions and family life.

At present Administration is managing a primary school. By 2000 AD this school, with modern amenities can certainly be converted into a High School, with both English and Malayalam medium classes. At present there is a Consumer Co-operative Society with branches at Vellanikkara and at Mannuthy. At present there are 1600 members with a turn over of roughly Rs. 9.5 lakhs and an anticipated profit of Rs. 35,000. When it was started in 1976 it had 254 members with a turnover of roughly Rs. 80,000 with a profit of Rs. 1,600. Within the next 15 years it is reasonable to assume that the turnover, the membership and the profits will significantly increase. There will be diversification in the activities like credit facilities, trading in pharmaceutical items, textiles, farm produces etc. It may not be too ambitious to open branches in various other campuses if rules permit.

All these welfare activities certainly have relevance in boosting the morale of employees. The obvious spin of is better productivity. After all, the purpose of an organisation is to enable ordinary human beings to do extraordinary things. Therefore any reforms/facilities, that may be introduced will certainly improve the productivity of them thereby increasing the overall efficiency in the working of the University in various fields, stipulated under the relevant act.

Needless to point out that, already we are faced with a problem of processing of millions of bits of data within next 15 years, the demand on 'Finance' and 'Administration' ragarding data processing will be rather huge. Certainly this calls for the installation of a suitable computer. Already a policy decision had been taken with regard to the installation of a computer. But the capability of the same will have to be increased over the next 15 years. At the same time the fear of employees about blocking of avenues for promotion will have to be erased. On the contrary, the installation of a computer will open up new vistas of employment to the employees, who otherwise would have stagnated.

Quicker data processing in any case is essential especially in the realm of research in the University. Moreover updating of students' records and other related academic matters require the services of a computer.

Within the next fifteen years, there is considerable scope for introducing automation in the various offices also. The advantages will be the quicker processing of files, better productivity in the staff, and ultimately substantial improvement in the overall efficiency of organisation.

Thus in short, "Administration" and "Finance" have got crucial supportive roles to play in 2000 AD. In view of the anticipated multidimensional expansion in various fields of activity of the University, the tasks and responsibilities of "Administration" and "Finance" also will increase considerably. The achieve better productivity, it is necessary to motivate the employees by job enrichment and improvement in the service conditions. There is considerable scope for introducing the concept of performance budgetting and for increasing the income from internal resources of the University. Substantial accrual of income from internal resources will certainly make the University truly autonomous. This may be the aim of KAU for 2000 A.D.

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Campus Planning

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Introduction

India is a developing country. It is an accepted fact that planning has got its importance in all walks of life. Immediately after independance, the 5 year plan has been resorted to and this has been followed and is being followed at present except for a short period when the concept of rolling plan was tried. The five year plans were successful but during the course of implementation, it is found that several problems arose and success achieved was not upto expectation. It is to meet the challenge of the future that the Kerala Agricultural University thought of a more advanced planning with a new concept "2000 A. D.".

"Kerala Agricultural University 2000 AD" aims at a forecast of Agrarian–Socio-cultural climate which the scientist has to reckon with in the coming decades, besides the vagaries of geographical climate and is a direction setter for teaching and research efforts. Research and development go side by side. Technology is developing and we do not know what is going to happen tomorrow. It is necessary that all research activities are carefully planned with an eye on the future.

In a developing country the increase in population created difficulties in planning. Whatever planned is made null by the increase in population as the demand increases in greater proportion than development. With the increase in the development of industries the problems are bound to become more serious in future years. The problems of habitation arise and more and more accommodation will be required. The problem becomes grave on account of increase in population. To tackle all these problems properly, planning has to be resorted to considering the future developments. It is here that we feel the necessity of long term planning.

Now-a-days planning has became very difficult because of the multiplicity of authorities. There is not enough co-ordination among the various wings. Hence there is need for policy making bodies and advisory co-ordinating bodies drawn from different departments so that implementation can be enforced in a more purposeful manner, but it has to be borne in mind that such bodies should not be an obstruction for the implementation.

General aspects of planning

The first aspect to be considered for campus planning is the availability and suitability of site. Before acquiring the land, we must have an idea of the extent of land required for the development of the campus and also its suitability and work–

ability for the purpose. Campus should have adequate land. It is also equally important to study the soil conditions, water resources, drainage facilities in and around the area as far as possible. While acquiring land we must avoid as far as possible the public roads and Highways that pass through the campus, resulting in the spliting of land into two or more, as it will cause unnecessary expenditure for fencing, unsafe, nuisance from traffic and public, etc. At the same time the highways and public roads in the outskirts of the campus are welcome for transportation and easy access. This is the ideal site for planning.

It is estimated that by 2000 AD, India may require an additional 80 million houses per year within next 16 years, considering the increase in population. Government will have to make more institutions like schools, hospitals, colleges of Technology, Science, etc. for them. Lots of development is required. Hence we have to think of flats tor residential purposes, instead of single individual houses in the campus. We must try to reserve land as much as possible. Further acquisition of land will become a problem in future on account of increase in population. Spreading of buildings may be avoided as far as possible and more open spaces may be provided in the campus for healthy conditions. Easy accessibility is the prime necessity for development.

Land scaping and natural topography of the sites are not respected sometimes by the planners. We can learn a lot from our old cities in this respect. Available trees, wells, lakes, rocks, hillocks, etc. should be retained in the land as far as possible while planning the campus. The Architect and Engineer should follow the approach of fitting particular aspects of the building to a particular characteristic of the site. The buildings should harmonise and merge with the landscape characteristics of the site. This means even after development the basic characteristics of the site remain and are enhanced by the characteristics of the building.

To achieve this objective, a thorough study and understanding of the site factors is essential. This study is known as site appreciation or site analysis. Site analysis includes the study of topography, vegetation, climate, soil condition, access and surroundings. Site analysis should aid in the location of various uses within the site, for eg. parking, service areas, etc. It aids the integration of what is preserved with what is proposed.

There is a thinking that road layout is better when laid parallel to the contours. But from practical point of view in the case of gentle gradient, the road a layout at right angle to the contours will be more outstanding because water supply and drainage can be more satisfactory. When road runs parallel to the contours buildings on the higher contours cannot be served easily by water supply and drainage system. With this layout buildings on the lower contours are sunk and have to face many drainage difficulties in tropical India because monsoon rains can rush to their plinth.

Good site planning should emphasise and exploit the characteristics of the site. This may strengthen the identity of the site and impart to it a sense of place. Site planning should help in placing the building in such a way that open space is complementary to built-up space and serves necessary outdoor functions in the most appropriate locations. The proposed building should blend with the landscape of the site and with the general skyline. The beauty of the landscape can be enriched by planting bushes, shrubs, grass and flowering and ornamental trees which belong to the native vegetation of the area. Modern architectural ideas will fail wherever the architect disregards the social and aesthetic values of the user. There has been a marked tendency in different parts of the world to recapture traditional visual and social values.

To optimise spaces and to reduce the volume of building materials, the architect must have a knowledge of the functional minimum and psychological minimum space requirements for various activities. The architect will be required to exercise a great deal of restraint and providing spaces and volumes purely for aesthetic reasons. A study of different plan forms is required to arrive at the most economical one in terms of the volume of materials used. For example, a square plan form is more economical than a rectangular plan form of the same area, in terms of the volume of the materials used.

The Architect or Engineer must make minimum use of scarce materials like timber and cement. Use of locally available materials must be encouraged. This calls for the development of innovative technics of construction.

Orientation

While preparing the campus plan for a particular project the architect should not forget the proper orientation of the buildings depending upon their utility. Orientation of building depends upon the direction of prevailing wind in that locality. He should also see that sufficient protection is considered in the design to arrest the western sun wherever not necessary.

Landscaping

We may come across with different nature of grounds with slopes and hillocks. Planning should be as such that landscape is exploited to the maximum. As for as possible the nature of ground should not be spoiled by unnecessary cutting and filling. The 'kudils' and the major hotel building of Tourist Corporation at Kovalam Beach Resort, designed by the renowned Indian Architect, Padmasree Charless Correa stand as an example for preservation of the gifted natural landscape.

Surface drainage

Surface drainage is important while planning a campus. One of the commandments of the road design is that there must be good drainage. Road system without drainage will mean many times more funds for maintenance as foundation of the roads subside. Wherever water deposits, metal distintegrates to create portholes. Good foundation and good drainage can reduce maintenance many times more than can be imagined. Whenever they are built without proper foundation and drainage creates additional problems of road settlement and surface wear and tear.

It is seen in practice that building projects are taken up first and roads later for the development. This appear to be a wrong practice ie taking building project first before forming the approach roads, culverts, bridges etc. and also the water supply and drainage facilities. If the roads are formed the transportation of materials will be easier for construction and also for the work supervision. Water supply are also equally important to facilitate easy construction.

These are some of the aspects to be looked into for campus planning. The implementation of projects is another aspect to be looked into. The planning is in paper but the implementation is in field. The success of plan lies in its effective implementation. It may be noted that the population is increasing and consequently the demand and necessities increase. Nobody is satisfied with whatever is received. We are in the midst of discontented labour. Collective bargaining and sons of soil theory are gaining more and more power and is affecting the actual implementation of the scheme. The labour force is always having a grudge against the present social set up. To achieve success in planning it is necessary that the discontentment is removed. We must realise the loss on account of strikes and such other obstructive tactics. We must see that the resources are utilised for developmental activities. The planning should be such that the development should also be maximum labour oriented. The practice of taking obstructive tactics has to be avoided. Everybody must cultivate a sense of duty. The differences such as political, social, religious and such other differences have to be forgotten in planning and the planning has to be for a society.

The aims should be for a healthy and prestigious development of the campus. The planning for longer periods has to be thought of but care has to be taken that it should not be very rigid. It may be noted that technology develops. Nobody knows what is going to happen tomorrow.

Planning for longer periods with provision to accommodate the latest technology as and when required may be thought of for future planning.

Master Plan for Developments

The Kerala Agricultural University has under its control five educational campuses besides the several Research Stations and instructional farms.

The educational campuses are:

1 The Main Campus at Vellanikkara, Trichur where the headquarters and faculty for Horticulture are accommodated.

2 The Veterinary College Campus at Mannuthy, Trichur where the Faculty of Veterinary Sciences is accommodated.

3 The Fisheries College Campus, Panangad, Ernakulam where the Faculty of Fisheries is accommodated.

4 The Agricultural College, Vellayani, Trivandrum where the Faculty of Agriculture is accommodated.

5 Institute of Agricultural Technology, Tavanur where the Rural Institute is located.

The Vellanikkara campus is comparatively a new campus. The area has been acquired for the Agricultural University. A Master Plan has been prepared by Sri. H. S. Chopra, Senior Architect of the Punjab Agricultural University. The campus was proposed to house the following faculties besides the Headquarters.

1 Faculty of Horticulture.
2 Faculty of Basic Science & Humanities.
3 Faculty of Home Science.
4 Faculty of Forestry.
5 Faculty of Co-operation.
6 Faculty of Agricultural Engineering.
7 Faculty of Fisheries.

The faculty buildings, Hostels for students, Teachers hostel, Hospital, Workshops, Auditorium, Stadium, Game courts, Library, Gymnasium, Swimming pool, Student Centres, quarters for staff, Guest House, instructional farms etc. are all encompassed in the Master Plan. The cost of building programme was estimated to Rs 20 crores at that time with a plan period of twenty years. Eventhough the University started about more than ten years back, it has to be admitted that the progress achieved is not upto expectations. The main bottleneck is want of resources to proceed with construction works. So far we have completed only three academic blocks besides the construction of three hostels and about ninety residential buildings. Now the construction of three more hostels are in progress and quarters for 36 families arranged. The construction of an Administrative block has not been started so far. The next priority has been given for the Administrative block.

The Faculty of Veterinary Science is accommodated in the adjoining Veterinary College Campus at Mannuthy. The Faculty was started in 1955 before the formation of the University. At that time no Master Plan was prepared. The main building was completed in 1959 and additional structures added to cater the additional needs later. At present the Directorate of Extension, the College of Co-operation and Banking and the K.A.U. Press are also situated in the campus. A Master Plan is under preparation considering future expansion.

The Fisheries College at Panangad was started very recently. Originally the College started functioning at Mannuthy temporarily from the year 1979-80 and later shifted to Panangad. Only some semi-permanent structures have been constructed initially. Now a Master Plan is under preparation for the development of the campus. Detailed drawings of the faculty buildings are also being prepared. The constructions of permanent buildings will be started soon.

The Agricultural College, Vellayani was also established in 1955 before the formation of the University. The old palace building with surrounding area was being utilised for the purpose. Here also there was no Master Plan.

Additional accommodations were later provided according to the urgent needs. When the University was formed it was attached to the University. It is proposed to prepare a Master Plan by utilising the existing accommodation and providing additional facilities considering future expansion.

The I. A. T., Tavanur was a Rural Institute taken by the University in 1975. This was planned only as a Rural Institute. Not much improvements could be done there. However, proposals for improvements including raising the station to that of an Agricultural Engineering College are under consideration.

There are a number of Research Stations located at different parts of the State. I think I need not explain the practical difficulty of improving the status of all these Stations. However, I am happy to inform that the University is trying its best to raise the standards in almost all these Stations with the limited resources available.

C. Thought Papers on Education

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Research, Education and Extension in Horticulture— Need for a Separate Faculty

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Kerala, the land of coconuts, is a unique crop cafetaria where fruit trees, vegetables, ornamental plants and plantation crops grow in harmony. The warm humid tropical climate of this lusty land gave birth to crops like pepper, turmeric and eggplant. The Portuguese, French, Spanish and British travellers came to India primarily in search of horticultural crops. Kerala found a predominant position in world maps, because it was here the first Portuguese navigator landed in search of 'black gold'. The oriental spices—the cloves, cardamom, cinnamon and all spices—grown in this land were distinct and much sought after and relished. These are a few bare facts of history. The recent relegation of Kerala to a position of near non-significance in horticultural crops, the dismal decline in production of coconuts and pepper, failure to control maladies like root (wilt) disease in coconut and bunchy top in banana etc. are matters which should worry both scientists and administrators. The threadwise analysis of the dismal picture may only be of academic relevance, what is needed is a time bound, objective oriented and realistic approach to bring back the glory and charisma that this beautiful land deserves so much.

Out of a total cropped area of 29.31 lakh ha., horticultural crops occupy 65.28 per cent of the area. This is equivalent to 50.09 per cent of the total geographic area of the State. Plantation and Spice crops alone occupy 45.58 per cent of the total cropped area constituting 69.83 per cent of the area under horticultural crops. Coconut alone accounts for 30 per cent of the agricultural income of the State. This works out to 15 per cent of the total income. This crop employs 10 lakh workers. The horticultural crops other than fruits, vegetables and florist crops bring an income of Rs. 1000 crores/year. Spices alone fetch Rs. 138 crores. About 10 million farmers are directly involved in the management of horticultural crops. The above statistics is provided just to indicate the magnitude of contribution these crops make to national economy even under the present neglected level of research, extension and education in this most vital sector. Another area grossly neglected is fruits, vegetables and florist crops. The per capita consumption of vegetables in Kerala is only 26 g/day, well below a minimum requirement of 150 g/capita/day. Consumption of fruits is negligible compared to a minimum requirement of 90 g/capita/day. The florist industry in Kerala is still in its infancy. The ideal warm humid tropic conditions so favourable for orchids, ferns and many of the foliage succulents are yet to be tapped. The horti-based industries like production of oleoresins, flavourants, essential oils, .medicinal decoctions, etc. need technical support and manpower. The effectiveness and efficiency of unani system of medical practice and the ayurvedic system depends mainly on availability of true-to-type raw materials. This is an area most challenging to horticulturists in Kerala. The Western Ghats of Kerala abode a large number of precious medicinal plants requiring proper scientific identification and cataloguing. The gene erosion in these rare crops due to deforestation and other manifold human encroachments should be timely prevented. Gene sanctuaries need to be planned, developed and properly administered.

Horticultural therapy has been an effective method of medication since time immemorial. Recently the rejuvenation of interest in horticultural therapy has been phenomenal in western countries. Environmental pollution, occurrence of acid rains etc. are regulated and controlled through planting of suitable cleansing trees.

The above striking aspects pass my thoughts, when I view the enormous prospects and scope for developing horticulture in this tiny State. I am quite aware of the significant contributions made by my fellow scientists to solve many of the problems of horticultural crops. The development of F1 hybrids in coconut and arecanut is considered land marks in practical plant breeding. Research achievements in rubber, especially introduction of high yielding clones, are lauded in scientific meetings. Development of package of appropriate practices in crops like banana, pepper, etc. has boosted prospects in the above crops. Cocoa cultivation was a success story. Its failure to make inroad into the monopolistic hold on marketing should be an eye opener for planners. Need for indigenous research on cocoa processing was well pointed out. Diversification of uses was another area where we failed miserably. Our contributions in diseases resistance breeding in vegetables have interested farmers and scientists both in India and abroad.

The horticultural seed industry is yet to take a scientific rooting in this State. The production of certified seeds of horticultural crops is negligible compared to the demands. Good seed contributes approximately to 30 per cent of the total production potential of a crop. Establishment of seed gardens, elite seed nurseries and seed multiplication centres would go a long way to mitigate the present stagnation in crop productivity. Flower seed industry, if properly developed, would add to the foreign exchange earnings of our State. The export potential of vegetables, fruits and florist crops has yet to be explored and exploited. The new avenues of employment in the hort-based industries and related concerns are the answers to the present stagnation in employment growth.

Sources of any endeavour depends essentially on basic and applied research and development. I may list out a few areas where considerable scope exists for dedicated research.

Gene conservation and establishment of gene sanctuaries in pepper, cardamom, cashew, banana and indigenous vegetables and fruits.

2 Exploitation of under-utilised crops like gooseberry, drumsticks, curry leaf etc.

3 Pest and disease forecasting and biological control of devastating pests and pathogens.

4 Genetic engineering techniques to control root (wilt) disease of coconut/ bunchy top in banana.

5 Development of hydroponics, aeroponics, etc. in florist crops.

6 Formulation of package of practices for orchids, ferns and other foliage succulents.

7 Biotechnology for fermented and non-fermented products from horticultural produces.

8 Post-harvest handling of fruits, vegetables, florist crops, etc. for export.

9 Development of nutrition gardens in tribal areas.

10 Village planning, town planning and city planning with emphasis on indigenous flowers and ornamental plants. A state policy on role of florist crops in country planning has to be formulated for effective implementation.

The Academic Council of the Kerala Agricultural University has aptly realised the need for establishment of a post-graduate faculty in Horticulture to strengthen research, teaching and extension efforts. This would bring forth additional sources of funds so vitally required. The existence of four full fledged post-graduate departments in the area of horticulture can form a vital framework in this task. The departments of Pomology and Floriculture, Olericulture, Plantation Crops and Spices and Processing Technology have contributed significantly to the generation of manpower and knowledge in relevant disciplines. There is urgent need to generate research base in fruit nutrition, fruit breeding, fruit physiology, plantation crop management, plantation crop breeding, spice crop production and produce technology, medicinal and aromatic plants improvement, tree physiology, tree crop breeding, ethno-medical botanical studies, tribal horticulture, horticultural therapy, nursery management, indoor gardening, landscape horticulture, avenue planting and management, environmental horticulture, vegetable breeding and improvement, post-harvest technology of fruits, vegetables and plantation crops, extension horticulture and tree management.

The need for establishment of a faculty in Horticulture was realised in States like Tamil Nadu, Karnataka, Maharashtra, Uttar Pradesh and Himachal Pradesh. Actions are initiated to start separate faculty in Horticulture in Andhra Pradesh and Assam. Establishment of a faculty in Horticulture is a correct and timely action in the right direction in our pursuit for a prosperous State.

Perspectives and Possibilities in Forestry Education & Training

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Forestry education in India has a long history. Various training institutions under Government of India have effectively met the training needs of the country. Over the years, however, there have been major developments under Forestry sector. The emerging technology into the Indian scene has new challenges in Forestry education and training at all levels. The great shift in national emphasis to matters relating to environmental protection and afforestation has major implication for training needs in Forestry and Agriculture Sectors. The activities of the State Forestry Departments were so far restricted to the forest estates. Admittedly the traditional forestry practices cannot continue to be stretched further without diluting professionalism. The new demand for training and education in Forestry has necessitated the need for Agricultural Universities taking up the responsibility of imparting forestry training at various levels. It is therefore safe to predict that the existing dichotomy in forestry and other allied disciplines would be harmonized before the turn of the century by trained personnel capable of conceptualizing and appreciating multi-disciplinary delivery service and dynamics of the land use system.

The total production of fuel wood in India for 1980 from all sources was 130 million tonnes. The demand now is about 150 million tonnes and it will rise to 225 million tonnes by the year 2000 A.D. for the growing population of the country. The recorded annual production from the forest land is 15 million tonnes. The implementation of VI Plan may contribute an additional 25 million tonnes of fuel wood per annum. Thus there is a wide gap of about 95 million tonnes of fuel wood per annum in the requirement at the current level of consumption. With the proposed gradual withdrawal of fossil fuel as per the energy strategy outlined in progressive plans, this gap is likely to intensify in future years.

The projected man power requirement of India by the year 2000 A. D is 11000 professional Forest Officers, and 33,500 Forest Rangers/Deputy Rangers. At present only half the above number is in position.

Kerala Forest Situation

Kerala State has a total geographic area of 38 864 sq km which is 1.18 per cent of the area of the country At present it supports about 3 9 per cent of the population. Net forest area as a percentage of geographic area is 27.64 per cent under cultivation and 9% is put to non agricultural purposes which includes waste lands. The per capita forest area is 0.18 ha (1977). The population assessed in 1977 was 24.3 millions which is likely to increase to 40 millions by 2000 A. D.

The total technical forestry personnel is reported to be 2790. It is this context that Kerala Agricultural University has formulated two proposals for setting up of an independent faculty of Forestry. The proposal is to set up an under-graduate programme at a cost of Rs. 380 lakhs at Thiruvazhamkunnu and the establishment of a Department of Forestry for a post-graduate course at Vellanikkara at a cost of Rs. 50 lakhs. The scheme will be financed by the I. C. A. R. The second one is a project for introducing a four year course in forestry with the help of the World Bank at a total cost of Rs.165.2 lakhs, spread over to a period of 5years.

The proposed faculty of Forestry has also the primary objective of economic upliftment of the hill tribes and other inhabitants and to ensure that they adopt new methods and technology to be developed and at the same time preserve their old culture without losing their entity. The technological development would be in tune with the ecological and environmental characters of the area.

The faculty of Forestry includes (1) an undergraduate programme of training about 30 students per annum from the four Southern States of Kerala, Karnataka, Tamil Nadu and Andhra Pradesh and (ii) the establishment of a Department of Forestry and offering post-graduate course, in Forestry and allied disciplines. The specialisation will be provided in Forest Entomology, Plant Pathology, Soil Science, Wood and Timber Mechanics, Forest Genetics, Tree Improvement, Nature Resources, Cultural Anthropology, Forest Research Economics, and an Instrumental Programme on Environment. Over the next 15 years, we would have a qualified team of personnel trained in forestry and allied disciplines who could direct and gear the goal of the schemes of the Five Year Plans.

As observed by our revered Vice-Chancellor in his article Kerala Agricultural University-2000 AD., "We have to introspect where we stand in the middle of these trends.........Has Kerala Agricultural University reacted to the changing realities of the situation intellectually in the conception and orientation of its research programmes.........and pedagogically in the design and content of its courses of instruction?". I cannot claim to provide any 'formula' which could be adopted in all circumstances. Indeed, the aspects of the problem in forestry education and training are numerous and the infinite number of possible combinations create conditions that differ greatly from one to another.

While, the aims of forestry education and training cannot be divorced from those of forestry itself, the real role of forestry education lies in the successful management of forested land—as an ECOSYSTEM–not just of trees. Yet if we agree on this definition, significant objectives of management include, *production of wood forage* and *Minor Forest Products, Watershed management, Conservation of fauna and flora recreation* and *Tourism.* Two changes in emphasis, will need to be reflected in major changes in curricula. Firstly to the change from forestry based on the utilisation of native forests to plantation forestry and secondly commercially oriented forestry to forestry for local community development.

Yet again when we look at the employment potential, the nature of forestry education would also be influenced by the range of employees. If the graduates of the Forestry College of Kerala Agricultural University are largely employed by the

State Government Forest Service, then the nature of the appropriate education would be in narrow terms. If, however, a range of Government and commercial agencies recruit from the College, then its curriculum, would be far more embracing.

There are other limitations. Training at the University level is severely hampered by the lack of qualified staff. The paucity of teaching and demonstration material would be another limiting factor. The main handicap in introducing Forestry course in an essentially Agricultural University is that the Trimester system is of a short duration with a number of intervening holidays and it cannot do full justice to the changed curricula. This system will have to be changed either to the Semester or Traditional type with flexibility.

Forestry is an out-door subject. Adequate emphasis has to be on forestry practical tours.

Research by national and researchers attached to international institutions is another important avenue for supporting the development in Agro–Social Forestry. In many ways, the farmer is well ahead of the scientist, but the latter must strive to work with the farmer hand in hand.

Research and development must provide accurate growth models for trees and food crop stand simulation for a clear understanding of production potentials and management alternatives. Research plots to be established for these studies should be located in assessible areas. Thus they would support the teaching programme and in addition provide living paradigms of the art and hence buogant diffusion points for disseminating desirable integrated land use systems.

The guide aims in the forestry would be:

i) to arrange for the control and management of natural resources in the public interest consistent with the environmental conservation,
ii) To ensure equitable access to natural resources in the public and private domains and provide a better use of such resources.
iii) To integrate rural development.
iv) To disseminate as widely as possible information and knowledge about soil erosion, and methods of controlling it, and
v) To restore the balance.

In short the focus would be to protect and conserve the ecosystem while ensuring a decent standard of living for the people.

Forestry programmes alone, however, cannot solve all the problems of the poorest inhabitants of the forest areas. Considerations must also be given to other technical aspects and to requirements of socio-economic and political nature.

Land is our basic resource and the quality of the environment in which we lead our daily life in decades to come will be markedly traceable to our ability to compromise between the destruction and preservation of not only the life in the forest but also in wilderness all around—If we fail— all humanity will be the loser!

Let me conclude by quoting Robert Frost:
"We dance round in a ring and suppose,
But the secret sits in the middle and knows"

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Role of Agricultural Economics—Perspectives and Possibilities

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To the futurologist the Agrarian economy of Kerala in 2000 A. D. presents two alternative scenarios, one of secular stagnation with the State increasingly dependent upon other States for its essential requirements of food and other consumer goods and the other of a mixed and integrated farming system reinforced by a growing agri-business sector. Which course of development it will take depends upon the planning of agricultural policy, research, education and extension in the next two decades.

Kerala Agriculture at the cross roads

By the turn of the century Kerala's population is expected to go upto 360 lakhs and its requirement of food (cereal equivalent) to about 60 lakhs per year. Even the most optimistic trend estimates of production within the State would have a deficit of nearly 24 lakhs tonnes by 2000 A. D. How will the agricultural economy of the State face up to this challenge? On the other hand, the agrarian structure of Kerala does not present a very rosy picture for the future. The declining land-man ratio which is abnormally small at present (0.11 ha/per capita) will become more unfavourable in future, that forming as an occupation would become unattractive to any new entrants in the profession. By 1971, 92 per cent of the operational holdings the State were below 1 ha in size and their number would go up considerably by the end of this century. Again it has been observed that inspite of the improvements in agricultural technology (Biological, chemical and mechanical) that we have witnessed in recent years, agricultural productivity in Kerala has remained stagnant during the past two decades except in the case of a few crops like rubber and tapioca. This stagnancy is more due to economic and social reasons than technological. According to a study by the Bureau of Economics and Statistics it was estimated that even as early as in 1966, 71 per cent of the owner-cultivator holdings in the State did not have even single member actually engaged in agriculture and even among households whose main source of income is agriculture, 35 per cent have no member with agriculture as his main occupation. Although modern technology in agriculture is neutral to scale, as most of the biological and chemical aspects can be effectively used even on small farms, they are not neutral to capital and management which are indivisible. Hence the need for optimising the use of such scarce resources like capital and management through better organization in the farming sector.

Therefore the future strategy to overcome the disabilities of size, should be to maximize income per unit area, by multiple cropping and mixed farming practices. Research for the development of such technology and management for organizing such complementary crop, livestock and fishery enterprises in production, marketing and processing, should receive high priority in the years to come.

Again Kerala agriculture is becoming a high-cost economy with the result that in the years to come our farm products will become non-competitive in the national and international markets. The remedy obviously lies in reducing input costs and effective utilization of byeproducts for reducing unit cost of production and development of processing for making value-added products. This calls for adequate research support for the development of post-harvest technology which is very much lacking in the State today. In this connection it may be recalled that the expenditure on agricultural research constitutes less than one per cent of the total planned investments in the State during the 5-year plan periods. A cost-benefit analysis of agricultural research in the State would therefore be useful.

Role of Agricultural Economics

To deal with the problems of the changing rural sector, there is need to have highly trained specialists endowed with a conceptual frame work and analytical tools to participate and influence the socio-economic transformations that are affecting in agricultural sector. The future of agricultural economics in the next two decades, as a discipline and as an area of work will become wider and will have a more predominent role in the Educational System of the State. Efforts should be concentrated on the definition of programmes relevant to the agricultural realities of the state and to identify and carry out research projects which would permit a better understanding of this reality. Such research should be the basis of the graduate teaching in Economics.

Research

Adequate way of generating more research of good quality is to reach a certain level of integration among the various research programmes. This can be done through identification of common problems such as Economic model of the new agricultural enterprises, the relation between technology and production, rural poverty, income distribution, and employment etc. In the next few years, research programmes in agrl. economics should give priority to the management aspect of multi-crop and mixed farming system, so as to maximize income per unit area and employment of family labour.

Similarly programmes for providing various incentives and their impact should be evaluated for policy formulation. These include schemes for price support, agricultural insurance, financing of agricultural marketing and institutional infra-structure, such as rural roads, supply centres, warehousing facilities at different points of the marketing process etc. which are complementary to agricultural production.

Teaching

As in research, teaching in agricultural economics also should receive more emphasis on multidisciplinary approach to analyse agricultural problems.

In addition to basic knowledge economics and quantification techniques, the curriculum should include complementary support from Statistics, Sociology, Agronomy and Extension. This can also be achieved by admitting students coming from different fields, such as agricultural engineers, sociologists, economists, specialists in forestry, fishery and livestock enterprises. It is also desirable to develop undergraduate programme in agriculture with electives in Economics, for giving support to the postgraduate programme.

National perspective

Considering the commercial nature of Kerala agriculture, and the endowment of skilled manpower, it is necessary to develop a national perspective in our training programmes. This calls for greater flexibility in the curricula of postgraduate programmes in agricultural economics, so as to meet the qualitative and quantitative requirements of professionals in Government, Co-operative and private sectors, not only within the State, but also outside. In fact, by the turn of the century, K. A. U. should be on a position to produce specialists in homestead farming, tree crops, forestry and fishery economics to man important positions in Asia and Africa.

An Agenda for Action

Proliferation of small peasant holdings in Kerala offers both challenges and opportunities for the future of Agriculture. The opportunity lies in the fact that it strengthens the socialistic concept of production by the masses, instead of mass production by capitalistic methods. But the real challenge consists on the organization required for cooperative or joint management of the farming system, for the supply of inputs, marketing services and processing facilities. Thus the creation of an economically viable agricultural system is a pre-requisite for attracting young entrepreneurs to agriculture and allied jobs.

In the special context of Kerala, a mixed and integrated farming system mutually reinforcing the benefits of crop/live stock/forestry enterprises is necessary for better utilization of all the resources of the farm household. This requires building up of basic functional relationships of inputs and outputs with production function analysis. Again crop planning and crop management studies suited to different regions and size holdings to maximize production and employment need to be undertaken by agricultural economists on priority.

As most of our crops are perennials not adaptable to situations of price fluctuations, a system of price stabilization and orderly marketing has to be thought of for policy formulation.

In addition to techno-economic evaluation of development projects economic surveys and market studies are required for finding new methods and uses for our farm products both within and outside the country.

Again, considering the immense possibilities of exploiting high value products, special areas can be identified for their production, and KAU research and extension can be tailored to the requirements of export markets.

The Department of Agricultural Economics in KAU should formulate economically viable models of mixed farming systems for different agroclimatic regions and for different resource endowments of farming households, and provide consultancy service and help technical departments to formulate turn-key projects in agri-business for young entrepreneurs. By the turn of the century this department should develop into a Centre for Rural Development conducting research and imparting training in the management of agricultural production, agri-business and programmes of rural health nutrition and rural environment.

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A Perspective of Faculty of Co-operation

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1. Present Status and Problem

The relevance or irrelevance of any exercise in futurology, must, however, take into account some basic societal features. Indian Society is a very complex one and much more so in Kerala. Three decades of diverse developments have sufficiently altered the face of Kerala. It is another matter that the benefits of the growth centres have not flowed uniformly to one and all. We, today, stand at the threshold of such contrasting possibilities where, at times, it appears that Kerala will soon burst into post-industrial society and sometimes one feels that the stagnation in the productivity per unit area of land in most of the crops in Kerala despite sizeable investments of resources and technology has been the most disheartening feature of the past decade or so. The overall impression that Kerala presents is one of a predominently rural society punctuated by several strong urban growths.

2. Emerging Trends in Kerala Economy

The Vice-Chancellor of the Kerala Agricultural University in his paper for discussion at the High Level Committee for Land and Water Resources, State Planning Board, held recently has gone to say: "The ubiquitous coverage of the population by partisan political activity serves as a decisive factor in organisation of economic and productive functions at the local levels. The high degree of political organisation of labour and the competitive collective bargaining advantage gained thereby has tended to reduce the productivity per man-hour of agricultural labour as well as push up the wage cost".

According to the food projections for Kerala 2001 A. D., made by the State Planning Board, large deficiencies are indicated. In respect of cereals, the deficiencies work out to 18.28 lakh tonnes for 1991 and 22.18 lakh tonnes for 2001. Kerala has once missed the "Green Revolution". The reasons are perhaps more of economic, sociological and organisational origin than of technology. The declining size of the average farm holding which are already small, the diversity of crop combinations, the variety of activities and occupations that each member of every farm family undertakes, the lack of organised marketing, warehousing and processing facilities at different levels are the contributory factors to this state of affairs. Each one of these factors, taken individually, may be quite common to India as a whole but the combined effect compounded by the smallness of each farm as a productive unit does pose much more serious problems in 2000 A.D.

The fragmentation of holdings as a result of the implementation of the Kerala Land Reforms Act in 1961 and its various amendments put agriculture on small plots nonviable as a full time occupation and the phenomenon of 'Sunday farmers" emerged. The most tragic fact is that the fragmentation of holdings of extreme order combined with the multiplicity of ownership interest by the law of succession and the pressure of population on the land did not attract sizeable loan funds either for working capital or for permanent improvements. The High Level Committee on Co-operative Credit in Kerala (1980) observed. "One of the major problems that confronts the co-operatives in the field of credit, is the low level of off-take of short term credit for paddy cultivation".

3. Technological and Social Dimensions

For developing societies the choice of right technology is an extremely important matter and we have to examine, "the desirable, undesirable consequences of technology". However, this cannot be done in isolation of the man and the society, his values and the national temperament and character and given resource endowments. Our friends engaged in technology transfer will find that many western techniques already being adopted are inappropriate for the given context and much too wasteful. We have seen that a number of countries without a significant internal resource base have recently stimulated economic growth. The examples include Greece, Italy, Malaysia, Formosa, Israel, South Korea and Hong-kong. They have found a means of developing human resources in such a way that they are enabled to seize opportunities in inter-national trade. Richard E. Meier, in his paper on Material Resources presented to the compilation entitled "Mankind 2000" has stated that "any strategy for development offering real hope for success forces us to consider wholly new and quite strange alternatives each of them placing unique demands upon applied science and engineering". According to him both the capitalist and the socialist systems demonstrate that they can generate economic growth. He points out: "Their respective preferences for public and private ownership of production facilities and of land are similarly irrelevant, because what matters for any modernising economy is the presence of a vigorous, effective management".

4. Objectives of rural development

There is a lot of confusion, among ourselves, which presently obscures the meaning of rural development, stems from the multiplicity of objectives which we claim to pursue in the name of rural development. These objectives, may generally be classified into three major categories.

(a) Since most of our rural population is dependent on agriculture, the first objective of rural development is concerned with agricultural production and productivity. In Kerala situation, increase in agricultural production is possible only by increased agricultural productivity.

(b) The objectives of increased agricultural production and productivity must be accompanied by improved nutrition for the urban and rural poor.

(c) Nutritional aspects of the poor inevitably leads to the identification of a third set of objectives viz. equality and redistribution of income.

5. Issues related to rural development

A large part of the practicalities of rural development depend upon the rural poor obtaining more effective access to application of modern technology—not only of producing food, clothing and shelter but also for procuring drinking water, fuel, basic health services and an environment which is conductive to healthy development of the young. These tools for better living are unlikely to get into the hands of the poor unless there are better services. Looking at these problems, it is necessary to consider the size and nature of the task of rural development because it has certain characteristics which help to explain why we are less successful in rural development than in other areas of development. Kerala has many unique demographic features which distinguish it from other States. The density of population is the highest with 654 persons per sq. km. as compared with an average of 221 persons in the country as a whole. It is the state with the highest sex ratio of 1034 females for 1000 males compared to 935 females per 1000 males in the country. The literacy rate amounts to 69.17 per cent.

In addion to the size of the task of rural development, its nature is also complicated by the multiplicity of functions involved. Even if we were able to concentrate on the most technocratic objectives of rural development, increased agricultural production and productivity, we would soon encounter the difficulty that increased agricultural production, as in the case of milk, has to be accompanied by such functions as storage, transport, agricultural processing and marketing. The strategy for rural development is also concerned with the problem of redistribution of resources. The implementation of "land reforms" in Kerala made homestead farming with a miscellany of crops a paradise for the intermediary traders and speculators who could dictate the prices and terms to the discomfiture of the producers of small means. We should pay more attention to the distribution of the quantum and distribution of earnings from agriculture by concerted action through an appropriate agency, an organisation of the people for the people by the people.

If one takes together the following four characteristics of Rural Development- the mind-boggling numbers involved, the number of functions involved ranging from storage to marketing, the question of increasing and improving the distribution of the earnings from agricultural and allied activities plus the need to provide welfare services (which are not directly associated with matching income)- it would be sufficient to explain why our progress of the village poor is so slow despite the advances made in technology and science. As pointed out elsewhere the full potential of genetic, technological and physical infrastructural developments can be realised only if socio-economic and socio-cultural factors are also taken into consideration and the counter-productive elements inherent in them at present are neutralised.

6. Corrective Organisational measures

By and large, the world countries have approached the task of economic development by one of two routes which can be characterised as "collectivism" and "capitalism" where as we are trying to follow a path known as socialistic pattern of society between these two extremes. We justify this on the ground that unbridled capitalism puts the welfare of the more fortunate individual before the welfare of the society as a whole, while strict collectivism sacrifices the individual for the greater good of the general mass. Unfortunately we are now having a political system in which we find a union of bureaucrats and politicians who run the government for themselves by themselves.

Both professional administrators and professional managers have certain jobs to do if the country is to achieve economic development. They have to manage the processes of planning and organising, monitoring progress, making mid-course corrections when necessary and seeing that physical and financial audit are carried out with speed and propriety. They have to see that the necessary technical functions are carried out within their organisation by properly qualified and well motivated staff. In any organisation, whether it be a co-operative or a voluntary organisation or a joint stock company or a public sector enterprise, are many potentials for conflict between different groups of members, between different groups within elected Board of Directors, between urban interest group and the rural or producers' interests. In many ways, a rural producers' co-operative is a microcosm of our society. The professional manager has to look into these kinds of conflict resolutions.

7. Co-operatives and voluntary organisations

Kerala could be really proud of the ubiquitous coverage of the rural population under co-operatives and had taken the lead to make them the peoples' organisation. Almost every village in Kerala has a primary credit society and elections to leadership positions in each of them are contested with all the vigour and tension of political elections. Democratic forms permeate the hierarchy of societies right upto the apex level. It was therefore only logical to believe that they would be instrumental to a radical transformation of the new agrarian systems given birth to by the Kerala Land Reforms Act. But the credit societies are more concerned with the short term advances and their recoveries rather than increase of agricultural productivity. In the areas of production, processing and marketing, consumption, farming, etc. co-operation in Kerala has very little of which to be proud. The offering and availability of co-operative credit without the simultaneous organisation of the production function and processing and marketing of the produce could not solve the problem of the diminishing productivity of the small farm. The Anand pattern co-operatives have very well demonstrated that, professional management and keen commitment to the ideals of the movement are essential elements of success than political power games.

The inadequacies of these organisational arrangements highlight the need for the encouragement of voluntary organisations of producers at the grass-root levels. Contrary to the earlier tendency, towards centralisation of authority, conformity with central directives and the corresponding bureaucratisation of all activity, there is now some promise of a more participative democracy based on greater decentralisation of social and economic action. The avowed commitment to Gandhian values accords high priority to the "last man" building from the bottom upwards, and self-reliance through community action. Other elements in the new approach are a marked rural bias with the primacy of agriculture, a new rural movement, the adoption of strategies that maximise employment, an emphasis on household, small and mini industries in the countryside and appropriate planning for appropriate technology. Not only is community initiative invited, but a large area of operation is indicated in the broad field of rural and social reconstruction. The authorities will part with responsibility to the extent that there are meaningful initiative from below. This then is the challenge of 2000 A. D.

8 Characteristics of Voluntary Organisations

The origin of voluntary work in Kerala, as elsewhere can be traced back to social service with its antecedents in charity. Hence its close links with social reform and missionary activity aimed at spreading enlightenment and alleviating suffering. Education, medical care, and concern for the physically and socially disabled were among the preferred field of service. In time, emphasis shifted from the individual to the community though the accent continued to be on welfare while moral responsibility remained the driving force.

Voluntary action has always had its professional corps, notably doctors and educators. In its earlier phases, the activity of voluntary agencies was largely autonomous and now this autonomy has more or less disappeared. The administration reaches out to distant corners, while planning and central funding has increasingly come to pre-empt local initiative. Voluntary action in its relief and development phase has therefore been called upon to fit into official policies and programmes. The relief phase brought into the movement a lot of people motivated to assist their less fortunate fellowmen, but not necessarily professionally oriented. The following development phase, however, has witnessed the entry of a whole new band of professionals. This professionalisation of voluntarism marks a new departure. Being small and independent of bureaucratic constraints, voluntary agencies agencies can afford to experiment with ideas, technologies, organisation and anything else.

Look at Mithraniketan at Vellanad, Trivandrum. It has sponsored village industries and extension activities among the neighbouring farmers through a series of training programmes. It has also pioneered the establishment of various co-operative societies designed to organise the productive skills of village artisans. The Peoples Dairy Development Project at Kalady is essentially oriented towards milk production and closely resembles to the model of the Anand Pattern, though it has not officially opted for reconstitution of the societies sponsored by it as Milk Producers' Co-operative Societies under the Kerala State Milk Federation. There is the felt need of an organisation/agency who can attract experts to aid and assist the farmers, and village artisans, to plan work and market the produce/ products. Multipurpose comprehensive leadership for the building up of the internal strength of the infinitesimal farmer, the village artisans, educated unemployed, and the workers of the traditional industries is the challenge and opportunity to the Kerala Agricultural University in 2000 A. D.

9 Management personnel for co-operatives, voluntary organisations and development agencies

Apart from the State policy and the particular socio-economic environments in the country, several other factors-voluntary effort, mass participation, social control, harnessing of local initiative and resources, tend to make co-operatives ideal institutions to help achieve the policy objectives of the State and its planning apparatus. Widespread misgivings about their performance and general decrying of their alleged failure to come up to the expectations of the community are there. Yet at the macro-level, whether it be in centrally planned economies or free enterprise system, co-operative organisation is obviously preferred in a variety of fields and will continue to be preferred by the powers that be, for attaining specific policy objectives. It is really the performance at the micro level of these co-operatives, however, that creates doubts about their efficacy in meeting the expectations of the community as well as in becoming live agents of change. Appropriate management systems altered to their specific requirements can surely pay way for meeting this challenge well.

The area over which the co-operative activities extend and where they are likely to dominate in 2000 A. D. cover such vital sectors of the economy as agriculture—supply of inputs, marketing and processing of agricultural produce, production of cattle feed and fertilisers, rural banking and public distribution system, village and cottage industries, handloom and handicrafts and fisheries. Large size co-operatives have now emerged in such diversified areas as mentioned above. Thus the size of an average successful co-operative or similar organisations will continue to grow. Attempts at professionalisation of management, curbing growth of vested interests, introducing sound personnel policies, making rational investment decisions and creating a community of interest to all types of co-operatives are bound to come sooner or later. The co-operatives often prove handy instruments to strengthen the political base of the leadership and also as avenues to protege of the political big-wigs. The co-operative leadership often comes from political cadres in Kerala as against from bureaucracy in other parts of the country. One may not have to wait for long before professional management really takes over the reins in the co-operatives.

In the beginning the size was too small to require anything more sophisticated. But as the size grew, the decision making process remained and continues to remain traditional. This is one of the basic causes of the poor performance of the co-operatives in general. The decisions by the Boards are not always taken in the larger interests of the co-operatives and the community that they seek to serve. Personal factors—may be social, political, economic or even self interest play a dominant role in the process of decision making. The location of units, the investment pattern, recruitment policy, pricing strategies, the product mix, questions of recovery of dues from borrowers are not always decided on rational, objective and scientific basis. This, in turn, adversely affects the performance of the co-operatives and their capacity to achieve their real objectives. The quality of decision making has always remained a function of the type of leadership.

If the organisational styles of the co-operatives and voluntary organisations were exceedingly feudal in the 50s and feudalistic and patronalistic in the 70s, it should be consultative and participative in 2000 A. D. The decision making authority was vested with the state administrative apparatus in the fiftees and it should be dispersed within the organisation and based on objective evaluation in 2000 A. D. The training function was focussed on government procedures and controls in the fiftees and the focus was on co-operation – theory and practice with some orientation towards management in the seventies; years to come the focus will be on principles and practice of scientific management of co-operatives as enterprises. There was no need felt in the matter of selection of personnel in the past whereas reliance is placed on state bureaucracy and kinds of the leadership in the present and in future, 2000 A. D. recruitment to co-operatives would be selective, merit based, and highly professionalised. The members of a co-operative or a voluntary organisation can hire the services of the best of experts and as such these experts would be the leaders of the peoples organisations in 2000 A. D. The experiment at Anand or the working of the Peoples Dairy Development Project at Kalady, the co-operative Hospitals, the makers of Dinesh Beedi are all the pointers in this direction. The co-operative enterprise can thus bring the economist and the agronomist, the sociologist and engineer, veterinarians and managers and communicators and executives under its fold.

The structural changes emerging in Indian Economy necessitate an ever-increasing demand for technically trained professional men. A whole spectrum of such professionals is required in the following areas:

i) Teaching, Extension and Research related to co-operation, rural organisations and rural development

ii) Co-operative enterprises

iii) Development Departments and Agencies

iv) Commercial Gramin Banks

v) Non Government—non formal organisation

The Kerala Agricultural University has to take up the uphill task of providing the necessary personnel to organise and manage the ever-increasing programmes and projects in all the related areas aiming at the alleviation of rural poverty in Kerala. It is for this reason that the Kerala Agricultural University started an under-graduate programme viz,, B. Sc. (Co–operation & Banking) in 1981. It is in the fitness of things that the University may seriously consider the question of fully equipping the proposed Faculty of Co-operation in order to provide the State with the necessary personnel for the fulfilment of the objectives and programmes mentioned elsewhere.

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Teaching of Agricultural Statistics

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Introduction

Any applied science needs statistics as one of its tools for laying out the experiment, collecting the data, analysing and interpreting it. This tendency is more so in the case of Agricultural Science. Hence agricultural institutions are highly in need of the application of statistics. When statistics applied to agriculture (agriculture include Agriculture, Veterinary and Fisheries) it is called Agricultural Statistics in the broad sense. In the present set up of applied oriented research in agricultural universities and agricultural institutions, teaching of agricultural statistics is a must. As agricultural statistics is considered to be the solution for all types of quantitative research, it is worth thinking of its teaching in the different agricultural institutions. The agricultural universities and other similar institutions are the places where the teaching of agricultural statistics is highly needed. To have a clear understanding of the application part of the subject, it is essential to have a clear basis of it. Hence teaching of basic principles of the subject is also essential before going to the application part of it. As most of the agricultural institutions devoted to agricultural teaching and research, are following the trimester pattern of education, I am discussing only the teaching of agricultural statistics under the trimester system in this paper.

An applied scientist will be viewing the subjects as a means to understand the works of the various authors whose research articles generally contain the frequent use of statistical application. For example, a research article in breeding will always contain the frequent use of matrix notations and applications of multivariate techniques. Similarly a research paper in agronomy will often contain the layout analysis of a 3^3 confounded factorial experiment or splitplot design. A work in nutritional study will generally contain a bit of simple tests of significance or layout and analysis of a switch over trials. Hence to understand all the applied oriented research, the workers may be needing a good understanding of agricultural statistics. Thus in the applied institutions, especially agricultural institutions, teaching of statistics is very, essential. Below, I am presenting a frame work of teaching of agricultural statistics in agricultural institutions under trimester system.

Programme

Mainly the teaching of Agricultural Statistics in an educational institution can be divided into two stages, viz. (i) in the undergraduate stage and (ii) in the postgraduate stage. Under the first stage, that is, in the undergraduate level one should concentrate more on the fundamental level. A good basic is needed to build up the subject. Hence more weightage is to be given to mathematics in under-graduate level. At least two courses in mathematics are to be given. They are, a course in algebra and a course in differential and integral calculus and basic ideas of determinants and matrices. In the algebra course a little bit of trigonometry and co-ordinate geometry can also be introduced. A fundamental course in Statistics in the banner of Fundamentals of Statistics can be introduced after the basic mathematics courses. These courses can be phased in a systematic manner, so that the mathematics courses are offered during first two years and the Statistics Course in the next year. The credit hours for each of the courses will be 4+0 for the mathematics courses and 3+1 for the statistics course. The course outline of all these courses are given at the appendix-I. These courses are mainly for undergraduate students both in Agriculture and Veterinary Sciences.

Now we shall come to the postgraduate level of teaching of Statistics in the Agricultural Universities and Agricultural Institutes. The programme of offering Agricultural Statistics to postgraduate students, who are not majoring it, but taking it only as a minor or supporting course can be categorised into five plans.

Plan-I

Agricultural Statistics Courses needed for post-graduate students who are majoring in Plant Breeding, Animal Breeding and Genetics.

Plan-II

Agricultural Statistics Courses needed for post-graduate students, who are majoring in Agronomy, Agricultural Botany, Soil Science, Plant Physiology, Nutrition and Horticulture.

Plan-III

Agricultural Statistics Courses needed for post-graduate students who are majoring in Entomology, Pathology, Pharmacology and Nematology.

Plan-IV

Agricultural Statistics Courses needed for post-graduate students who are majoring in Agrl. Economics, Extension and Sociology.

Plan-V

Agricultural Statistics courses needed for post-graduate students, who are majoring in Microbiology, Bacteriology and any other post-graduate discipline.

Students of Plan V and all other plan students will have to take a basic course in Statistics which is slightly higher in standard than that of fundamentals of statistics offered in the under-graduate level, in the name of principles of Statistics, covering the discreptive Statistics, distributions, estimation and test of significance including the commonly used non-parametric tests in a 4+1 credit hours. Plan-V students need to take only this course.

The students of Plan-I need a serious study of Agricultural Statistics over and above the principles of Statistics Course. They will have to take a course in Design of Experiments covering Principles of experimentation, simple designs, its layout and analysis. Factorial experiments, confounded factorial experiments, split–plot designs, incomplete block designs etc. in a 3+1 credit hour course. Also they will have to take a course in Genetical Statistics covering uses of x^2 test in detecting independent segregation of factors and testing of linkage, Estimation of linkage, Hardy-weinberg equilibrium, Migration, mutation and selection in breeding, Heritability, Genetic Correlation, study of genetic diversities, selection indices, stability parameter analysis, Path Coefficient analysis and Diallel analysis in a 3+1 credit hour. A student who is doing doctorate level studies may have to take another course of 3+0 credit hour in Matrices and Regression analysis. The course outline of all these courses are given in Appendix-II.

The post-graduate student of Plan II will have to take, over and above the principles of Statistics Course of 4+1 credit hour, the Design Course of 3+1 credit hour, suggested in the case of Plan I students.

The post–graduate students coming under plan-III will have to take over and above the principles of Statistics Course of 4+1 credit hour, a course in Biological Statistics covering Construction of growth curves, Construction of birth, mortality and life tables, negative binomial, log–normal distribution, etc. Biological assays and Probit analysis of 2+1 credit hours. The course outlines of this courses are also given in the Appendix–II.

The Plan-IV students will have to take over and above the principles of Statistics Course of 4+1 credit hours, a sampling course covering simple random sampling, multistage, and multiphase sampling, stratified sampling, systematic sampling, cluster sampling, regression and ratio method of estimation, non–sampling errors in a 2+1 credit hour Course. The post-graduate students of Agricultural Economics will have to take another course in Economics Statistics covering mainly index numbers and time series analysis in 2+1 credit hours. Students who are doing doctorate level studies in Extension will have to take a Course in multivariate analysis covering tests of multivariate—hypothesis—Hottilings T2, Mahalanobis D2, Multiple and partial regression and correlation. Principle componant, canonical and factor analysis in 2+1 credit hours. Students who are doing doctorate level studies in Agricultural Economics will have to take a course in econometrics of 2+1 credit hour. The course outline of all these courses are given in appendix-II. Over and above these statistical courses, it is very much useful to all the post-graduate students to take a course in data processing and computer programming of 2+1 credit hours, whose course outline is also given in the appendix–II.

Few Agricultural Universities, such as PAU, HAU, UAS, KAU and Agricultural Institutes like IASRI are offering M. Sc. Courses majoring Agricultural Statistics and PAU, HAU, and IASRI are offering Ph. D. courses also in Agricultural Statistics (in PAU and HAU it is named as M. Sc. Statistics and Ph. D. Statistics). As these courses are not common in all Agricultural Universities and Agricultural Institutions, I am not giving a detailed exposition of these courses. As the Institutions conducting postgraduate studies leading to M. Sc. and Ph. D. in

Agricultural Statistics are very few, the curricula of these courses can be discussed among themselves and a collaborative effort is to be made to dispose with the anamolies in the syllabus. A common syllabus in this course will always give recognition and due importance to this course and also it will help to keep a high standard for this course.

So far I have been discussing only about the courses. But an equally important point worth mentioning here is about the staff pattern of the Agricultural Universities and Agricultural Institutions, where a strong applied oriented statistical teaching is needed. The staff pattern of the Agricultural Statistics Department is to be as follows:

For each Agricultural Universities/Agricultural Institutions at least one Professor and Head of the Department is needed. (If there are more than one campuses, one Professor in each campus is desirable. The Senior most among them will be Head of the Department and may be posted at the headquarters. Where there is rotation of Head of the Department, whoever comes as head may be posted at headquarter for administrative conveniences and for ready consultations). For every single campus Institutions at least two Associate Professors must be needed in the Department and there should be at least four Assistant Professors in Agricultural Statistics and one Assistant Professor in Mathematics is also needed in the Departments.

The minimum staff pattern for the Agricultural Statistics Department can be summarised as follows:

A. Single Campus Institutions

i)	Professor of Agricultural Statistics	1
ii)	Associate Professors of Statistics	2
iii)	Assistant Professors of Statistics	4
iv)	Assistant Professor of Mathematics	1

Over and above this a sufficient number of non-teaching staff (as per the standard norms) must be provided.

B. Multi-campus Institutions

a) For the main campus the staff pattern must be the same as that of the single campus institution:

b) For other campuses

i)	Professor of Agrl. Statistics/ Assoc. Professor of Agrl. Statistics	1
ii)	Assistant Professors of Ag. Statistics	3

The postgraduate programme in Agricultural Statistics is to offered at the headquarters in the case of multicampus institutions. If Ph. D. programme in Agrl. Statistics is also offered, one more Professor over and above the Head of the Department must also be posted at the headquarters.

The teachers must be well qualified. The essential qualifications of the Professor and Assoc. Professor must be Ph. D. in Agrl. Statistics or Statistics. All the teachers must be paid according to the recommendations of UGC or ICAR. Over and above these a good library containing fairly well collection of Statistics books and journals is a must at each campus. The Campus at which postgraduate programme in Agrl. Statistics is there, a fullfledged library containing almost all the modern publications in Statistical books and journals and their back volumes must also be available.

Each Agricultural University/Agri. Institutions must have a Computer at the headquarters. It is also desirable that each campus of a multi-campus Agricultural University/Agricultural Institution to have a mini Computer. The computer and the staff must be attached to the Agrl. Statistics Department.

In KAU, the courses in Statistics other than that of M. Sc. (Ag. Stat.) are offered under different banner. In the Agricultural Faculty, it is being offered as Agrl. Statistics. In the Veterinary Faculty and in the Fisheries Faculty it is being offered as Statistics. The funniest part is that each faculty is having its own system of arranging the courses. Sometimes the title of the course being the same, but the contents show different degree of coverage in standard-wise, as well as in topic-wise. This leads repetition and declining standards. This is because, there is no proper coordination between faculties in the case of Agrl. Statistics teaching. This anomaly can be rectified if the different Statistics sections in the different faculties are unified under one Head. Sometimes this unification of Statistics may create certain administrative problems. Hence a better solution would be, that a Basic Science & Humanities Faculty may be formed and the Statistics Department from the various faculties may be amalgamated into a Department under the Basic Science College.

Before concluding I would like to record my sincere thanks to the Vice-Chancellor, Kerala Agricultural University and the Director of Extension for giving me this opportunity in presenting my opinion about the teaching of Agricultural Statistics. I know there are a lot of short comings in my presentation. I hope all of you will excuse me for it.

APPENDIX I

1 Algebra 4+1

Addition, subtraction, multiplication and division of algebraic expression, factors, Permutation and Combinations, functions, linear and quadratic equations. Solutions of simultaneous equations. Polynomials, Ratio and proportions. Measurement angle and trigonometric ratios.

Coordinate of a point, locus and its equations. Change of origin, Straightline and circle.

2 Calculus 4 cr. hours

Function, limits and continuty of functions. Differentiations, meanvalue theorems, Maxima and minima. Partial differentiation.

Integration of rational and trigonometrical functions and transcendental functions. Definite integrals. Differential equations.

Determinants, its addition, subtraction and multiplication. Elementary ideas of matrices and its application.

3 Fundamentals of Statistics 3+1

Definitions and scope of statistics. Presentation and summarisation of Statistical data, Graphical representation of data, Mathematical notations, Measures of Central tendency and measure of dispersion. Elements of tests of hypothesis Z-test, t-test and X^2 test, Linear regressions and correlation Elementary ideas of sampling and design of experiments.

APPENDIX II

1 Principles of Statistics 4+1

Descriptive Statistics—mean, variance frequency table, histogram, frequency curve, etc. Elements of probability Binomial, Poisson and Normal distributions. Population, sample, Parameter and Statistics. Sampling distribution and sampling errors. Estimation, point and interval. Tests of hypothesis Statistical hypothesis, kinds of errors, level of significance. Tests of significance of different Statistical hypothesis-Z-test, t-test, X^2 test, F-test. Non-parametric tests. Simple Correlations and regression, Multiple and partial correlations and regressions.

2. Genetical Statistics 3+1

Probability as applied to genetic systems, concept of frequency of gene and genotype. Hardy–Weinberg law; Forces causing change in gene frequency. Theory of in-breeding. Estimation of genetic parameters and testing of genetic and environmental components. Heritability, genetic correlation, study of genetic diversity, selections, indices stability parameter analysis, path coefficient analysis, diallel analysis and estimation of g. c. a. and s. c. a.

3. Matrices and Regression Analysis 3+0

Eliminating matrix operation, Inverse of matrix Rank and linear independence, linear equation and generalised inverses—Latent roots and vectors.

Linear regression, Multiples, and partial and polynomial regression, regression analysis, Coefficient of determination, estimation of regression equations.

4. Design of Experiments 3+1

Analysis of variance, one way and two-way classifications, Fixed random and mixed models. Principles of experimentations. Simple experimental designs—CRD; RBD and LSD. Multiple range tests; Missing plot technique. Transformation of data. Analysis of Co-variance. Factorial experiments, confounding, split-plot, strip-plot designs. Switch over trial. Incomplete block design-BIBD and PBIBD, Lattia designs.

5. Computer Programming 2+1

Introduction to computer science, Number systems, Digital computer Architecture—Central Processing Unit, Memory organisation, Input-output devices (Visual Display units, Printer, Floppy disk drive, Winchester disk drive, Hand disk drive, Magnetic tape unit). Evaluation and fundamentals of operating systems, modes of operation—open shop, closed shop, Multi programming, time showing, one-line, real-line. Soft ware development tools, Assembles, Compilor, Interpreter, Linkage editor, Text editor, Debuggor. Introduction to programming languages—BASIC, COBOL, PASCAL, FORTRAN, Computer programming in BASIC.

6. Biological Statistics

Reproduction and mortality rates and their estimation study of population, growth application of poison, negative bionomical logistic, gompertz and log-normal distributions to population studies.

Biological assay—Probit analysis—quantitative and quantal responses—dose—response curve—relative potency—L. D. 50.

7. Sample Surveys 2+1

Methods of constructing and analysing designs for survey investigation,—simple random sampling, stratified random sampling, Multistage sampling, systematic sampling. Ratio and regression methods estimation. Non-sampling errors.

8. Economic Statistics 2+1

Analysis of economics data obtained through research investigations—application of regression techniques—production function—demand function—cost of function—income distribution—elasticities—analysis of time series data—decomposition of the time series data into trend, seasonal variation and business cycle, index numbers and their importance—methods of construction of index numbers.

9. Multivariate Analysis 2+1

Properties of multivariate normal distribution, sampling distribution. Wishort's distribution, Hotellings T^2, Mahalanobis D2, distributions of sample correlations, simple, partial correlation and sample multiple regression. Multivariate analysis of variance and testing of hypothesis. Problems of identification and discriminatory analysis. Principal component analysis, Cannomical analysis and factor analysis.

10. Econometrics 2+1

Statistical inference in models arising in economics and certain other fields. Least square method regression theory, relationship to simultaneous equation and factor analysis problems. Specification error. Identification, time series, problems of aggregation.

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Faculty of Rural Home Science in Kerala Agricultural University

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What is Home Science?

It is generally believed that Home Science is nothing but dealing with the simple day to day work of any housewife, be it literate or an illiterate and generally people fail to comprehend the need to study Home Science in a systematic manner for it is an inherent factor in all women. The saddest thing is the fact that a great majority of the educated masses also entertain this misconception.

But according to Ellen H. Richards, founder of Home Science (1882), the family is the heart of country's life and every Philanthropist or Social Scientist must begin at that point. According to him, Home Science allows for a harmoniously organised family life in order to satisfy under the best possible conditions, the physical, social, economic, aesthetic, cultural, emotional and intellectual needs of all members of the family and their relationship with the community. It is a combined beauty of art and science towards achieving healthier and happier human beings and towards building better homes, which can impart dynamics into the families, to meet the pressing demands of the society. Through the discipline of Home Science, the urban and rural family members in our country are to be assisted in acquiring knowledge which will enable them to develop attitudes and practices leading to sound decisions and intelligent action governing all aspects of their living.

Home Science has evolved into a vast field with so many branches that its scope knows no bounds. Almost every other branch of pure science is correlated and contributes a part of the foundation in building this discipline.

In India Home Science was first introduced in schools as domestic science in the early years of the 20 th century. Later it was introduced at the College level. The idea of Home Science as a discipline as it is today was born at the All India Women's Conference in 1926. Today Home Science is taught upto the Ph. D. level, in various universities. Nearly 142 institutions offer Home Science in our country at the Bachelor degree level.

Home Science in Agricultural Universities

Home Science has been integrated into many agricultural universities at the Faculty level, since it has much to offer for integrated rural development in preparing the rural home makers to fit into the economy of today and help to increase the productivity and prosperity of the nation. Unlike the ones in traditional universities the Faculties of Home Science in Agricultural Universities offer rural oriented programmes and hence are more concerned about rural women's needs, attitudes and aspirations as a basis for getting targets for assisting them to improve their level of living through proper training, education and supportive services.

A faculty of Home Science in an Agricultural University is expected to take up family oriented programmes, to help families, understand the basic principles of development of both human and situational components, as they relate to protection of total resources and human development. The rural women are to be taught to understand the function of the family as related to the improvements of living conditions and levels of living. The families are to be helped to plan within the family, goals for the family, community and nation, and work out strategies for achieving the goals with respect for national prosperity, property and prestige. Knowledge and skills in planning the use of resources available to the family for optimum achievement of aspirations and expressions of human values are to be imparted to the rural women. Besides this, the rural women must be taught the importance of relationship of improved levels of living with limited family size, spacing, family dependency and community participation. The patterns of family and community living in their cultural setting are the important factors responsible for changing the economic conditions whether the family, community and nation, the mobility of individual and families, the availability and quality of education and the roles and states of women and the extent of equality between men and women. These aspects are to be restudied in detail.

Compared to men, women need special attention because there are a number of handicaps which prevent women from becoming equal partners in development.

1. As members of the labour force, women are considered as less productive (being less effluent and irregular in work) and hence paid low wages. The fact that this may be due to their child rearing and household respensibilities is not taken into consideration.

2. Women's varied tasks make them more integral to economic life than men. Besides being solely responsible for the cultivation of food crops in many area, women have to process the crops, monitor the food storage, prepare and cook the food and generally apportion food helpings to family members according to their requirements and availability. In this process qualitatively and quantitatively her share is the smallest. Moreover it falls to women to nurse the sick members of the family. Thus although both women and men grow some or all of the family's food requirement, women bear the responsibility of managing the family health. Because of this alone women are more conscious of the food chain itself and pay more attention to maintaining it. When domestic chores and child care are added to their work and when one sector requires their greater attention, it is always at the expense of their commitment to another. As the real income of farming families increases, the nutritional status of the family, especially that of women and children worsens.

3. The all India trend for the declining sex ratio of male: female as 933:1000 is attributed to poor environmental conditions, inadequate services for material care,

preference for the male child and the discrimination against the female child, repeated pregnancies and malnutrition resulting in high material mortality, poverty and an excessive work load for women. This health profiles of women call for planned social action.

4. Even if women are employed, major decisions at home are invariably taken by men for them and it is clear, men are unlikely to go out of their way to support the lessening of womens burdens, if that conflicts with their own perceived interests.

5. Parents are usually inclined to spend less to educate female child due to the traditional systems of descent and inheritance through male children, etc. Moreover it is generally believed that equality of opportunity for women may turn them away from the traditional role which nature imposes on them.

6. Social norms like child marriage is closely interlinked with the level of education, social attitudes and economic considerations. Rural society consider it a waste to spend on the education and maintenance of female for long since they have to spend on their marriage and dowry. Moreover in the rural society, only married women are permitted to work outside the home.

The time has now come to perceive women in a broader perspective keeping in view of the multifarious roles she has to perform as bread earner for the family and manager of the farm and household resources. This has also lead to recent disquiet about the role of women In development bringing about demands to promote the integration of women in the economy.

FACULTY OF HOME SCIENCE IN KERALA AGRICULTURAL UNIVERSITY

The review Committee on Agricultural Universities in its report (1978) recommended that the Agricultural Universities which have not so far established faculties of Home Science should make a beginning by setting up at least a strong Home Science Department to conduct research and award diploma/certificate courses. ICAR has suggested that these programmes are to be developed primarily with concept of rural women as both primary food producers and home makers. The Applied Nutrition Unit existing in the College of Agriculture from 1965 onwards was raised to the status of a mere section to work on these lines in 1978 in Kerala Agricultural University. The Applied Nutrition Unit as well as the section were financed by external agencies like UNICEF and ICAR for the last 15 years. Decisions were taken at the level of the general council in 1980 to start a Department of Home Science again with ICAR aid. The fact that the activities under this programmes are to be covered by resident instructions, research and extension in a new faculty is only a compensation for the initial lagging behind during the earlier years. This has brought Kerala Agricultural University on a par with 12 other Agricultural Universities which have separate faculties to deal with the problems of rural women.

The major objectives of the faculty of Home Science are:

(1) To develop and offer resident instruction in Home Science at undergraduate and postgraduate levels. The programmes will be oriented to rural situations and problems.

(2) To identify the research gaps in the field of Home Science and conduct research in a manner that will supplement the production programmes undertaken under the faculties of Agriculture, Veterinary Science and Animal Husbandry and Fisheries.

(3) To develop and conduct extension programmes.

RESIDENT INSTRUCTION

A. Undergraduate programmes

1. B. Sc. (Rural Home Science)

B. Sc. (Rural Home Science) course is proposed with the objective to enable students to develop an understanding of the nature, scope and philosophy of Home Science and its role in the development of agriculture and rural communities in the large context of national development. The course will help the students to achieve self reliance in order to accept their responsibilities for home living, citizenship and leadership in rural communities and to become aware of the national problems and the role of Home Science in combating these problems. The course will also help the students to become aware of the resources available within the families and develop the skills necessary for maximum utilization of these resources. The undergraduate course will also help the students to develop necessary skills in food production and its utilization and preservation, towards improvements of dietary habits and nutritional status of families and to develop the attitudes/ abilities and skills necessary for taking up professions in Home Science particularly in the rural areas. Thus the course is tailored to be different from the Home Science taught as a finishing course in traditional universities for upper and middle class girls. The B. Sc. course in Rural Home Science to be offered from the Kerala Agricultural University will be of 4 year duration.

B. Postgraduate programmes

A number of post-graduate programmes as detailed below are to be undertaken by the discipline of Home Science in Kerala Agricultural University.

Postgraduate Diploma Courses

A. Food Science and Nutrition

A. Post-graduate Diploma course in Food Science & Nutrition:

A number of developmental programmes are introduced in our country to uplift the nutritional status of women and children in the community. State Departments of Agriculture, Health, Development, Social Welfare and Directorates of Harijan Welfare, Tribal Welfare, Municipalities and Central Government Department of Food are fully engaged in the implementation of such developmental programmes in our country. The officers who are responsible for the implementation of such programmes at the field level should have a basic knowledge of Home Science with special reference to Food Science and Nutrition to enable them to discharge their responsibilities efficiently. Moreover they must equip themselves with the recent developments in this field. The personnel now working under these departments mostly lack specialised training and information about the latest developments in the above field.

A post-graduate diploma course in Food Science and Nutrition is already offered by the Department of Home Science for inservice candidates of the above Departments.

B. Dietetics

The occurrence and cure of many diseases are very much influenced by the type of food consumed. The treatment of many a diseases especially functional diseases fail due to lack of care in the dietary pattern of the patients. The dietary prescription given by the doctors are not generally taken into much consideration and the doctors themselves are too busy to follow up the suggestions given. This situation depicts the need of personnel who are capable of translating the dietary prescription into menu, providing meals and who have adequate time to maintain close and cordial co-operation with the patients as well as with the doctors. Moreover people should also become aware of the diseases that are known to be primarily due to faulty nutrition and the role of defective diets in contributing to the onset of general diseases. Services of such trained personnel in Hospitals are essentially required. In Kerala at present only very few hospitals are having the services of such trained personnel. A postgraduate Diploma course in Dietetics of one year duration is proposed for meeting the above requirement for such a course will be useful to the sponsored candidates from the Directorate of Health Services and Department of Social Welfare.

C. Child Psychology

Pre-school years are crucial from the point of view of the optimum development of the child. It is at this stage that proper foundation for later development is laid, many skills learned and proper value and attitudes are formed. Such developments are influenced by the condition of the family. Affectionless children often suffer personality disturbances and disorders that are not overcome later by family and community experiences.

The extension personnel involved in the implementation of development programme for pre-school children should be aware of the importance of pre-school period. A post-graduate Diploma course in child psychology of one year duration is proposed for the benefit of the above personnel.

Post-graduate Degree Programmes

Food Science and Nutrition

Post-graduate programme in Food Science and Nutrition leading to M. Sc. Degree is to be started during 1985. At present no other traditional University in Kerala is offering a post-graduate degree programme in Food Science and Nutrition. Futher the post-graduate course in Food Science and Nutrition, proposed by this faculty is to train the students for work in rural areas. Kerala Agricultural University is identified as one among seven Agricultural Universities in the country to receive FAO/UNDP funds for the implementation of the above programmes.

Research Programmes

The research programme to be taken up under the Faculty of Home Science will be mainly emphasising the problems of rural homes. The disciplines of Food Science and Nutrition, Home Management and Child Development under this Faculty are to be sufficiently strengthened to undertake research projects in the field problem areas.

Food Science and Nutrition

When food is viewed in terms of a system of production, distribution and utilisation, in our attempt to improve the system, generally more time and money are allocated to the production component and utilisation part is always neglected. Since hunger and malnutrition can exist inspite of adequate production, the maximum utilisation of available foods is also equally important and absolutely essential. Loss and deterioration of available food resources further adds to the problem. Therefore studies on utilisation of different varieties of food crops evolved are to be taken up. Ascertaining the composition of varieties evolved, improving the qualities of inferior varieties by removing undesirable components or by adding new components, ascertaining the impact of residual effects of application of fungicides, insecticides etc. will also be very useful. No such systematic work has been carried out with any of the popular varieties.

Knowledge regarding the nutritive value of Indian foods is a valuable aid to wise food selection and information currently available in the field is rather scanty except for the publications of National Institute at Hyderabad. Even in the Publication, many food items only available in Kerala are seen to be not included. It is hoped, to enlarge this information by locating such foods and conducting nutritional studies on these foods, since such studies will be useful for the scientists as well as field workers in Kerala.

On the basis of the programmes submitted to ICAR, two *ad hoc* schemes have already been sanctioned and implemented. Another two schemes are in the pipeline. In addition to these programme, one *ad hoc* scheme already sanctioned by Science and Technology of the Government of India is being implemented. One research scheme is under the active consideration of the State Committee of Science and Technology. Programmes on the importance of processing low-cost weaning foods, and on various aspects of child nutrition are already being contemplated for getting funding from external agencies like IRDC.

Establishing Nutrition Rehabilitation Centres

Malnutrition among children is a major health impediment in Kerala State. While Kerala has achieved substantial reduction in infant and child mortality, the nutritional status of the children still remains precariously poor. The only way the Faculty of Home Science can make an attempt on this serious problem is by establishing Nutrition Rehabilitation Centres in selected campus of the University. Seriously malnourished children can be admitted to this centre and can be rehabilitated with proper nutritional rehabilitation and medical care and to seek the active participation of mothers in the rehabilitation, by training them in all aspects of nutrition and child care, so that when they are sent home with their children they continue to take proper care of the children. The centres can provide training to para medical and health staff of the Directorate of Health Services, in various aspects of nutrition and scientific management of malnourished children. It is also proposed to raise and maintain a Nutrition Garden in the centre to demonstrate to mothers the importance of locally available nutritious foods.

Home Management

Standard of living of population is affected by a wide variety of factors which can be classified as economic, social, geographic and religious. The economic determinants provide the basis and the social and religious influences shape one's level of living. Scientific management of the home and our domestic life contributes greatly towards a richer and fuller enjoyment of life and can eliminate much drudgery and even misery. An ideal home life is to be unhampered by the traditions of the part but utilising all the resources of modern science to improve the home life. The knowledge and skills for running a modern home have changed because the productive activities at home have decreased and the exchange systems have become predominant in the national economy. Large number of economic decisions are made in the homes. The household dictates what consumer goods are needed and the industries produce them. Hence the women who is the manager of the homes must be able to organise, plan, to lead and to think economically. Studies on the utilisation of time, money and energy in performing various household activities by rural and urban home makers with special reference to labour saving devices, work areas, storage facilities, utility value of various household goods, consumer economics, income expenditure pattern of the population with special reference to savings, credit facilities etc. are to be taken up to get adequate data regarding the problems faced by women. Such data will be useful as baseline information for planning education programmes in the field of Home Management.

Child development

Modern living has created general problems such as environmental pollution, malnutrition, explosion of population growth, etc. An extremely genuine situation exists today in relation to the nutritional status of child population which forms about 40 per cent of the total population. Sufficient efforts are to be made to improve this situation, since the physical and mental stress of our population is very much increased due to this problem. The problem is acute in the rural areas and in the slum areas in the towns. Research pertaining to these major problems in the field of child development is to be taken up by the Faculty of Home Science.

Extension Education Programme

The message of Home Science education must reach every nook and corner of rural India. For that we may need a well informed agency with a spirit of dedication for the service to the community.

Home science education for extension personnel

Though in a very limited number, we have already a band of workers, working in the rural areas. With the economic development, development in communication etc. the nature of the demands of the rural families are becoming more sophisticated. The present workers with their academic qualifications are not in many cases able to answer to their demands adequately. The Faculty of Home Science in Agricultural Universities can play a very vital role in helping these functionaries by providing scope for higher training to them.

The extension personnel, implementing developmental programmes for the uplift of women and children in the State, are to be kept abreast of the latest information on the various aspects of Home Science and allied subjects. They are to be equipped with skills on innovations in the field of home practices. Training programmes (preservice, inservice, refresher), seminars, symposium are to be planned and conducted by the Faculty of Home Science for the benefit of the extension personnel.

Home science education for rural women

At present there is no definite programme by which knowledge and skill can be updated by rural women/women in slum areas for better economic utilisation of time, money and energy while attending to the routine work, entailing unpleasing back-breaking monotony.

Successful home making involves many responsibilities and talents on the part of women and in our country, education programmes are offered at the University level to impart scientific knowledge to women regarding ideal home making. But these programmes have limited value to our rural women, since their content is not fully oriented to our local conditions. Hence certificate courses on rural Home Science to provide adequate theoretical and practical knowledge in ideal home making to rural women to equip them to have a happy healthy fruitful life in a rural environment will be very useful. Such courses will help rural women understand their problems in ideal home making and will make rural women aware of the need for providing better environment in and around the home. On similar lines, on campus and off campus training programmes of different duration are also to be organised on various aspects of home living for the benefit of rural and urban women.

Distance education programme is one of the media through which our women can be reached. Such a course does not require the housewives to leave their home to acquire the knowledge. Moreover the knowledge and skills gained can be put to practical test in their own homes and can be disseminated to other members of the family and later to the members of the community. Thus distance education programme will be complementary to the efforts made through other media to educate a vast section of women. These programmes are to be taught by a combination of correspondence texts, radio, broadcasts and other audio-visual techniques such as records, cassettes, slides, filmstrips, etc. Adequate personnel contact programmes are also to be organised to bridge the communication gaps. Two correspondence courses on Better Infant Feeding Practices with UNICEF aid are already offered by the Department of Home Science. Distance education programmes on different aspects of Home Management, Food Science, Nutrition, Child Psychology, etc. can be tried.

Evaluation of developmental programmes implemented in the State for the benefit of women and children

In order to combat the problem of malnutrition and under nourishment among the vulnerable segments of our population, several developmental programmes are implemented in the State. The programmes have in operation in the State can be classified into three groups according to the agency of implementation viz. State Government, State Social Welfare Advisory Board and Voluntary agencies. As a result of the multiplicity in the number of agencies there is overcrowding and overlapping of the programmes. There is lack of meaningful coordination between different agencies. Detailed periodical evaluative studies on the operation of these programmes are essential to avoid the drawbacks mentioned. Since the Kerala Agricultural University is having a popular image of being more concerned in community development programmes than any other institution in the State, such studies as indicated above are to be undertaken by the Faculty of Home Science.

Popularising new foods

There are a number of recognised model research institutions like CFTRI in Mysore, engaged in research and development of food technology and then transfer. They have devised a number of products for the less privileged sections of the community. The infrastructure of many of these institutions do not stretch to ensure that the products are introduced among the less privileged populations. The Faculty of Home Science in the Kerala Agricultural University can take up suitable *ad hoc* schemes in collaboration with these institutions to popularise such new foods in the State and to find out the impact of these foods.

Mobile extension units

Systematic campaign is to be launched for the application of need for better food, health education and standards in living condition among the under-privileged section of the population. Mobile extension units can be designed for important campuses to bridge the gap existing between theory and its practical application in the field of Home Science.

Community canning centres

A lot of food is being wasted every year for want of proper storage facilities and preservation techniques. The poor communication between the scientific institutions and the actual user has to be blamed for this misfortune. It must be remembered that this country can hardly afford to waste food, since it has to feed millions of people. Therefore, low cost preservation techniques, which could be easily adopted at lower scale of production, are to be evolved and popularised. Community canning centres in important campuses of the University are to be proposed to encourage the preservation of perishable food crops for house consumption and spread the message of preservation among the people. These centres will offer service facilities as well as short term training courses in domestic methods of preservation.

Other programmes

Besides the major extension education activities discussed above, it is expected to take up the following programmes also under the extension education programmes of the Faculty of Home Science.

1 Publication of manuals/guides/newsletters etc. for field level change agents of different State Departments.

2 Publication of annual abstracts and reviews, research reports, research notes, etc. in the field of Home Science for the benefit of field workers.

3 Publication of technical bulletins useful for field workers and housewives.

4 Publication of visual aids such as charts, posters, graphics, cartoons, leaflets, folders-games, slides, mobile photo exhibits etc. and reviewing them from time to time.

5 Development of monitoring indicators and systems in the regular and regional exchange of information.

6 Development and application of models of community involvement in formal and non formal education.

7 Developing Home Advisory and Consultancy Service.

8 Participating in radio and television programmes in collaboration with AIR and Doordarsan for rural home makers.

Formation of a training cell with UNICEF assistance

UNICEF has sanctioned a training cell at a total outlay of Rs. 5.5 lakhs for a period of three years under the Department of Home Science to undertake various extension programme. By the effective implementation of programme it is anticipated to expand the activities of the training cell and to convince UNICEF as well as funding agencies, to elevate this to the status of a Training Institute in Rural Home Science under the Faculty of Home Science with the objective of imparting technical guidance to all the State Government Departments and voluntary agencies of the southern states in the implementation of various development programmes conducted for the uplift of women and children and of assisting the less privileged population of the society in improving their standard of living.

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Challenges of 2000 A. D and the Proposed Agricultural Engineering Faculty at Kerala Agricultural University

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1.0 Introduction

Agricultural Engineering is a vigorous hybrid of agriculture and engineering with dominant engineering characteristics. It relates to the scientific application of the principles of Civil, Mechanical, Electrical and Chemical engineering to the production and processing of crops, animals, fisheries and related fields.

The major objectives of agricultural engineering teaching, research and extension are:

1. To increase production and productivity through various engineering inputs like optimum development of water resources and irrigation facilities, proper irrigation management etc.

2. To reduce cost of production and processing through selective mechanisation and alternative energy utilisation as well as by minimisation of energy requirements.

3. To reduce drudgery without causing unemployment and social tensions through the creation of better physical environment.

The above three operations and objectives should lead to the increased economic return to the cultivators and increased employment generation in rural areas.

2.0 Increasing need for Agricultural Engineers

By the year 2000 A. D, which is only 15 years away, requirements for food, fibre, fodder and agricultural raw materials for industrial uses will be almost double (considering likely 50% increase in population and rise in standard of living). Table-1 gives the yield targets of some of the crops in 2000 A. D. These yield targets will require due engineering inputs. Intense watershed development and radical change in irrigation technology will be essential. To achieve this high yield levels, there will be a great demand on appropriate handling, processing, storage, marketing of the agricultural products. The dairy, meat and fish industries will also pose challenges of considerable magnitudes to the agricultural engineers of 2000 A. D.

The present milk production of about 25 million tonnes a year has to be increased to 64 million tonnes in 2000 A. D. Agricultural engineering has to play a vital role in dairy development by providing research input and expertise for animal structures, dairy machinery, cattle feed plant machinery and the economic use of animal wastes. To meet the increased demand of meat and poultry products, research and trained manpower will be needed for design of appropriate structures, hatcheries and processing and packaging of poultry produce.

Table-1

Estimated production of various important crops animal products and fisheries by the year 2000 A. D

Sl. No	Item	Area Million ha	production Million tonnes
1	Food crops	128	250
2	Cotton	11	12 (lint)
3	Jute	1	2.6 (raw jute fibre)
4	Oil seeds	23	25
5	Tobacco	0.5	0.75
6	Sugarcane	5	410
7	Fruits and Vegetables	12	104
8	Plantation crops	3	3
9	Fodder	15.5	600
10	Others	1	Not estimated
11	Fisheries (Inland & Marine)		8
12	Milk		64
13	Meat (from all sources)		2

These figures are according to the National Commission on Agriculture Report 1976.

Kerala has abundant resources for the development of aquaculture. Inland and coastal aquaculture has a great potential for increasing employment, income and nutrition. Engineering research input is required into the design and development of fish hatcheries, fish ponds, fishing gear, processing machinery, packaging, transportation and marketing.

3.0 Proposed Faculty of Agricultural Engineering to meet the Challenges of 2000 A. D

Realising the challenges of 2000 A· D and beyond and corresponding need of research and trained manpower requirements as well as non existence of any formal institute of imparting collegiate education in Agricultural Engineering in Kerala, the Article 19 of Kerala Agricultural University Act of 1971 states that the University shall have a Faculty of Agricultural Engineering and Technology. In persuance of this sacred Act, we, in the University, have taken initiative to meet the challenges of 2000 A. D through the creation of the Faculty of Agricultural Engineering. A 256 page full-fledged proposal has already been submitted to the University Authorities which is under active consideration. The copies of this proposal will perhaps be available to the interested engineers, scientists and administrators as soon as it is formally considered by the competent authorities.

A few salient points of the proposal as discussed in the above report are indicated below.

3.1 Teaching Programmes of the Proposed College of Agricultural Engineering (COAE)

Five distinct classes of academic programmes are envisaged and they are undergraduate diploma and degree, Postgraduate diploma, Masters and Doctoral studies Programmes in Agricultural Engineering. Short details can be seen in Table-2.

3.2 Research Programmes of COAE

The special features of Kerala's topography, soils, climate, land use, cropping pattern, socio-economic and agrarian characteristics are to be kept in mind while formulating relevant research programmes of the College and Faculty. Keeping the above perspectives, 30 specific thrust areas in Soil and Water Engineering and 20 specific thrust areas in other disciplines of Agricultural Engineering are identified. These 50 thrust area are over and above 28 thrust areas identified by Anand Rao Committee of ICAR.

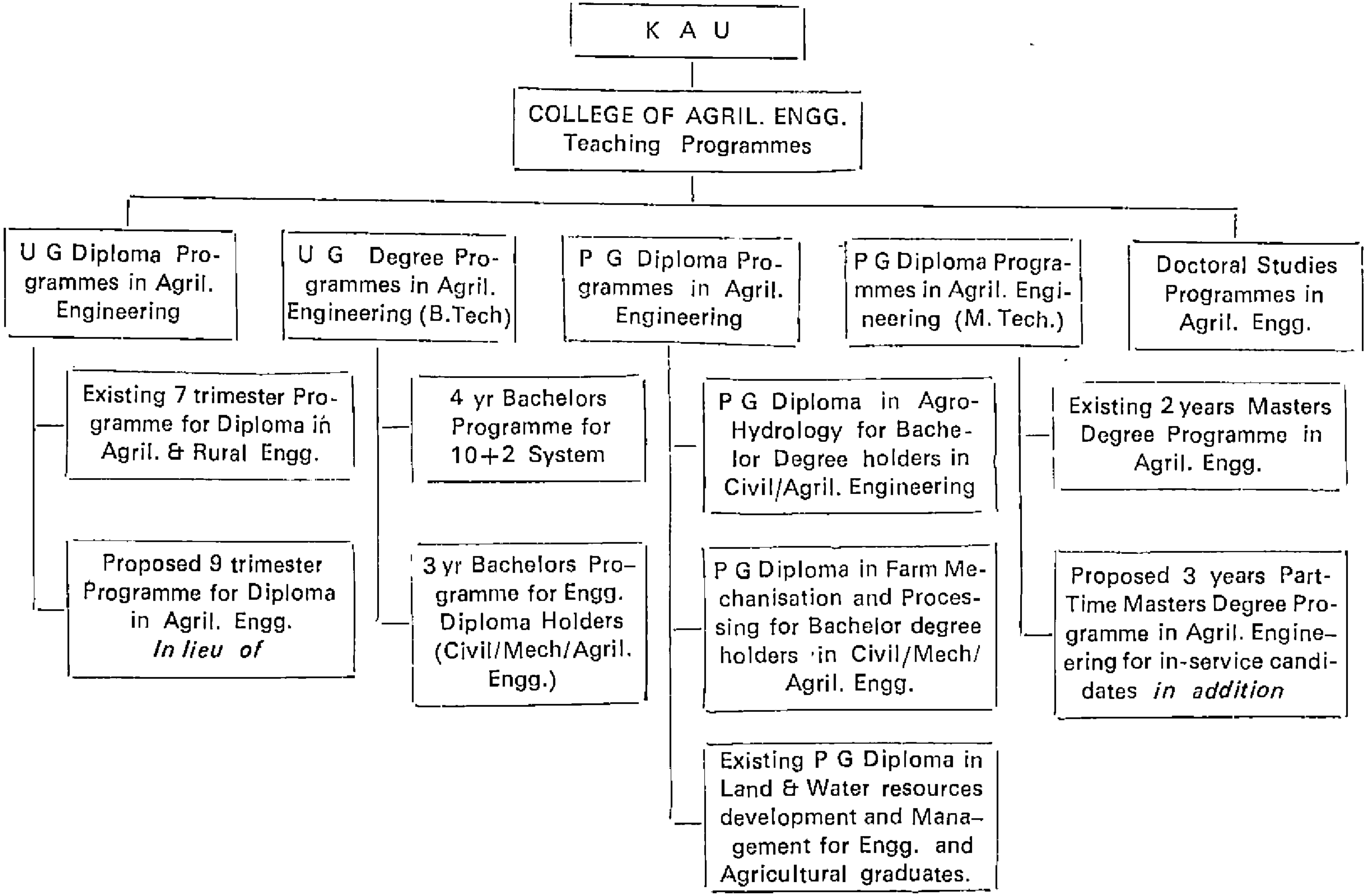


Table-2. Teaching Programmes of the proposed faculty

3.2.1 *Thrust Areas as identified by Anand Rao Committee of ICAR*

3.2.1.1 Soil & Water Engineering:

1 Soil erosion studies undulating topography in intense monsoon

2 Planning for Water Resources Development to convert single crop rice fields (which is more than 50% of the total rice fields in northern region) to double crop.

3 Subsoil moisture conservation.

4 Groundwater engineering—Design of tube wells and open wells relevant to northern Geology.

5 Conjunctive use of surface & groundwater.

6 Techniques to explore available moisture by adjusting sowing times to overcome drought hazard.

7 Problems of low rainfall and black cotton soils of Chittoor in Palghat district.

8 Efficient utilisation of water available (through large numbers of irrigation projects in Central Region) for multicropping.

9 Water Management Studies for irrigated, rainfed, single crop and double cropped rice areas.

10 Studies on the physico-chemical properties on impeded drainage and measures to improve drainage in such areas.

11 Methods of application of water.

12 Conservation studies on surface run off.

13 Studies on soil and moisture conservation in the homestead farms of southern region characterised by steep slopes and valley with well distributed rainfall parameters.

14 Water Management and Soil Engineering Problems specific to Kuttanad and Kole lands of Trichur–Water Logging and Salt Water intrusion problems.

15 Agricultural water management problems of Kayal lands and lands reclaimed from lakes.

16 Drainage and infiltration studies of Onattukara and Pokkali lands of Quilon, Alleppey and Ernakulam.

3.2.1.2 Post Harvest Technology and Agricultural Processing:

1 Post harvest processing of coconuts particularly those harvested during monsoon.

2 Processing of paddy in relation to quality of rice.

3 Utilisation of bye products of rice viz, rice husk, bran oil, bran, straw etc.

4 Physiological changes in tubers and measures to prolong the shelf life of tapioca tuber.

5 Cheap method of storage of tapioca in small quantity.

6 Storage pests and dried products of tubers.

7 Physiological changes in banana and pineapple in storage.

8 Methods prolonging the shelf life of banana and pineapple.

3.2.1.3 Farm Power and Machinery:

1 Development of tillage operations to conserve subsoil moisture relevant to various regions.

2 Design of improved axial and other pumps for dewatering operations of Kuttanad and Kole area.

3 Utilisation of wind power as prime mover for pumps in Kuttanad and Kole areas.

4 Design of implements and tools suitable for preparatory works in the rice fields and uplands.

3.2.2 *Additional Research Areas for the College of Agricultural Engineering:*

3.2.2.1 Soil and Water Engineering:

1 Development of rainfall simulator and studies of soil erosion through it, in simulated physiographic regions of the Kerala State.

2 Transport and erosion characteristics of overland flow.

3 Hydrological characterisation of small watersheds.

4 Design of Terrace system for soil and water conservation.

5 Design, development and testing of silt recording units.

6 Studies on bank protection with spurs.

7 Seepage through small dams.

8 Soil erosion and seepage studies under various vegetative covers.

9 Waste land reclamation and development.

10 Assessment, development and conservation of surface and groundwater in agricultural watershed.

11 Saline water irrigation and irrigation with sewage and waste water.

12 Soil water plant environmental relationship.

13 Irrigation economics—cost: benefit studies of various types of irrigation, re-use of water etc.

14 Design and installation of advanced methods of irrigation (like drip, pulsating etc.)

15 Water requirements of crops, tailoring of crop scheduling and irrigation schedules.

16 Evaluation of water production function and improvement of water use efficiency.

17 Tank irrigation with pisciculture.

18 Optimization of field bothies.

19 Operational research projects in various command areas.

20 Development of low cost water storage structures.

21 Water recycling in water shed.

22 Subsurface drainage—spacing and efficiency.

23 Ways and means to minimise (or maximise as the case may be) percolation and evaporation loss.

24 Control of groundwater table for land reclamation and agriculture.

25 Groundwater Hydrology—Aquifer properties, wells in hardrock and lateritic aquifers.

26 Remote sensing applications for surface water, groundwater and water quality delineation.

27 Forest Hydrology.

28 Hillslope Hydrology.

29 Slope stability, caving and landslide preventive measures.

30 Contingent planning for droughts and floods.

3.2.2.2 Farm Power and Machinery (including Energy and Post Harvest Technology):

1 Mechanisations relevant to small paddy farming systems.

2 Mechanisation relevant to upland and hillslope farming.

3 Improvements in bullock driven ploughs and other agricultural implements.

4 Mechanisation of dehusking operations for arecanut and coconut.

5 Utilisation of solar and bio energy for water lifting systems.

6 Biogas for cooking and mini agriculture operations.

7 Energy from agricultural waste and utilization of agricultural wastes for making paper, brick and other useful items.

8 Harnessing solar energy for water heating, cooking, refrigeration and air conditioning.

9 Weedbased biogas and its utilisation.

10 Weed control through mechanical system.

11 Development of equipment systems for tillage and harvesting for special regions of Pokkali, Onattukkara, Kuttanad and Kole lands.

12 Development of manually operated paddy transplanter.

13 Equipment system for the tillage of soil for coconut and arecanut plantations.

14 Improvement in the mechanisation of pesticide and fertiliser applications to various agricultural and horticultural crops.

15 Improvisation of driers for paddy, coconut etc.

16 Handling and packing practices for agricultural products.

17 Dairy and agricultural housing systems.

18 Storage engineering for perishable and semi-perishable items.

19 Rural transportation systems.

20 Management in crop production, handling and marketing.

3.3 Extension Programmes of COAE

23 major areas of relevant extension programmes are identified for the Faculty and are given below:

1 Demonstration of techniques for selection, installation maintenance and repair of pumping sets.

2 Demonstration of equipment for land grading (animal/power)

3 Field demonstration in lining of water courses and field channel and allied structures.

4 Field demonstration on the installation of underground pipe line for water conveyance on the farm.

5 Field demonstration of techniques of construction of tube-wells in the coastal belt, lateritic midlands and rocky highlands of the State.

6 Demonstration of water and soil moisture measuring device.

7 Establishment of demonstration farms/operational research for integrated soil water management practices including drainage.

8 Field demonstration/operational research of groundwater recharge techniques.

9 Field demonstration of improved water lifting devices.

10 Field demonstration/operational research of soil conservation procedures and structures for soil conservation and irrigation.

11 Field demonstration of improved implements and practices.

12 Preparation of technology transfer material and information regarding improved on-farm equipment and practices.

13 Guidance/consultancy to the farmers on procurement, operation and maintenance of improved equipment.

14 Training to farmers and rural artisan on operation, fabrication and maintenance of simple farm equipment.

15 Consultancy to small scale equipment manufacturers on production of improved farm equipment.

16 Demonstration of improved post-harvest equipment and practices.

17 Consultancy to rural entrepreneurs taking up agro-processing activities.

18 Creation of awareness about post-harvest losses and potential of increased income through post-harvest technology.

19 Introduction and popularisation of improved storage and storage practices.

20 Demonstration of devices run by solar energy, biogas and other nonconventional form of energy.

21 Demonstration and popularisation of rural sanitation techniques.

22 Demonstration of low cost rural housing and farm structures.

23 Training and basic rural electrification problems.

3.4 Organisational Set up of the COAE

To meet the requirements of 2000 A. D. and effectively persue the teaching, research and extension programmes of the Faculty, 5 Departments, 5 Central Units and 16 Specialised Laboratories are envisaged. Basic structures of the envisaged set up is shown in Table-3.

3.5 Manpower and Space Requirements of COAE

Over and above the project staff, the core staff of the College will consist of 84 in the technical cadre and 77 in ministerial cadre. The minimum covered and open space requirement will be of the order of 36000 square meters and 50 hectares.

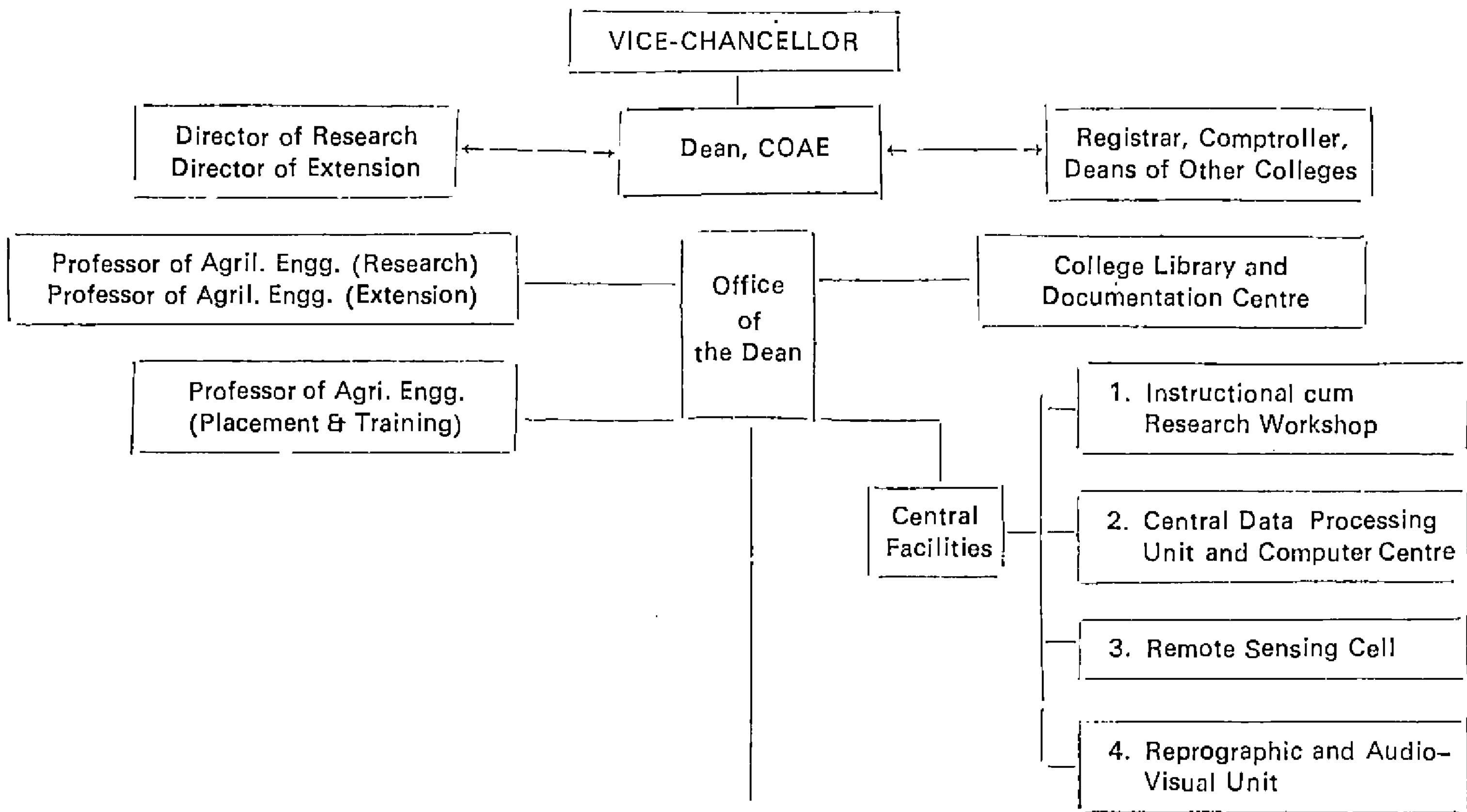
3 6 Location of the College

To avoid duplication of manpower, infrastructure and consequent financial burden as well as for effective utilisation of already created under utilised facilities, it is recommended not to locate the college outside the existing 5 teaching campuses of the University.

3.7 Financial Implications

Total capital investment for the college will be of the order of 677 lakhs spanned over 4 years. The distribution of this 677 lakhs is 540 lakhs for buildings, 76 lakhs for departmental labs, 45 lakhs for Central Facilities and 16 lakhs for Vehicles. If the college is located in one of the existing teaching campuses, then there will be saving to the extent of facilities which may be translerred for the exclusive use of COAE. A preliminary estimate indicate that if COAE is established at IAT Tavanur, then the capital investment will be limited to Rs. 500 lakhs i.e, there will be a saving of Rs. 177 lakhs apart from the fact that it will also give an opportunity to utilise the underutilised large laboratory, workshop, hostel, library and other building complex existing in the IAT Campus.

The recurring expenditure for basic core staff will be of the order Rs. 50 lakhs per year.


VICE-CHANCELLOR
Director of Research
Director of Extension
Dean, COAE
Registrar, Comptroller,
Deans of Other Colleges
Professor of Agril. Engg. (Research)
Professor of Agril. Engg. (Extension)
Office of the Dean
College Library and Documentation Centre
Professor of Agri. Engg. (Placement & Training)
Central Facilities
1. Instructional cum Research Workshop
2. Central Data Processing Unit and Computer Centre
3. Remote Sensing Cell
4. Reprographic and Audio-Visual Unit

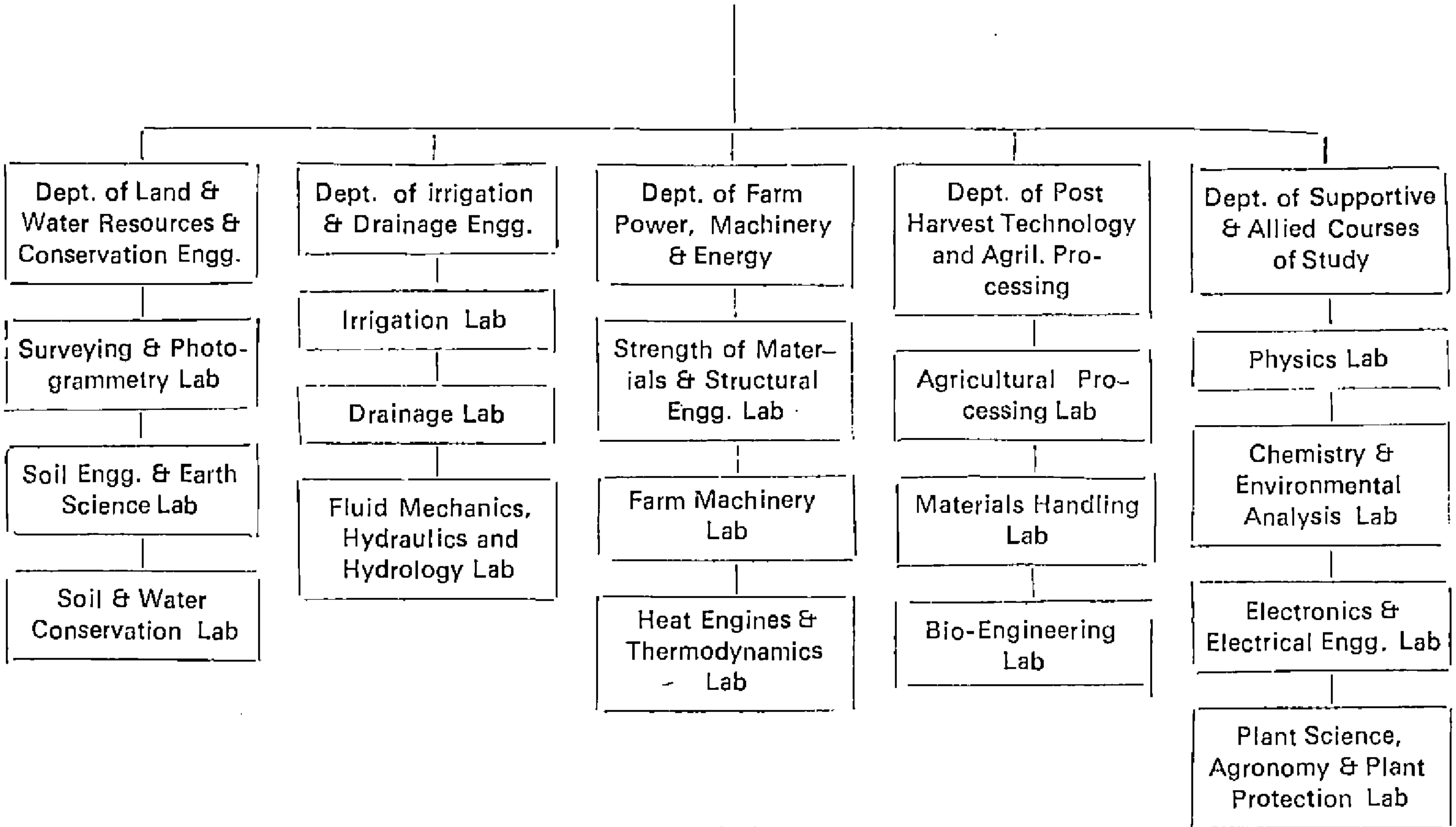

Dept. of Land & Water Resources & Conservation Engg.
Surveying & Photo-grammetry Lab
Soil Engg. & Earth Science Lab
Soil & Water Conservation Lab
Dept. of irrigation & Drainage Engg.
Irrigation Lab
Drainage Lab
Fluid Mechanics, Hydraulics and Hydrology Lab
Dept. of Farm Power, Machinery & Energy
Strength of Mater-ials & Structural Engg. Lab
Farm Machinery Lab
Heat Engines & Thermodynamics Lab
Dept. of Post Harvest Technology and Agril. Pro-cessing
Agricultural Pro-cessing Lab
Materials Handling Lab
Bio-Engineering Lab
Dept. of Supportive & Allied Courses of Study
Physics Lab
Chemistry & Environmental Analysis Lab
Electronics & Electrical Engg. Lab
Plant Science, Agronomy & Plant Protection Lab

Table-3

D. Satellite Papers

a) Research

26

Environmental Scenario in Kerala in 2000 A. D.

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Engineering College, Trichur

ABSTRACT

Projection of a few of the aspects of environment such as water, energy, urbanisation and agriculture in Kerala in 2000 has been attempted. If we continue the present life style, and method of utilisation of raw materials and energy then the year 2000 would dawn with numerous collosal problems!

Introduction

Kerala State, with a geographical area of 30,870 km^2 and with the highest population density in the country, had a population of 16.90 million in 1961, 21.35 million in 1971 and 25.40 million in 1981. The projected population for the State in 2001, as per Decreasing Rate of Growth Method, would be about 30 million. The nation has a population of 670 million in 1981 and it is projocted that it would be about 940 million in 2001. If the above rate is assumed for Kerala, the population in 2001 would be 35 million. These projections are only approximate. However, these figures give us a guidance for planning our future activities.

It is not only the quantitative increase that may affect our resources, but also the qualitative changes and rates of demand per capita, that may stress the environment.

In the case of environmental and ecological system, the relationships between various physical and biological parameters are nonlinear. As such it is difficult to give a correct picture of 2000 from the mass of data, we presently have. Still an approximate picture could be painted and this is one such attempt. The projection herein tried is with regards to water, water pollution, energy, agriculture and urbanisation.

Water

Out of the estimated total run off of 78,041 Mm^3/ annum only about 42,772 Mm^3/annum would be utilisable in Kerala. The domestic demand in 2000 can be assumed as 150 lcd. The present suggested national average for domestic water supply is 135 lcd for urban areas and 70 lcd for rural areas. Since Kerala is located in a rainfed humid region and the people are habituated to use more water than their counterparts elsewhere in the country for personal cleanliness, a figure of 150 lcd has been assumed for both rural and urban people in 2000. Based on the above assumptions, the total daily demand would be:

350 x 150 mu lit = 52.50 Mm^3

The annual demand would be:

52.50 x 365 = 19162.5 Mm^3

Say 19,000 Mm^3

This works out to be 45 per cent of the available surface run off in the State. The ground water source amounting to about 5850 Mm^3, has been utilised in more or less satisfactory way.

The industrial water demand in the year 2000, would increase to about 20 per cent of domestic demand as against the present rate of 8 to 16 per cent. This would aggravate the problem still further.

The quantity of water needed for irrigation, power generation and other purposes would also be enormous. Kerala has about 1.5 M ha under paddy and coconut, which require irrigation facilities during non-monsoon periods. The demand for irrigation has been projected as about 2400 Mm^3. Thus the total quantity of water required for domestic, industrial and irrigation purposes works out to be, 19000 Mm^3+3000 Mm^3+2400 Mm^3=25,200 Mm^3.

In this calculation, the quantity required for power generation has not been included. For thermal power generation about 1 Mm^3 of water would be required for each MW of installed capacity.

Water pollution

It has been documented that presently more than 0.5 Mm^3 of industrial effluents are released into the bodies of water in Kerala, each day. This works out to be about 1.80 Mm^3/annum. These effluents exert high BOD on the water, besides their toxic effects on aquatic flora and fauna. During the year 2000 this volume would also be higher if we adopt the present technology. Thus if we assume that waste flow would increase to two times the present quantity, the effluent volume/annum=360 Mm^3. The volume of domestic sewage from urban areas and agricultural fields would also make up the total bulk of waste water. Assuming that only 10 per cent of the domestic water supply emerges as waste water, the volume would be 1900 Mm^3. We can ignore the agricultural run off.

Thus total waste flow/annum = 2260 Mm^3.

The minimum volume of surface water required for dilution of treated effluent is about 20 times the effluent volume. Thus the run off required to abate pollution = 2260 x 20 = 55200 Mm^3

Now we can add up the water requirements in 2000 AD, as 25,200 + 55,200 =80,400 Mm^3.

The available supply would be only 42,772 + 5,850 = 48,622Mm^3
From the above calculations, we get the grim picture.

By the year 2000, the water resources available would be just half of what would be needed if we follow the present style of life and technology.

So it is imperative that we must practice utmost economy in water use in domestic, industrial, irrigation and power generation activities. Dry methods of production must be practised. Effluent recycling must be enforced. Irrigation by waste water must be adopted. Then only we can make both ends meet, with regards to water.

Energy needs

The energy crisis will loom large on the people of the year 2000. Kerala even now has one of the lowest per capita consumption of electricity in the country. This picture may change. The bulk energy is obtained through hydel power. Presently the installed capacity of generating units is 1011.5MW. The total identified hydel potential including Mini and Microhydel projects is about 3750 MW. By 2000 A. D., we may require a total installed capacity of 4000 MW, about 4 times the present installed capacity. Besides, commissioning all the hydel projects, we must start work on a 250 MW thermal plant, inspite of its heavy pollution potential. Utilisation of organic wastes for biogas generation and utilisation of the same at individual/community level must also be encouraged. Wind energy must also be tapped urgently.

Urbanisation

Rapid urbanisation is not a phenomenon peculiar to Kerala alone. Kerala has certain problems of its kind. From the point of view of life style, per capita consumption of good materials, water and energy and density of population, Kerala is considered as a large urban area. However, from the points of view of detached living owning, individual plots, wells and so on it looks rural. The population increase may affect the extent of our paddy fields and forests. Now itself our paddy fields are getting converted into gardens, building plots and quarries for clays and sand. This trend is bound to increase in 2000. Such a devastation may adversely affect the run off, percolation and evaporation. The greenary may be affected to large extent. Forest encroachment may be on the increase, So proper protection of forests must be ensured.

The extent of forests in Kerala has been evaluated as 24 per cent of the geographical area. Of this 24 per cent, the natural forests constitute less than half the other half being plantations and degraded forests. This state was sustaining forests covering more than 40 per cent of the geographical area, the bulk of which has been devastated by plantations and encroachment. Reservoirs have submerged about 0.6 per cent of the total forest area and another 0.6 per cent has been utilised for other purposes during reservoir construction. Compared to this 1.2 per cent, the destruction of the forests to the tune of 50 per cent or so has been accomplished by planters, encroachers and the forest department. Thus it is unscientific and illogical to correlate between hydel construction and forest decimation. There are innumerable examples to prove this fact. Deforestation for harvesting timber must be stopped forthwith. The vegetal cover must be increased. If the present trend continues, probably Kerala will present a withered look in the year 2000.

Agriculture

As per 1978-79 data the area under agriculture in the state is about 2.2 M. ha. In future this area would shrink considerably. Agricultural practices must be tuned to the climatic setting of the state. If the present trend continues, the manure, fertilizer, pesticides and top soil loss from agricultural land will be on the increase. This, ultimately fills up our water bodies and may create problems of eutropication and floods. Contour ploughing and silt traps and fencing by herbs and plants must be practiced. During monsoons, ploughing must not be encouraged. Canopy trees must be planted throughout in order to reduce soil loss by blasting rainfall.

Conclusion

A few of the environmental parameters have been touched upon in this discussion. If the present style of life continues, the year 2000, will not present a pleasant picture. Shortage of water, land, forests and energy would be felt on an increasing scale. The concept of utilisation of waste water and waste matter has to be changed. It must be considered as a resource and reused. Waste water must be used for irrigation and replenishment of ground water. Afforestation of vacant lands must be done on a war footing. Besides commissioning all the hydel schemes, we must start work on an oil fired thermal station of 250 MW capacity. At the same time strict discipline and economy must be practiced in energy utilisation. Individual houses must be discouraged. Instead flats must be built and national area conserved. Community kitchen and dining halls should be encouraged instead of the practice of individual cooking. Cloth washing and such other activities must also be done on a community scale. This would conserve energy. Mass transport facilities must be made available. And private ownership must be stopped gradually. The enlightened community must own all the facilities and services and run the same for the community. Extravaganza must be avoided in all activities. With a limited geographical area, limited water resource and limited material resources and an increasing density of population, Kerala will face many problems in the year 2000, if we do not discipline ourselves properly. The State must own the responsibility of running all services directly and not through private ownership. Unless this is done from now onwards, we may not be able to cope up with the challenges in the year 2000.

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Agricultural Research in KAU 2000 A. D.

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Dr. S. R. Sen, a well known Agricultural Economist of India, recently emphasised the need to focus attention on small farms below two hectares, which constitute 75 per cent of 80 million operational holdings in the country. The pressure of population and inheritance laws that provide for equal shares to all children, are bound to result in further fragmentation of holdings. Dr. sen believes that it would be desirable to divert capital from non-developmental and long-gestation programmes to the small farms and related sectors. Technological innovations suited to small farms will be necessary for the ultimate improvement of agricultural situation in the country.

In Kerala the per capita operational holding has already reached the lowest level (0.11 ha). The unique system of homestead farming, predominated by a variety of perennial crops singles out the agricultural situation in Kerala from the rest of the states in India. Multiple and mixed farming in these small holdings will continue to be the characteristic feature of agriculture in the state in 2000 A. D. The problems that the KAU scientists will have to face in 2000 A. D. are, therefore, complex and complicated. The greatest challenge before the scientist will be how to tackle the manifold problems of these small farms.

The system concept

The agricultural research and development programmes will have to be reoriented so as to instil the 'system' concept in the minds of planners, scientists and administrators. Although there has been a growing realisation of these facts in recent times, a break-through in the approach to solve the situation is yet to be made. The greatest mistake which we have done in the past and that we continue to carry forward knowingly or unknowingly, is the single crop or 'monoculture' concept. This 'exotic' concept is redundant and has no relevance in our State. The research programmes of the K. A. U. have to be so modified as to tackle the problems of our particular farming system. The totality of the 'system' rather than its components in isolation, should be emphasised in our research programmes. The individual crop study should be aimed at to gain intimate knowledge of that crop, so as to fit in a most conducive system. The 'crop specialist' idea, that is, moulding a scientist solely for one specific crop based on all India pattern, appears to be unsuitable under our situations. Quite a large amount of data has already been generated in several major crops of the State. However, the gap between the actual production and the potential production appears to be distressingly on an increasing trend.

The problem oriented research and basic research

It is true the research of the Agricultural University should necessarily concentrate on the problems faced by the farmers. The real problem before the scientist is to exactly identify the problem of the farmers. The major problem I believe is how to tackle the overall farm development in the homestead farms, of which I have already made a mention earlier. We have at present prescriptions for fertilizing or plant protection of several individual crops. Think of a situation of a farmer who has 30 cents of land with a miscellany of crops like coconut, banana, pepper, arecanut, one mango, few cocoa and a couple of nutmegs. Do we mean to say that the farmer should purchase half a dozen pesticides and fertilizer mixtures in the process of management of this crops? Should he also advocate a variety of methods to incorporate his fertilizer into the soil and to spray the chemicals on the plants. This I believe is an example of problem in all its totality. Therefore we will have to develop simple technologies suited for the whole farm so as to make our recommendations effective for implementation.

The University cannot just be satisfied by merely carrying out field experiments with short term perspective alone. It should be realised that the very fountain of applied research will dry up if sufficient attention is not given to fundamental research also. There is considerable scope to make a complete analysis of the existing research programmes in KAU so that necessary changes are effected before the dawn of the 21st century.

The University as a seat of learning and research

The University should serve as a centre of highest learning and research. Our contribution in research in the ultimate analysis should not be judged merely on the immediate results; but also on what probable impact a finding could make on the furtherance of research including applied research. It is in this respect I lay greater emphasis on the postgraduate education and research. The standard of postgraduate education is a reflection of the competance of the Departments and ultimately earns name and fame to the University. The future standard of research and teaching in K. A. U., I believe, largely depends upon the quality of postgraduates that we produce from the Institutions of K. A. U. The famous Universities, the world over, including Agricultural Universities are known by strong Departments headed by competent and devoted teacher-scientists. The KAU has a greater responsibility now to build up Departments keeping in pace with modern times. Our traditional thinking should not stand in the way of creating new departments and institutions. New ideas have to be absorbed and old set up modified, if necessary, in the process of making a University. Let us not merely copy things from our neighbours, but at least in 2000 A. D., let the KAU be the model for others.

The set up of the research stations may also need change by 2000 A. D. It would be worthwhile to develop the present Regional Research Stations as University Centres, where in addition to research, postgraduate education can also be imparted. In the process of these Institution building, we may have to consider whether it is necessary to continue the several non-viable units as research stations.

The multidisciplinary approach

Proliferation of departments leading to narrowing down the field of specialisation of individual scientist is bound to occur in the process of scientific development. However, in a developing country like India over-specialisation may not be desirable. In Kerala, with its peculiar system of farming, over-specialisation at least in agriculture may not yield the desired results. The multidisciplinary/inter-disciplinary approach for the interaction of scientist from different disciplines will have to be ensured by proper institutional set up. Establishment of Centres of Excellence encompassing related disciplines or crops, and creation of multidisciplinary departments appear to be steps in the right direction.

The dynamics of scientific outlook

The scientific outlook cannot remain static and the scientist can no longer confine himself within the four walls of their laboratories. The K. A. U. Scientist should be aware of his social obligations, besides being politically conscious. Divorced from the changing trends, his scientific pursuits will have little relevance to the society. Ecological preservation, environmental protection, ecosystem development, biosphere reserves, genetic engineering, tissue culture, high density planting, tree architecture, farm forestry are only few of the areas in which there has been a greater awakening throughout the nation. The agricultural scientist in KAU will have to rise to the occasion and plan his scientific studies with a vision on the changing trends in scientific outlook. In the process of increasing production of agricultural/horticultural crops, we will be more and more confronted with problems on environmental pollution and eco-system preservation. Perhaps by 2000 A. D. many of our present day prescriptions will be outdated or will be banned out of social compulsions. This is a situation every agricultural scientist should well be aware of at the turn of the century.

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Agronomy—Prospects in 2000 A. D.

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Food production has been our highest priority ever since the beginning of the five year plans. Eventhough the food production has increased to a record 150 M. T. in 1983-84 our production has to be doubled with the turn of the century in order to catch up with the population growth rate of 2.5 per cent. With practically no scope for bringing more land under cultivation, the future production increase should mainly come from (1) increased irrigated area (2) multiple and alternate cropping and (3) increased productivity per unit area. As one of the densely populated states of the country and with one of the lowest per capita availability of land, the task ahead for Kerala is colossal. The annual growth rate of production of foodgrain between triennium ending 1961-62 to 1981-82 is only 1.1 per cent in Kerala as compared to the national average of 2.2 per cent. A concentrated effort on the part of all concerned with agriculture is urgently needed to overcome this stale mate in food production. Looking ahead of 2000 A. D. the agronomists' immediate tasks can be categorised as follows:

(a) Enhancing the ceiling to yield

Raising the ceiling to yield coupled with stabilizing the output is of utmost importance taking into consideration unavailability of more area for cultivation, economics of farming, energy needs and employment generation. Considering the gap between recorded yield of crops obtained in agricultural experiment stations and the average yield in farmers' field, the immediate pay off will come from the transfer of technology. In order to make this technology transfer more easy and effective multidisciplinary adaptive research has to be conducted, as being done at Kuttanad by KAU. The high yielding variety coverage is only 50 per cent in the first crop season and 30 per cent in the second crop season. The main reason for this low coverage of HYV is due to want of suitable varieties to cater to the different situations. The Department of Agronomy and Plant breeding have to be collaborated for attaining 100 per cent coverage with HYV by 2000 A. D.

There are further scope for improving the yield potential by studying the basic mechanisms of C assimilation, better understanding of dry matter, partitioning between grain and other plant parts for manipulating source-sink relationship and increasing nitrogen harvest index.

(b) Soil fertility

Fertilizer consumption per ha of gross cropped area in Kerala is only 33.3 kg as against 35 kg of the national average. In addition to the nutrients removed by crops, the large quantity of nutrients lost through leaching and soil erosion, leaves a huge net deficit of nutrients for crop production. Application of organic manures and biofertilizers can help in maintaining soil fertility at a satisfactory level. However, because of high cost and non availability, organic manures are not being applied in substantial quantities for crop production in Kerala. More attention is to be given for renewable source of organic matter like azolla, blue green algae, green manures and crop residue management. There is enough possibility of increasing the quantity of fertilizer used per unit area. One way of increasing fertilizer consumption is to provide high yielding fertilizer responsive varieties to suit varying conditions.

Fertilizer use efficiency is generally low because of improper agronomic practices. The fertilizer response for grain production is very poor in Kerala as compared to other states of the country. It has been estimated that even one per cent increase in efficiency of N would result in a saving of 1.5 lakh tonnes of nutrients, equivalent to more than a million tonnes of food grains. Utmost emphasis should be immediately given for increasing fertilizer use efficiency, not only taking into consideration the energy crisis, but also due to the environmental pollution problems. Intensive research on increasing the efficiency of P and K fertilizers are also to be carried out. Ways of increasing fertilizer consumption as well as use efficiency in uplands are also to be seriously thought off. Choosing the most suitable type of fertilizers for dryland situations have to be given importance as evident from recent findings that complex fertilizers gave increased efficiency under rainfed conditions than straight or mixed fertilizers. Conducting detailed investigations on the physio-chemical properties of various soil types in relation to crop nutrition and studies on the soil fertility improvement and management of problem soils of Kerala are other areas which need priority.

(c) Water management

For exploitation of yield potential the very base is an efficient water management system. The irrigated area in Kerala is only about 14 per cent of the net cropped area and this needs to be increased substantially towards the turn of the century. However, just constructing irrigation projects does not solve the problem. In most of our irrigation projects, there exists a wide gap between the development and utilization of irrigation potential. Development of command area does not keep pace with construction of irrigation systems. In fact agricultural Universities and research institutes should undertake anticipatory research on optimum water use pattern taking into consideration the soil and climatic parameters of the region. Unfortunately because of lack of such anticipatory research, we are not able to derive now full benefits from the water resources for several years after the creation of the resource.

Equally important to the irrigation water management is the rain water management as 70-80 per cent of the area under cultivation is rainfed. Continued research on matching the crop needs with water availability, conserving soil moisture through mulching and manipulating tillage practices, enhancing soil water storage, collection, storage and recycling of run off water have to be given priority on future research. Water requirement research of various crops and techniques for increasing the water use efficiency under varying 'agro-climatic conditions and involving and managing cultivars with considerable degree of stress tolerance are to be given importance.

Eventhough Kerala has excess rainfall in S.W. monsoon, the lack of proper drainage often limits crop production, especially under low lying situations. Research on the drainage requirement of crops, especially rice is in its infant stage has to be strengthened by 2000 A. D.

(d) Organic farming

Animal husbandry component has a great role to play in enriching the soil fertility of the cropping system. So also fisheries will have immense potentialities in rice farming and waterlogged areas. An integrated approach of crop husbandry, animal husbandry and aquaculture will have to be given due emphasis in the coming years.

(e) System approach

All the efforts in research so far had been oriented on the basis of individual crops. However, because of the highly fragmented and small holdings of the farmers of the State an approach relevant to the entire cropping system is to be considered. The ultimate aim here should be to produce maximum biomass per unit area per unit time. A system approach research will be more relevant for future agriculture, taking into account the complementary and non-competitive aspects of the different crops involved. The important areas which need much attention are:

i) Multiple cropping systems

With the judicious water management more number of crops can be taken from the same plot of land. Selection of most suitable crops in sequence taking in to consideration human nutrition, soil fertility, pest and disease problems and formulating agronomic practices like nutrient, water and weed management for the entire cropping system as a unit are to be urgently undertaken. Plant breeders should try to evolve "period specific" crop varieties to fit into most profitable cropping sequence. More emphasis on organic recycling and residue management are to be given under such a cropping system.

ii) Rainfed cropping system

Absence of an alternate technology in case of aberrant weather was much evident in Kerala during the recent drought. The usual crops which solely depend on an assured rainfall either could not be cultivated, or there was a total crop failure. Contingency plan should be developed and introduced to minimise such risks of total crop loss. Seed and fertilizer research have to be done so as to make the adoption on alternate cropping strategies and compensatory programmes under such conditions. It is also necessary to find most profitable alternate crop sequences under such situations. There are many under-exploited plants with much economic values, which are to be screened and suitable cultivation methodology formulated.

iii) Mixed and intercropping systems

Under Kerala conditions mixed/intercropping is a rule rather than an exception. The right combination of crops taking into account the major complementary effects like efficient interception of sunlight, tapping of nutrients and moisture from different depths of soil profile, non-overlapping, susceptibility to pests and diseases and biological N fixation are to be chosen. Breeders have a great task of inducing these complementary characters for the success of the system.

iv) Multilevel and three dimensional cropping systems

Though Kerala is the main arthitect of such an intensive form of cultivation the initial enthusiasm seems to have died off in recent years. The main reason for this is the non-availability of suitable crops to fit into such a system. Shade tolerant varieties of intercrops are to be screened and bred to fit into such a system, so that the competition between the component crops are minimal or zero. Introduction of grain and fodder legumes will provide feed for animals and thus there is a need for strengthening farm management research to suit individual farmer's need.

v) Agroforestry

This is an area which has got much relevance under Kerala condition where forest wealth is declining at a fast rate. The farm forestry will have to centre around the predominant crops like coconut in the homestead. Suitable silvicultural, silvi-horticultural and agri-silvi horticultural systems have to be developed.

(f) Soil conservation and management

The recent landslide in Wynad is a reminder of the grave danger due to the neglect of soil, which played havoc with the lives of thousands of people. The recent study by the Government team found that the entire geomorphic province of Wynad was in danger of recurrent landslips. If the disastrous problem is ignored, it may perhaps result in non-availability of any soil in the valleys, undulating plains and irregular hill slopes in the not too far distant future.

There are engineering methods for preventing soil erosion but are either costly or difficult on a large scale. Agronomic aspects of soil conservation can very well supplement the engineering methods for an effective soil conservation programme. Mulching, strip cropping, cultivation of trees on contours and selection of erosion resistant crops like congosignal are some of the methods worth considering. Some research have already been initiated in *taungya* system of cultivation. There is further need in investigating different aspects of this system under varying situations.

(g) Weed control

Being a humid tropical region, the weed infestation problems are very severe in Kerala. Moreover, the weed problems of various plantation crops remain more or less uninvestigated. A detailed survey to identify different weed species of Kerala, studying its biology and formulating an effective integrated weed management system incorporating all the available and suitable control measures need to be urgently undertaken.

Aquatic weed control is yet another major thrust area where the research is to be focussed. Special care has to be bestowed in suggesting control measures which are not harmful for the aquatic fauna and also keeping in mind the problem of bio-magnification of the pollutant.

(h) Agrostology

Due to limitation of availability of land exclusively for largescale fodder production in Kerala, a complete integration of fodder crops with other traditional crops should be thought off. The fodder should be cultivated as a complementary crop. The cultivation of perennial grasses and legumes will have to find a place in the homestead farming.

Though goat farming is popular in the northern districts of Kerala, lack of availability of good quality fodders in sufficient quantity, especially in summer months, is a major bottleneck. Drought resistant fodder crops have to be evolved to suit these tracts of the State.

Attention on non-conventional fodders such as water weeds, paper wastes etc. has to be focussed in collaboration with animal nutrition department.

(i) Seed technology

It is a branch of Agronomy where no emphasis has been given so far in the State. Seed testing procedures have to be standardized for all important crops. Absence of good seedling evaluation technique resulting in poor quality seedlings in cocoa, cloves, nutmeg etc. is rampant. Research on the choice of best planting materials for tapioca, sugarcane, sweet potato, etc. has to be intensified.

CONCLUSION

The impact of population growth on the size of the land holdings as well as on land fragmentation will be the important single factor governing agriculture in Kerala in future years. Thus improving the farm management efficiency as measured by productivity per day per unit of land and water should be emphasised in the coming years. The outlines discussed above include investigation of short, medium and long-term nature with perspectives to 2000 A. D. Many of the aspects listed above call for interdisciplinary action and given the requisite professional skill, resources and encouragement the desired food-population balance could be achieved towards the turn of the century.

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Ecologically Sound and low-cost Pest Management Methods for the Future

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ABSTRACT

Effective, sound and low-cost pest management methods are required to protect crops and stored commodities from depredations caused by pests without adversely affecting the quality of the environment. Utilisation of moderate level of host plant resistance and biological control using parasitoids, predators and microbial pathogens and development of novel methods of control using plant products, possessing insecticidal/antifeedant/hormonal/repellent/attractant properties should form the core of the management strategy of the future. There is tremendous scope for exploiting the insectistatic principles present in neem (*Azadirachta* indica) and Chinaberry (*Melia azedarch*). The search for cheaper ideotypes of insecticides should be continued actively. Innovations in the manufacturing process should be brought about to reduce the production cost of pesticides. Key intermediaries required for pesticide manufacture are to be recognised and their local sources identified. Novel application equipment and devices capable of rapid field coverage without causing drift hazards are to be developed.

It is widely recognised that crop production measures are of vital importance to realise the production potential of crops in tropics. In spite of heavy investment for crop protection, the ravages caused by pests continue to be heavy due to wrong choice of insecticides and faulty application techniques. By the turn of the century, insect control operations are likely to become more and more expensive due to escalation of cost of insecticides and increase in application costs. Unless we develop sound, effective and low-cost technologies for pest management using safer materials, it would be impossible to sustain production levels without adversely affecting the quality of the environment. Insecticides have become an important tool for crop protection and the requirement of insecticides for maintaining the present food grain production of 150 million tons is estimated at 20 lakh tons of technical grade materials per year. The impact of these toxicants on the environment is quite obvious. Due to steeply increasing cost of raw materials which are mostly petrochemicals and also due to increase in the manufacturing and development costs, the insecticides are becoming prohibitively expensive. The economic returns from pesticides are no longer what it used to be before. The dwindling returns make it very difficult for the small and marginal farmers to use synthetic organic insecticides. Integrated pest management strategies are to be adopted by putting together all ecologically sound, less expensive, effective and feasible methods such as host plant resistance, use of insectistaticides such as antifeedants, repellents, pheromones, hormones, antihormones, etc., which are preferably of plant origin, adoption of biological, cultural and physical methods etc. Concurrent adoption of all these methods will keep down the pest population levels well below the economic threshold levels. Synthetic organic insecticides will be required only if populations exceed economic threshold levels or to contain sporadic epidemic outbreaks.

The strategy for the future should be to develop sound alternate methods which are safer to the ecosystem. Vigorous research efforts are to be stepped up to work out such alternative methods for future pest management programmes

Cultivation of resistant varieties of crops is considered to be an important adjunct to other management methods. Host plant resistance is a practical and effective method of pest control over large areas. This method has the unique advantage of ensuring insect control at all levels of pest infestation and does not involve any extra expenses to cultivators or cause environmental pollution problems. Remarkable achievements on host resistance have been made in South India in controlling the rice gall midge *Orseolia oryzae* and the rice brown plant hopper *Nilaparavata lugens*. The successful control of the rice gall midge over extensive areas in the Warangal belt of Andhra Pradesh using resistant varieties has been well recognised by farmers. In cotton, maize, rice, sorghum and wheat, strong sources of resistance have been developed. The remarkable field tolerance of Triveni to BPH and the moderate level of resistance in Karthika and Pavizhom varieties of rice to BPH have been very well established. Some of our tall *indica* varieties such as PTB-21, PTB-18 and PTB-33 have earned international reputation for resistance to all known biotypes of BPH.

In many cases, resistance may be due to antixenotic or antibiotic chemicals which have profound effect on the host plant selection, feeding and ovipostitional behaviour. Studies on the basis of resistance and the identification and characterisation of such substances can lead to the development of commercial formulations based on such principles. Substances such as dihydro-L Solanin, Solaculin and Soladulcin in potatoes, meliantriol and azadirachtin in neem *(Azadirachta indica)* tomatin in tomato, 2-tridecanone in wild tomato, 6-MBOA in corn, medicagaric acid in alfalfa are naturally occurring products which are worth commercial exploitation for pest management. Moderate level of resistance will be preferable to absolute resistance as the former will support adequate pest populations to ensure the sustenance of the associated parasitoids, predators and microbial pathogens. Sequential release of crop varieties with major genes for moderate level of resistance is the ideal strategy to counteract development of newer biotypes of pests. Multiline resistant varieties are useful for epidemic buffering.

If varieties with moderate level of resistance to one or two of the major pests could be developed, bio-control can form a strong component of the IPM systems in Kerala. This is possible because the use of insecticides can be reduced substantially in such a situation, thereby making the environment very much less hazardous to the natural enemy complex. The indigenous parasitoid and predator fauna as well as the microbial pathogens associated with major pests are to be identified through extensive surveys. The promising ones are to be conserved and augmented so that these operate as key biotic stresses against the pests.

Development of resistance in perennial crop will be a slow process and in such crops, considerable stress is needed to step up bio-control efforts. In Kerala, this is particularly needed in coconut, cashew, coffee, mango, and cocoa. Utilisation of baculoviruses for the control of *Oryctes rhinoceros* Linn. and the red palm weevil *Rhynchophorus ferrugineus* F. and larval and pupal parasitoids such as *Eriborus trochanteratus, Bracon brevicornis, Parasierola nephantidis* and *Brachymeria* spp. will be extremely useful to reduce pest population explosions. The utilisation of the redunid predator *Scycanus collaris* which is indigenous to Goa for the control of the tea mosquito bug infesting cashew appears to be worth exploration in the State. In coffee and cocoa the mealy bug *Planococous lilacinus* Ckll. is a very serious problem in the State. The use of coccinellid and lycaenid predators for controlling these bugs appears to be quite promising. Biological control measures are to be explored for the management of the idocerine jassid complex consisting of *Amritodus, Idioscopus* and *Idiocerus* which causes very serious losses to the mango blossom.

Interesting and exciting leads have been obtained on the utilisation of plant sources for insect pest control. Natural products of plant origin have been found to be preferable because of their bio-degradation, relative abundance and low cost. Insect control agents of plant origin are classified as toxicants, hormone mimics, antifeedants, repellents and attractants. These materials appear to be the appropriate choice for future crop protection. Among the plant sources reported to possess insecticidal and insectistatic properties the neem *Azadirachta indica,* China berry *Melia azedarch* (*Meliaceae*), sweet flag *Acorus calamus* (Araceae), malabar nut *Adatoda vasica*, red been vine *Abrus* precatorius (Fabaceae), Indian privet *Vitex negundo* (Verbenaceae), *Annona reticulata* and *A. squamosa* (Annonaceae) and *Parthenium hystrophorus* are relatively more important.

All parts of the neem tree, particularly, the kernels and leaf contain the triterpenoids Meliantriol and Azadirachtin which are strong feeding deterrents to grasshoppers, locusts and several caterpillar pests of crops. Neem kernel suspension (NKS) at 0.1 to 0.3% ensures complete protection of crops against invasion and feeding by the desert locust *Schistocerca gregaria*. The suspension is very good for the protection of tobacco and vegetable crop nurseries against caterpillar pests. NKS at 10% strength is found to protect developing grains from massive invasion by birds. Application of neem cake to standing water in rice fields promotes growth of blue green algae by controlling ostracods and crustaceans that feed on the algal mat. The cake is also effective against the rice root nematodes *Hirschmanniella oryzae* and oligopods feeding on rice roots. Neem cake infusion provides protection to vegetable crops against foliage feeding insects. Extracts of neem cake in cold aqueous alcohol possess very high degree of feeding deterrancy against insects. Emulsified neem oil at 25% strength applied as ULV sprays at 4 L/ha provides protection to the rice crop against the rice leaf folder *Cnaphalocrocis* *medinalis*. Alcoholic concentrates refined from a 5% ethanol extract of kernal contains 23% crude bitters and this is available for field testing against crop pests. Mixing powdered neem kernel with stored grains and pulses at 1–2% is found to be effective in protecting these commodities against numerous pests.

Neem is a hardy tree which grows well even on poor soils. The present production of neem oil in the country is about 83,000 tonnes/year. There is tremendous scope for utilising neem products for pest control without causing any eological disruption. The tempo of research on the commercial exploitation of neem derivatives for pest management needs to be stepped up. Extensive studies on the feeding deterrents of neem are currently in progress at the Max Planck Institute of Biochemistry and at the Justus Liebig University at the Federal Republic of Germany. In India, work on this is on hand at the National Chemical Laboratory, Poona. The China berry *Melia azedarch* is next to neem, in its potential for use in pest management. Dry rhizomes of sweet flag (Acorus calamus) contain the glucoside Acorin which is as toxic to insects as DDT. Dry rhizome bits mixed with stored grain provide protection against pests infesting grains and grain products.

Partbegin occurring in the troublesome terrestrial weed *Parthenium hysterophorus* is found to be a general antifeedant against many lepidopterous pests and insecticidal in action against termites and cockroaches. The cyanogenic glucoside Durin occurring in tapioca peel is also reported to possess strong antifeedant action against crop pests.

Studies on the identification and characterisation of insecticidal principles in China berry, malabar nut, red bean and the Indian privet are to be taken up to exploit these sources for insect pest management.

Vegetable oils are very effective in the protection of leguminous seeds against infestation by storage pests, particularly, the most troublesome beetle *Callosobruchus chinensis*. Smeering the seeds with groundnut oil at 15–20 ml/kg of seed is the most effective and least expensive method of protecting cowpea and other leguminous seeds from pulse weevil infestation. Non-edible oils from Mohwa *(Bassia latifolia)*, Karanjia *(Pongamia glabra)*, Palash *(Butea frondosa)*, rubber *(Hevea braziliensis)*, Punna *(Calyophyllum inophyllum)* and ratanjyot *(Jatropha curcas)* are to be evaluated against storea product pests such that their application for the protection of pulse grains meant for seed protection could be standardised. The oil soap prepared from Karanjia (honge) *(Pongamia glabra)* is popular in the Karnataka State for control of soft bodied pests such as aphids, hoppers and mealy bugs. Soaps from other non-edible oils are also to be tested extensively for their insecticidal properties.

Screening of chemicals for feeding deterrency or repellancy is to be continued actively to identify promising candidates for insect pest management. Aromatic amines are known to suppress feeding activity by the BPH on rice. Chlordimeform (Galecron) which has a chemical structure similar to aromatic amines is found to cause feeding inhibition to the brown plant hopper even at a very low concentration of 10 ppm. Copper stearate and copper resinate, triazines, organotins and dithiocarbamates are also reported to posses similar properties. These materials are very much less expensive and are not hazardous to man and livestock.

Novel methods of pest management such as use of pheromones, chitin synthesis inhibitors, sterilants, etc., are to be exploited in a massive scale for future adoption. Chitin synthesis inhibitors such as diflubenzuron and triflumuron interfere with the synthesis of chitin, a component of insect cuticle and thus prevent the formation of fresh cuticle after the moulting process. The chitin synthesis inhibitors are more effective against insects with complete metamorphosis. These compounds being selectively injurious to lepidopterous insects, are considered safer to the parasitoids, predators as well as to productive and useful insects.

Plant sources are to be extensively explored for the presence of auxiliary substances such as solvents, dispersing agents, emulsifying agents, stabilisers and synergists so as to bring about reduction in the manufacturing cost of pesticides. Dillapiole, an undesirable constituent of the oil of *Anenthum sowa* is found to be a good substitute for piperonyl butoxide which is useful for synergising pyrethrum. A process has been developed for converting Indian turpentine oil to synthetic pine oil which is used for making solvents and synergists. Terpenes, alcohols, esters, essential oils are reported to be attractants for some crop pests. A chemical P-methyl acetophenone isolated from the rice plant is found to be attractive to larvae and adults of the striped rice borer.

Control strategies for a pest management system are based on estimates of pest population densities. The sex phenomones of the respective species are useful for surveying areas of infestation, monitoring population levels, as mass-trapping agents and also as mating suppressants through confusion technique. Sex phenomones of the pink boll worm of cotton (*Pectinophora gossypiella*) and cotton boll worm *(Heliothes armigera)* have been characterised and these are utilised for the above purposes.

In order to develop less expensive and safer insect management methods for the future, Juvenile Hormone (JH) and Juvenile hormone mimics occurring in plants are to be utilised extensively. In insects with complete metamorphosis, contact with JH, JH-analogues or JH-active substances prevents attainment of adulthood. Methoprene, a potent analogue of JH is used in developed countries for the control of mosquito larvae. JH-mimics occur extensively in plants. Neem, *Parthenium* sp., and *Aegeratum* spp. have been reported to contain such substances. Potent inhibitors of JH such as Procecone-2 can also be used for pest management by blocking the activity of JH in insects. In adults, JH is indispensable as a gonadotropic hormone and blockage of its activity in adults will adversely affect insect fecundity.

Organic insecticides are to be used in crop protection whenever pest populations cross economic threshold levels. The ideotype insecticides of the future should have a toxophoric molecule which acts selectively on different targets in insects and these should be non-hazardous to mammals and beneficial fauna. The faster bio-degradability is an ideal attribute for the insecticides. Synthetic pyrethroids such as deltamethrin, cypermethrin, permethrin, constitute a group of new insecticides that have very high insecticidal activity, low mammalian toxicity and faster bio-degradability. They are bio-active at very low dosages of 10-20 g ai/ha and are less polluting to the environment. At present the cost of synthetic pyrethroids is prohibitive for an average farmer. Innovations in their manufacturing technology can be brought about to reduce the manufacturing cost to the extent possible. Recently the National Chemical Laboratory, Poona has developed a technology for the manufacture of Indothrin a synthetic pyrethroid. It is very necessary to develop indigenous manufacturing methods for key insecticides which are of considerable value in crop protection. New processes for the manufacture of chlordane, dimethoate, endosulfan, ethion, fenitrothion, imidan, menazon, nicotine sulphate, monocrotophos, diazinon, DDVP, quinalphos and phenthoate have been developed in the country. It is also necessary to initiate research to identify alternate sources of key intermediaries which are required for the production of insecticides.

The efficiency of pesticides very much depends on the thorough coverage of the target plant parts without causing hazards to the persons who are applying the toxicants. By the turn of the century, labour for insecticide application will become very scarce and the application charges are, therefore, likely to increase considerably. Development of improved models of sprayers and dusters which can be easily operated without drift hazards is an urgent necessity. Electrodyne sprayers and dusters in which droplets and dust particles are electrically charged as these escape the nozzle, are very advantageous to avoid drift hazards and to ensure better target coverage. In these, the spray/dust particles are charged opposite to the plant charge and hence there will be better target coverage. Pesticide containers provided with ULV dispensing devices can be developed for easy application of soluble concentrates and ready-to-use emulsions.

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Ecologically Sound and Low-cost Pest Management Techniques

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Demographic projections of the world populations done by UNO shows that it is likely to reach 6500 millions by 2000 A. D. If birth rates do not decline significantly during this period it could reach 7200 millions. If the birth rate decline is extremely rapid it may stop around 5950 millions. The increase in population will be more rapid in less developed countries than in developed countries. FAO has estimated that food production should increase four per cent per annum to keep pace with the population growth, but recent productivity has fallen far below this target.

Food production can be increased either by expanding the land under cultivation or by increasing the yield per ha. The extension of cultivable area will necessitate heavy capital investment too which is far beyond the capacity of many developing countries. Obviously the easier alternative will be to increase productivity.

In intensive cultivation the increased loss caused by pest needs no emphasis. Although the magnitude of losses by pests (insects, rodents, birds, weeds, bacteria, fungi, viruses, mycoplasma, nematodes, etc.) has not been adequately measured in developing countries pre-harvest and post-harvest crop losses have been estimated by FAO as around 30 per cent. Even in most developed agricultural countries they are still large. Pests also play a vital role in limiting the livestock production and in transmitting many dreadful contagious diseases among human beings.

The rapid change in the world food supply between the abundance in 1950s and 1960s and the acute shortage felt after the poor harvest of 1972 and 1975 led to the realisation of the urgent need to increase production by the international bodies. The United Nations World Food Conference held in 1974 and the General Assembly Session in September 1975 had emphasised the magnitude of the pest problems in limiting agricultural production and the need to suppress the loss not only for protecting the present food production but also the increased food production that will be possible in the years to come.

Ever since man started raising crops for his daily food he had been meeting the challenge from pests. For thousands of years he could do nothing against these pests depriving him of his valuable commodities. Slowly he learned how to improve his conditions through trial and error experiences. Even before the emergence of crop protection sciences man evolved many cultural and physical control practices many of which were found to be scientifically valid eventhough they relied on empirical methods. Such methods include sanitation,t illage to destroy over wintering insects and inoculum, removal of alternate host of pathogens and insects, use of trap crops, fertilizer and water management etc.

Today we know that appropriate use of these cultural methods can reduce the damage potential of many diseases and pests. But many pests with high damage potential could not be checked effectively by the above methods or their combinations. As biological knowledge grew between the eighteenth and nineteeth centuries and as pest problems became more severe due to an intensification of agricultural practices man had to make an intensive search of more effective pest control measures. Various chemicals and concoctions were recommended for the control of insects and diseases as early as 18th century. Though the principle of plant resistance to insect pests and diseases were known earlier deliberate development of pest resistant varieties was not possible until the discovery of Mendel's law of heredity in 1900.

The success of chemicals and host resistance in controlling plant pests set aside the importance of cultural control. The discovery of synthetic organic pesticides (Chlorinated insecticides, OP compounds and carbamates) tempted the Entomologists to recommend exclusively the insecticides for solving all the pest problems. This excessive reliance on synthetic pesticides went unabated for 5 to 15 years in different parts of the world. For a while the practice boosted the yield of a large number of cultivated crops particularly in developed countries where the crops were raised under a thick pesticide umbrella.

Pesticides were proved to be the most reliable tools for preventing crop losses and to enable the farmers to produce good yields of high quality crops. Under intensive production technology, it was widely felt, that the high yielding crops could no longer be cultivated without intensive pesticidal use. Undoubtedly the so-called insecticidal revolution has been an enormously fortunate event in human welfare. But the overenthusiasm of the entomologists and chemists led to a complete ignoring of ecological considerations in pest control.

Soon it was realised that the unilateral use of any control procedure can have unintended side effects in the agro-ecosystem. The excessive use of chemical pesticides lead to complications such as hazards to people, pest resistance to pesticides, emergence of secondary pests, pest resurgence, deleterious effects on non-target organisms, environmental pollution, etc.

Awareness of the undesired effects of pesticides in the human environment led the plant protection scientists to evolve a new pest control strategy with restricted use of chemical pesticide. That approach led to the 'pest management concept' which is a philosophy and methodology to restrict pest numbers to non-injurious levels. Integrated control is the term used interchangeably with pest management in U. S. A. This prevents pest losses with the long term objectives with regard to economics, society and the environment. Most of the available techniques for pest management are not new. Exploitation of plant resistance, cultural control, microbial pesticides, genetic control, chemosterilants, pheromones, hormones, repellants, antifeedants, electromagnetic energy etc. are done in the pest management system. Quarantine, eradication and regulations are also used as legislature tools in pest management.

The development and management of an integrated pest management system requires a multidisciplinary approach. Modern computer technology and 'system analysis' provides a means by which the resulting tremendous volume of complex information from several .disciplines can be integrated and synthesized into a practical viable strategy.

Though the integrated pest management is ideal ecologically and economically (from the point of view of the cultivators) there are limitations to this approach (1) information available on the ecosystem and various pests are often very meagre (2) time and significant expenditure will be involved in developing integrated approaches (3) pest management techniques are not justified in all situations. The intensive use of pesticides on cotton has induced several problems leading to an economic disaster situation in many developed contries. This led to new research efforts in controlling the major pests which had already developed resistance to the organochlorine insecticides and some to O. P. (Organo phosphorus) compounds also. The research has focussed on the development of resistant varieties, natural enemies, microbial pesticides, pheromone traps and other control tactics.

The use of system analysis and computer models have been resorted to for gaining understanding of system interactions and the consequences of applying the different control tactics. The ultimate goal of modelling is to imitate and represent all occurrences that take place in a particular cotton field or group of fields at any given time from planting till harvest. This can be used for predicting fertilizer, pest control etc., for optimising the yield for the farmer. This sort of analysis has been developed for a number of pests in developed countries. This branch of science in its infancy is likely to solve some of the most difficult pest control problems in future. Researches leading to the development of such technology for our crops suffering heavily from pest incidence should be our strategy for achieving ecologically sound pest control techniques.

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Crop Diseases of Kerala and their Control Strategy for 2000 A. D.

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Diseases pose very important, if not the most important, problem in crop production in Kerala. The production of rice, coconut, arecanut, tapioca, pepper, rubber and other important plantation crops is greatly hampered by several diseases of known and unknown etiology. The causal factors of these diseases may be inanimate or animate agents or viruses and / or combination of many such factors. Although the different principles of plant disease control, viz., avoidance, exclusion, eradication, protection, resistance and therapy and the methods of plant disease control; viz,. cultural, physical, chemical, biological and legal methods based on the above principles were sufficiently well known, traditional plant pathologist has always over emphasised the pathogen and under emphasised the host and studied the life cycle of causal agents individually with a view to find out their most vulnerable point. Epidemiology was generally concerned with the mechanism of spore dispersal and simple weather factors considered usually in isolation. Only in recent studies on epidemiology the population dynamics and interaction of both host and pathogen are taken into consideration. We have to study this as a system and the pathosystem is as complex as any other system. This type of systems concept in Plant Pathology is relatively new. A system is anything comprising of constituent components interacting together and functions in a coherent way. Systems analysis has to be conducted to achieve improvement in systems management. This type of systems analysis and management are essentially multidisciplinary.

The pathosystem is a dynamic system. Such a system can have stability only if it has systems balance. The systems balance can be achieved by systems control and control involves communication between units of a pattern. Plant pathosystem is essentially a subsystem of the eco-system and is defined by the phenomenon of parasitism which involves all the hosts and parasites of the eco-system. In a natural or wild pathosystem the systems control is achieved by the communication between the three basic components of the pathosystem, viz., the host, pathogen and the environment. But in an artificial or crop pathosystem a fourth component is also involved, viz., the man. The plant pathosystem analysis must compare the artificial pathosystem with the natural pathosystem and our pathosystem should aim at restoration of the systems balance, which is very important in natural pathosystem and is very conspicuously absent in artificial pathosystem.

The application of plant protection chemicals usually provides only temporary control of parasites and they must be frequently reapplied. In a similar manner most of the breeding for resistance has evolved only temporary resistance. These indicate that they were mostly mismanagement of pathosystems. A very efficient pathosystem management is done in the case of sugarcane in Hawaii. Apart from the chemical protection of the seed setts once in every fourteen years the Hawaiian sugarcane crop is grown without the use of pesticides and there is no serious crop loss due to parasites. To achieve such success in the pathosystem analysis we have to conduct very detailed analysis of the pathosystems.

By detailed study of pathosystems, we can prepare models which are simplified representation of systems. Therefore, a model also can be regarded as a system. As Kranz (1974) defined, a model can be a verbal statement, a hypothesis, a theory or law. Models are means of expressing one's opinion about a system. There can be more than one model for a system. The preparation of conceptual models is the first step in making a model and it aims at arranging the available information in a sensible manner for critical analysis. The conceptual models provide the sequence of operations and the decision making level and it also gives an empirical idea on the system and the factors that interact influencing the system's behaviour.

Geophytopathological models

Geophytopathological models are also conceptual models on disease spread displayed diagrammatically by maps and signs. This type of model is a three dimensional analysis of disease involving prevalence or severity, space and time. These will be useful in locating the primary foci, to evaluate varietal reaction, weather parameters and in disease forecasting. These maps will have isochrons which indicate the source and nature of disease spread in relation to space and time. Joshi *et al.* (1974) tried to correlate the isochrons with isotherms. This has been done in the case of rust diseases of wheat in north India and this type of work can be done for other diseases of other crops also by 2000 A. D. The Commonwealth Mycological Institute has published a number of such maps indicating the distribution of different plant diseases. Isodemic lines in these types of maps may reveal the probable direction of disease spread. Such maps can be used for the purposes of prognosis and forecasting of diseases.

Bioclimatic models

By monitoring the relevant weather parameters and then relating them to disease development, prediction models can be developed and these are known as bioclimatic models. The so called Dutch rules were proposed during the early part of this century to predict the out break of late blight of potato about one week earlier. Similar criteria can be formulated in the case of many important diseases. The "Indian stem rust rules" formulated by Nagarajan and Singh (1975) is an example of such possibilities and in 1976 they successfully developed an empirical method to predict the occurrence of stem rust of wheat about one month before its appearance in the field. Similarly Nagarajan *et al.* (1979) have developed a model to predict brown rust also. Work on these lines are also to be taken up by our University for the important diseases of Kerala.

Synoptic models

The long distance spread of many pathogens depend on certain definite upper air conditions. Based on the synoptic weather charts and the correlations drawn on the occurrence of diseases, warning systems can be developed.

Linear or holistic models

In practice, completely linear relationship does not occur between variables in the case of plant diseases. A regression model postulates a linear additive relationship between concomitant and dependent variables. But the disease growth in the lag and plateau stages is not linear.

Multiple Regression Analysis

Multiple Regression Analysis (MRA) can be used for the development of predictive models. But we have to reduce the number of concomitant variables to minimum. The holistic approach takes the epidemic as a complete and self-contained system. We can reduce the regression equation to less than three or four concomitant variables. Otherwise we can test with all the concomitant varibles and gradually eliminate the one variable after another till there is no appreciable change in the regression value. Kerr and Rodrige (1967) developed a linear equation in this manner to predict blister blight of tea. MRA has been widely used for forecasting the incidence of cereal rusts, apple scab, coffee betry disease, coffee rust etc.

Deterministic and stochastic type of models

Deterministic models are those formulated on the basis of the inference that epidemics are determined by antecedent causes. Most of the models are, by and large, deterministic type. But stochastic model give the probability associated with each possible outcome in epidemics.

Simulations

Analytical solutions to many complex problems can be arrived at by using electronic data processing systems. But enough data should be available to find out the analytical relationships of many epidemiological problems. Simulation is the use of mathematical models to quantitatively reproduce some aspects of real world (Kranz and Hau, 1980). That means simulation is the use of a model under specific set of conditions. When simulation is attempted with the aid of computer it is known as computer simulation. Simulators may not provide a solution for all problems, but they will help to understand the system in detail. At first we have to prepare a schematic diagram indicating the sequence of events in the disease development. Then we have to make flow diagrams showing the various phases of interaction. Eventhough this sounds simple, usually for many epidemiological questions there exist no analytical relationship due to paucity of data. When large number of variables are in line epidemic results and if many variables are out of line the epidemic may be mild or altogether absent.

Weather is an imporant factor which continuously influences the development of an epidemic. For the sake of convenience we can use the movie makers technique of slicing up the action into discrete frames in this case also. We can slice the weather data for a growing season into 3 hr slices, 8 per day and 7 days per week. This gives about 700 periods per growing season. Each slice of weather is recorded in a computer card and such cards provide the computer memory for 700 periods. The temperature, rainfall, humidity, wind speed, information regarding whether the leaf is wet or dry etc. will be indicated for every 3 hr period. Then we can provide the computer the data on how the pathogen in question and the host would respond to these weather variables. For example we can give information regarding the temperature curve for spore production germination, penetration, lesion enlargement etc. to the computer. Based on these items of information provided to the computer it may be possible to predict whether there will be an epidemic in a given set of conditions.

'Blitecast' is such a computerised potato late blight forecast model being operated in the eastern U. S. A. written Fortran IV. The farmer telephones the computer centre the following details.

1 Maximum and Minimum temperature of the day
2 Number of hours with more than 90 per cent humidity
3 The maximum and minimum temperature when humidity was 90 per cent.
4 Rainfall during 24 hrs to 1 mm accuracy.

The computer operator feeds the details to the computer. In about 3 minutes the computer analyses the weather data and gives the information as to spray or not. Such prediction systems are there in many advanced countries. Such type of systems have to be prepared in the case of diseases affecting our crops also.

In brief the following are the measures to be taken by 2000 A. D. by Plant Pathologists for the control of crop diseases.

1 To minimise the use of pesticides
2 Manipulate management practices for less disease incidence
3 A well organised forecasting system which each individual farmer can utilise to the maximum extent.

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Future Strategy in Plant Disease Control

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The green revolution ushered in by the introduction of high yielding varieties and improved farming technology, has brought in certain limiting factors like higher incidence of certain pests and diseases. Continuous monoculture of genetically similar plants forms a congenial environment for the development of pathogenic micro-organisms well adapted to the genotype of the host plant. Such an environment provides the pathogen with a substrate that is continuous both in space and time. Thus, a disease which is not particularly destructive on plants growing in a diverse ecosystem becomes more destructive on plants growing in intensive monoculture. The increased application of chemical fertilizers which are essential for cultivation of the high yielding varieties, further aggravates the situation in unduly favouring the development of pathogenic micro-organisms. In our country alone, plant diseases account for 26 per cent of the annual estimated total loss of Rs. 5,000 crores due to pests, diseases and weeds (Dharam Vir, 1981).

The aim of this paper is to identify possible logical approaches to plant disease control in the future. It is a known fact that in the present set up, man has 'to live with the disease' and hence, it should also be the aim of plant pathologists to manage the disease by utilising all the available practices, instead of always trying to "cure" or "eradicate" the disease. Such an approach will be a much more economically feasible one.

To begin with, a systematic approach to diagnose the disease is essential. Logical and efficient disease management is always based on accurate knowledge of the host-pathogen-environment complex. Fry (1982) has suggested a systematic procedure to diagnose a plant disease, which is:

1 Observing the problem

2 Formulation of a hypothesis to explain the observation

3 Testing the hypothesis

4 Adoption or revision of the hypothesis.

Plant pathologists have, indeed, been following more or less the same method for plant disease diagnosis. But, lack of a more scientific approach could be the reason for the prevalence of a number of diseases with unknown etiology.

The next step is to create theoretical base for disease management. The incidence and severity of the disease in a plant population may vary with time and environment. There is, therefore, a need to develop analytical models to facilitate plant pathologists for developing disease management strategies. Such models should help to identify disease cycles and the nature of epidemics.

On the basis of data obtained by diagnosis, the first step in disease management is to reduce the amount or efficacy of primary inoculum. Quarantine is one such measure and has been in vogue all over the world in some form or other. But repeated entry of newer diseases into newer localities has discredited this approach to some extent. There is an urgent need for more efficient quarantine measures. Mathys (1977) has suggested that for efficient quarantine operations, the world may be divided into large regions rather than every country enforcing its own quarantine. Such a system will help to restrict the entry of newer pathogens into larger areas.

Use of certified, disease-free seeds or planting materials is another essential approach in keeping the plant disease at low bay. This, coupled with cultural practices like destruction of alternate and/or collateral hosts or other sources of inoculum will help in reducing economic losses due to plant diseases.

In tropical countries, especially where sunlight is in plenty, efforts must be made to trap solar energy to inactivate/control plant pathogens. Experiments conducted recently in Israel, have indicated that mulching moist soil with polyethylene sheets during summer months could raise the soil temperature to such an extent as to inactivate or kill soil borne plant pathogens, like species of *Pythium*, *Phytophthora* and *Verticillium* (Katan, 1980). When applied properly, the solar heat treatment not only reduces the population of plant pathogens, but also aids in weed control.

Electromagnetic radiations and other sophisticated technology including laser beam treatment can be utilised for plant disease control (Raychaudri and Verma, 1977). Plant viruses have been inhibited in tissue culture, by incorporating radioisotopes into culture media. This approach is now being extended in the control of post-harvest fungal diseases especially of peaches, straw berries and tomatoes (Roy *et al.* 1973). Ionizing radiations, including electromagnetic energy with wave length less than 100 nm (eg: X-ray and gamma ray) are sufficient to kill pathogen or host cells. Generally, the susceptibility of fungi to ionizing radiation is much less than the hosts. Success has been obtained only for surface fungal infections and there too complete control of rots cannot be achieved by radiation doses within the tolerance limits of fruits and vegetables. Therapy of seed-borne infections generally is not possible because the pathogens are more resistant than the seeds. However, the control of loose smut of barley by irradiation of seeds with gamma rays renews the need to study this problem from a different angle. Combinations of radiation and chemotherapy may be one such approach. Captan combined with radiation could prevent the progress of blackrot infection in apples (Roy and Mukewar, 1973.)

Biocontrol is another strategy which has been recognised as an effective means of disease management. Plant protectionists are now devoting greater efforts to develop biocontrol techniques (Baker and Cook, 1974; Bruehl, 1975). Use of antagonists like *Trichoderma harzianum* and *Laetisaria arvalis* has been useful in controlling *Rhizoctonia solani* and *Pythium* spp. (Elad *et al.*, 1980; Odvody *et al.*, 1980). Initial reports on biocontrol effects of mycorrhizae have been encouraging (Marx, 1972). Endomycorrhizae afforded some protection in sweet orange plants against infection by *Phytophthora parasitica* (Davis and Menge, 1980). Unfortunately, reports on field scale experimentation on this aspect are few; but, this approach may be useful for the control of soil borne diseases.

Cross protection technique also offers good scope for control of plant diseases. This technique is being utilised in the control of swollen shoot of cocoa and citrus tristeza (Thresh, 1958; Costa and Mueller, 1980). Broadbent (1976) reported 10 per cent increase in yields of greenhouse tomatoes by using a mild strain of TMV (MII-16) selected from wild type TMV, treated with a mutagen. Cross protection is also being attempted in Tamil Nadu, against bunchy top disease of banana.

Meristem culture is yet another new approach which may be useful in future plant disease control programmes. This technique involving isolation of disease-free cells and utilising them for developing seedlings, will be useful for raising disease-free/disease-resistant plants. Meristem culture alone or in combination with heat has been successfully employed to eliminate viruses and MLOs from a number of crop plants (Kassanis and Verma, 1967; Kartha and Gamborg, 1975). This technique has a profound scope in developing disease resistant clones for the control of root (wilt) disease of coconut.

Mutation breeding is being pursued for the development of resistant clones/varieties. Irradiation with gamma rays and also chemical mutagens can be tried for obtaining disease resistant clones, especially of plantation crops like cardamom, pepper, tea, coffee, etc.

In chemical control of plant diseases, target hitting systemic fungicides used in combination with non-systemics, may prove more useful to overcome the problem of resistance by pathogenic micro-organisms. Highly potent fungicidal formulations having better residual toxicity, even during rainy seasons, are needed for effective field control of plant diseases. Encapsulated formulations with slow release of the toxic component may also prove useful to control recurring plant diseases. Improved plant protection equipment for use under diverse conditions should also be developed for obtaining better coverage and efficient control of plant diseases.

The recent trend in the control of plant diseases, phanerogamic parasites and insect pests, especially of tree crops, through injection of suitable pesticides and other chemicals needs special mention. Plant diseases like lethal yellowing of coconut (McCoy, 1982) and sandal wood spike (Raychaudhuri, 1977), insect pests like black-headed caterpillar and red palm weevil in coconut (Natarajan and Channa Basavanna, 1977) and phanerogamic parasites ofteak (Ghosh *et al.* 1984) are being controlled by tree injection of suitable chemicals. Attempts are also being made to control root (wilt) disease of coconut through injection of antibiotics. There is immense scope for application of injection technique with cheap easy-to-operate devices for the control of diseases, pests and nutritional disorders of perennial tree crops.

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Nematode Pests—
Their Importance and Relevance to Kerala's Agriculture

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Introduction

Plant nematology, because of its peculiar subject as well as its specific methodologies, must be regarded as distinct agricultural science. As a science its development was relatively slow. But the rapid strides it has made with contributions for the advancement of agricultural production, encouraged several developed countries to take up studies on nematode pest problems of their cultivated crops to boost production. This has resulted in the increased awareness of the subject and it is now recognised as a limiting factor in agricultural production.

Past developments

Though we can celebrate in 2001 A. D. the centenary of the first record of a plant nematode attack on our tea plants, made by Barber the real problem was felt two decades ago. When Butler made a report in 1906 on the nematodes attacking our pepper vines, none then thought, that our pepper vines will be brought to the present state of unproductivity. Scientific investigations on plant nematodes were initiated only in 1965 by establishment of a nematology lab with primary facilities at Vellayani. However based on the awareness of the problems existed, in 1972 KAU felt the need for more intensified work and a section was formed in the Department of Agrl. Entomology at Vellayani. In 1977 the I.C.A.R. launched the AICRP on nematode pests and KAU was chosen as a coordinating unit and a centre of the AICRP started functioning at Vellayani. The need for intensified research on nematode problems was subsequently realised and a unit was formed in the College of Horticulture in 1979.

Contributions from KAU.

Considerable information on several nematode problems existing in the State could be gathered and exposed during the past one decade. The pathogenic effect and damage caused by the burrowing and root-knot nematodes on pepper vine were established. Improving the growth of these nematode infected vines by application of chemical nematicides was brought out by field trials. The rice root nematode was observed to be present in all the rice tracts of our state. Its infection reduces tiller production by 25 per cent, resulting in yield decline upto 19 per cent. Prevention of the nematode infection of rice seedlings, in the nursery and giving a chemical root dip before planting, increase rice yield. A cyst nematode is found infecting rice in southern districts of our state, causing heavy crop damage, reducing yield upto 42 per cent. The burrowing nematode is a serious pest of banana, causing reduction in the bunch weight by 45 per cent. Banana is prone to the attack of the cyst nematode when grown in paddy lands. This may pose new problems in cultivation of banana under rotation with paddy in our wetlands. The popular vegetables viz., bhindi, brinjal, tomato, chillies, cucumbers and gourds are found attached by nematodes resulting in heavy crop losses. A limited study carried out revealed that important spices viz., cardamom, ginger and turmeric are also infected by nematode pests, causing decline and unproductivity of the plants. New records of 15 nematode species associated with spices and vegetable crops have been reported during the past one decade.

Teaching and Training

To meet the increasing demand of qualified personnel post-graduate level training was commenced from 1967. Though 15 candidates have been trained at M. Sc. level so far, only six are actively working in the University engaged in nematological investigations. In 1977 six post-graduate courses were formulated and they are being offered for benefit of the students specialising in plant nematology.

Developments aimed in future

By their ubiquitous presence the nematodes have emerged and established as pests and the problem has become basically a soil ecological based one. Even a couple of pests like the root-knot and the burrowing nematodes are found infecting a large number of economically important crops in our state. The major nematode problems are also found associated with our perennial high value cash crops on which the state's economy is entirely dependent. The nature of parasitic association of the important nematode pests in relation to the crops grown under different agro-ecosystem in our state have not been thoroughly probed. Only a beginning has been attempted. Collection of scientific information on the indepth relationships of the pests with their hosts as influenced by ecological factors will alone provide a sound footing to plan and programme on the management of these pests in future. At present checking infection of nematode attack is mainly centred around in the use of chemical pesticides. This approach had no doubt indirectly indicated the extent of the nematodes' role in limiting productivity. With the increase in the awareness of nematode problems the continued use of chemicals will only lead to several environmental misadjustments and creating new problems. Our State is endowed with rich flora which include several plant species having medicinal properties of anti-helminth nature. Cultivating such plants as intercrops/ companion crops along with the ones prone to nematode attack can be tried for developing suitable technology. Nematode pest problems on vegetables in certain areas are becoming endemic by continuous cropping in the limited land space owned by small scale farmers. Under such situations use of resistant/tolerant varieties will be the only practical solution. Development of such vegetable varieties should find a place under the vegetable breeding programme of KAU. Agricultural soils not only harbour nematodes but also other plant pathogens, and some sort of interactions between these organisms are always occurring at the time of manifestation of a plant disease or pest attack. Critical studies on the role of these organisms in various crop diseases should be taken up, so that the technologies developed for plant protection programme will have a meaningful approach for pest and disease management in future.

The agricultural revolution will continue to create unforeseen and unimaginary evolutionary forces, that will provide new challenges and opportunities. Agricultural revolution will continue to influence the evolution of education, research and extension functions of agricultural universities. It is for the KAU to foresee this trend and act accordingly.

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Research in Agrometeorology in 2000 A. D.

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By 2000 A. D. the population of Kerala is expected to cross the 35 million mark. In contrast to this increase in population the production of food as well as commercial crops in general show a downward trend. The pressure of population on land is quite high. Consequently the availability of arable land is very meagre. Therefore there arises an urgent need to evolve and adopt suitable technology for increasing the productivity of available land. Such a technology would necessitate the optimum utilisation of all available resources. Of such resources weather and climate form an integral part.

Agricultural production depends on various factors and variations in production are usually due to the variations in these factors. And it is not difficult to see that weather factors start influencing the crop right from sowing to harvest. Sequence of weather favourable or adverse have their impact on the growth and development of crop. It is estimated that more than two-thirds of the variation in yield is caused by the variations in the weather. Even so, all attempts to correlate weather with crop growth and development were only partially successful. Studies on crop-weather relationship have brought out certain broad features, but quantitative evaluation of the same is yet to be achieved.

Realising the vital need of a knowledge of crop weather relationship, the National Commission of Agriculture recommended to treat Agrometeorology as a major discipline. Accordingly, in the Kerala Agricultural University a Dept. of Agrometeorology was started in 1977.

With the advancement of knowledge of the soil-plant atmospheric system, specialisation in agrometeorology has become inevitable. Therefore various research programmes have been undertaken in the Department. Intensive and extensive research on borderland problems on agricultural physics, applied biology and applied statistics, is being proposed. The problems will be oriented towards the understanding of crop-weather-relationship, soil-climate, water requirements of crops based on climatic demand, meteorological aspects of incidence of pests and diseases, building up of rainfall climatology and determination of water availability periods to facilitate formulation of land utilisation policies, determination of cropping pattern etc.

As the three aspects viz. Teaching, Research and Extension are envisaged to be undertaken by the Department of Agrometeorology, its activities will become partly operational. Therefore, it is essential that elaborate and proper organisational facilities for the collection, scrutiny, processing and retrieval of observations have to be provided. For this the present centre at the Main Campus will be developed into a documentation and analysis centre. To be fully effective this centre should have an information dissemination service. It will have facilities for training, both basic and intensive, for operational staff as well as scientists from the university and also from the Agricultural Department.

There is an increasing demand for environmental data by students, research scholars and scientists of this University. It is therefore proposed to build up suitable data archives with quick and efficient retrieval and supply. The installation and operation of an electronic computer system for exclusive use of the Department will become necessary.

Arrangements will be made to publish climatological and agricultural data summaries in suitable formats in the University publications. Attempts will also be made to bring out special publications of the Department itself wherein that will be worth to meet the needs of agricultural scientists.

Rainfall is one of the most important climatic factors for agricultural production in our State. Therefore, it is natural that a number of studies have been made on this one parameter. But attention has been concentrated on annual, seasonal and monthly amounts of rainfall. It is seen that the variability of annual rainfall is of the order of about 20 per cent. Variations in seasonal and monthly amounts indicate probable excess or deficit of available water, the duration of the latter indicating dry spells. However, for a proper assessment of the possibility of raising specific crops and also to assess the impact of rain on perennial crops, detailed information on distribution of rains on shorter intervals (say, a week) is necessary. For, it is this rain that goes to the build up of soil moisture in the active root zone. Therefore a study of the weekly amount of rainfall used data at all rainfall recording stations should be undertaken. The results emerging from such studies could be utilised with advantage for other important problems like determination of suitable season for important crops grown in different parts of the State. Critical studies of rainfall distribution patterns could be of help to evolve suitable cropping systems in different agroclimatic regions of the State. The effects of water stress on environment, especially those of perennial crops could be assessed with help of soil moisture deficit that could be expected in various months of the year.

Irrigation is applied primarily to make good any deficiency of the moisture in the soil. Such deficiency can occur due to prolonged dry spells, when evaporation rate is high. Since the need for irrigation depends mainly on climate, it is natural that the answer to many problems in connection with irrigation should be found through a study of climatic data. Questions involving the quantity and timing of irrigation requirement could be answered by quantitative analysis of climatic data. When water supply is limited it is important that none be wasted. Even when it is abundant it is important to apply correct amounts. It thus becomes necessary to evaluate the water requirement of various crops, in the various stages of their development. Hence lysimetric studies are to be conducted for selected crops in selected regions.

Soil climatology

Variation in natural soil consists of variation in mineral and organic matter in the soil, the chemically bounded water that is mobile and the air that fills the space between the soil pores. Such variations are caused by changes in atmospheric conditions and also by production activity of man. The interaction between the soil and atmosphere is manifested in the temperature and moisture regime of the soil. Average of the factors that characterise these regimes constitute soil climatic facilities.

The characteristic features of the soil climate in any particular locality are not only the result of natural processes but also are influenced considerably by agronomic practices. Therefore, there exists the possibility of exploiting soil climate for increasing agricultural production.

For this purpose, systematic studies on climate with a view to assess their variations overtime and space in the state and to evolve methods of exploring the possibilities of utilising this information for the improvement of crop soil management are to be conducted. A network of observations wherein soil thermometers are to be installed is to be established and systematic and regular monitoring of soil moisture on a planned uniform basis is organised.

Crop weather analysis

Efforts to establish the relationship between climate and crop yields began in India as early as 1945 under All-India Coordinated Crop Weather Scheme. Analysis of data collected under this scheme has brought out relatively large dependence of crop growth and yield on rainfall and its distribution in various phases. Studies on the effect of simple climatic elements can only serve primarily as a first step towards a more complete understanding of the problems. The traditional emphasis on rainfall and temperature has now shifted towards consi–deration of energy budget and water balance. Such a broad based approach will call for experiments involving the use of sophisticated instruments in the field. It may also involve experiments conducted in artificially controlled environment. Therefore a comprehensive plan of field and laboratory experimentation has to be formulated and implemented.

Studies on crop pests and diseases in relation to weather

In the agricultural development programmes, involving the use of high yielding varieties of crop duration, the adoption of control measures against pests and diseases is of great importance. It has become part of cultural operations.

Weather plays a very important part in outbreak of pests and diseases in two ways. First, it provides meteorological conditions which are conducive for the development and spread of disease. In this the climatic factors may operate either directly on the organism or may excercise control through its indirect influence on intermediary host plants or animals. Secondly, the weather at the time following immediately after spray or dust application has very important bearing on effectiveness of the operation. It determines the form in which it is to be applied, the type of equipment to be used and the time of application. Again, many of the chemicals have harmful effects on man, animals and plants. It is, therefore, necessary to ensure that material applied over the fields does not drift into neighbouring areas.

It is not uncommon to find a pest or disease organism kept under control in certain regions by other predatory or parasite organism. Introduction of such natural enemies of pest and disease organism into regions where the later are in abundance, are often resorted to effect biological control of pests and diseases outbreaks. The success of such control operations depends upon the important natural enemies from regions, which are climatically analogous to the place under consideration. Determination of meteorological conditions favourable for occurrence of pests and diseases will be useful to estimate chances of such epidemics in different areas. Such knowledge will facilitate the issue of advance warning and advice for effective and economic planning of control operations either from ground or from the air. In view of this, this Department proposes to initiate action, in co-ordination and consultation with other agencies and institutions if necessary, to collect quantitative information on the extent and intensity of pests and diseases outbreaks and concurrent meteorological data with a view to determine predisposing meteorological conditions for outbreaks of pests and diseases.

A major activity proposed to be undertaken by this Department is the issue of agromet advisories to the farmers and other interested parties, at suitable intervals so that they could be helped in national crop management. With the aid of detailed charts of specific relevance to agriculture at State/District level and with co-operation of the meteorological centre of the Indian Meteorological Department, in the State, the weather services for farmers could be intensified. As a preliminary step, the weather requirements of crop as well as hazardous weather will be determined by surveys and questionnaires. On the basis of information thus collected, special charts will be prepared and analysed. The results will be interpreted in the light of the needs of the farmer in the context of the expected weather.

It is also proposed to devise an extension programme by which intensive and extensive training will be imparted to the field staff and officers of the Agricultural Department of the State. The programme will be designed to develop an awareness of the importance of weather sequences and their variation in agricultural production. All the above mentioned activities would require an adequate agro-meteorological data base. There is a fulfledged observatory working in the main campus of the University. In addition, it is proposed to equip all the research stations under University with all necessary instruments so that they will form a network of stations representative of the various agrometeorological regions of the State.

With rapid and phenomenal development of environmental sciences in the recent years there will arise considerable demand for professionally qualified agricultural meteorologists in the various institutions both national and international. It, therefore, becomes imperative to provide adequate facilities for agricultural scientists to acquire advanced knowledge and skill in agricultural meteorology. This University has devised suitable courses for various levels of learning and these will be implemented in due course.

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Research and Production Strategies of Pepper

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Introduction

India is the traditional home of spices and this has brought to her shores many invaders and explorers from different corners of the World. It was the home of spices which attracted traders and nagivators to this subcontinent. The cultivation of spices dates back to ages before Christ and history is replete with many stories of spices. Thus, spices have a hoary tradition intermingled with legendary history in which India figures as a prominent producer and exporter from time immemorial.

The Indian Standard for Terminology for Spices and Condiments lists about 53 spices and most of them are produced in India. Of these, black pepper *(Piper nigrum* Linn.*)* referred to as the "Black Gold" occupies a place of paramount importance and has been justly termed as the 'King of Spices'.

Origin and Distribution

Piper nigrum is a native of the evergreen humid tropical forests of the Western Ghats and harbours innumerable primitive forms and wild relatives of this species. The present day cultivated species of pepper must necessarily have originated from the wild forms by continuous selection and domestication through ages by man. The spread to Java is believed to be due to the Indian settlers and must have taken place in between 1000 BC and 600 AD. Marco Polo reported pepper in Java (now in Indonesia) in 1218 AD. In the 16th Century, pepper came under large scale cultivation in Malabar and to a smaller extent in Java, Malaca and Siam (Thailand). In 17th and 18th centuries the Dutch established large holdings in Java and Sumatra. Pepper cultivation was established in Sri Lanka in 18th century and later on in Kampuchea (Combodia). Early 19th century witnessed organised cultivation of pepper in Malaysia. The Dutch continued as the major producer till World War II during which most of their plantations were destroyed. By the middle of 20th century, pepper was introduced to other tropical countries like Brazil and Malagassy.

Area and Production

Pepper cultivation in India is restricted to an area of 1,10,850 ha with a production of 28,520* tonnes of black pepper annually as per official statistics but the traders estimate of production is about 35,800 to 40,000 tonnes/annum. The total world production of pepper increased from 38,000 tonnes in 1947 to 1,43,000 tonnes in 1980. India's share in this was 80% in 1947, but it is only about 25% today. Statistics reveal that India has the highest area under pepper

* Source: Director of Economics and Statistics, New Delhi

and even after a phenomenal increase in area under the crop, from 80000 ha in 1947 to 1,10,850 ha, the production remained static around 30,000 tonnes whereas the total world production witnesses a three-fold increase.

The State of Kerala accounts for the bulk of the produce, approximately 96% (ie., 28,000 tonnes from an area of 1,07,740 ha.). The total number of holdings of pepper is about 80,000 and the average holding size is 0.73 ha. Estimates place about 40% of the area under large scale plantation (more than 2 ha) and 45% under small holdings (0.32 to 2 ha)*. Homestead gardens account for the remaining area. It is paradoxical to note that the average yield of pepper is the lowest in its original home when compared to the other countries which started cultivation only a few centuries ago. The average yield of pepper is 4067 kg/ha in Malayasia, 3333kg/ha. in Brazil, 636 kg/ha in Madagascar and ranged from 551kg/ha to 925 kg/ha in Indonesia (due to two types under cultivation), whereas it is only 275 kg/ha in India. Thus, it can be safely inferred that the stagnant production is just a reflection of the very low productivity. The high yields in Malaysia and Brazil are mainly due to the well distributed rains and the high fertility status. But they, on the other hand also suggest that there is tremendous scope for improvement.

Future

The demand for pepper is fast growing. The demand growth rate in the World pepper market has been placed at 4% per annum by the Vth Session of the International Pepper Community held in New Delhi in 1977. The FAO and the International Trade Centre have estimated the growth of international demand at a compound rate of 4% per annum. The consumption within our country which is currently between 10,000 and 12,000 tonnes/annum is also increasing at the rate of two per cent per year**. The sharp increase in consumption in some Middle East and North African Countries in the very recent past has further increased the demand for pepper. The annual growth rate of the demand of green pepper is placed at 4-5% and that of pepper oleoresin at 6%. The National Commission on Agriculture in its report on pepper has projected that the likely requirement of pepper will be 45,000 tonnes in 1985, 51,000 tonnes in 1990 and 58,000 tonnes in 2000 A. D. It has been felt that the production during 1982-83 should have been 46,000 tonnes. But there has been a shortfall in production of 18,000 tonnes as per official estimates through the trade estimates place the shortage at only 10,000 tonnes. Analysis of the growth rate in demand both for internal consumption and for maintaining our present share in the export trade reveals that the production target for 2000 AD should be as high as 84,000 tonnes or double the present production.

As stated elsewhere, the present average yield of pepper is very low when compared to the average yield reported from other pepper producing countries like Indonesia, Brazil and Malaysia. Therefore immediate increase in production will have to be achieved by enhancing the productivity of existing vines.

* Bureau of Economics and Statistics, Trivandrum.

** Report of the National Commission on Agriculture, 1976.

Research work has revealed that some of the major factors which keep down pepper production in the State are,

1 Poor genetic stock cultivated in many of the areas.
2 Regular removal of unproductive and old vines and replanting of superior varieties is not practiced systematically.
3 Fertilizer application has not become an accepted practice among the cultivators. Even the improved cultivators practice either under-manuring or unbalanced manuring.
4 Lack of proper training and pruning of vines and other plantation management practices.
5 Timely plant protection measures are not adopted by the farmers, against the major diseases like foot rot (quick wilt) and anthracnose (fungal pollu) and pests like pollu beetle.

In our home state, the experience of progressive farmers show that a minimum of 1 kg/vine could easily be obtained under moderately good management practices. It has also been proved in the Research Stations of the country that high yields of 2 to 3 kg per vine could be obtained by the adoption of improved technology. So, the claim of the scientists that the average yield of pepper in the country could easily be enhanced to 1 kg/vine, cannot be considered to be hypothetical or over ambitious. The present yield gap between the potential and actual farm yield is in the order of 75%. It should however be emphasised that this may be an over estimate since it is based on the estimate of 1100 yielding vines/ha in persisting gardens. But the plant density of the bearing vines in the existing gardens will be of the order of 70 to 80% only. However, there is considerable scope for increasing the productivity of existing gardens by atleast 100% by adopting the known technology. If this target is actually achieved, the production of pepper in India will shoot up from the present 30,000 tonnes to more than 60,000 tonnes by 2000 AD. To achieve this target, the above mentioned constraints should be removed by proper development and extension work.

In general, the results of research and technology evolved have not reached the farmers and they are not convinced of the effectiveness of the scientific management practices in increasing pepper yields. There is a wide gap between research and extension activities of this crop, which should be bridged effectively and timely to enhance pepper production in the country.

Again, there are number of reasons for the lack of response from pepper cultivators, eventhough, the gifts of modern science are being extensively utilised in the production of other crops like rubber, cardamom, arecanut and coconut in the State. Foremost among these reasons, is the fact that the crop could endure neglect to a great extent due to favourable environments under which the crop was grown in the past. In the State, the crop is mainly grown on the fertile and virgin soils of the Western Ghats under ideal climatic conditions. So, the crop grew and gave moderate yields in the past, with little or no effort from the farmer. This age-long neglect has led to the belief that it is unnecessary, or even injurious to fertilize or intercultivate the crop. The cultivator also does not realise that the inherent natural fertility of soils has been considerably reduced due to continuous cropping, soil erosion etc., and that it requires scientific management practices to restore and maintain the soil fertility and crop yields. The low and fluctuating price level of the crop produce in the last two decades was a reason for neglecting the crop. But now, a favourable change has occurred in the scene. The attractive and steady price of pepper fetched in the last five years has brightened up the dismal arena and has aroused the interest of the cultivators to a great extent. Due to high quality, the demand for Indian pepper in the World market is also on the increase. From all aspects, the time is ripe to awaken the pepper cultivators and to educate them on the scientific methods of pepper cultivation. This can be achieved only by proper extension work.

Having identified the problems and possible methods of approach for increasing the production, it is time to ask ourself whether we have adequate research technology to transfer to the farmers in the different agro-ecological regions for achieving the target of 84,000 tonnes by 2000 A D. Unfortunately, the answer is a 'big No'.

Research

The scope for expansion of area is quite limited. With the present technology the production of pepper can be increased to 60,000 tonnes by 2000 AD provided all the known technology are translated into the farmers' fields. But the projected need for just maintaining the present status is the world trade and for meeting domestic need is 84,000 tonnes of black pepper. To achieve this target more viable technology has to be formulated by in depth research. At present research on this crop is too meagre as evidenced by the few recommendations made to the farmers on cultivation of hybrid pepper (Panniyur–1), fertilizer application and pest and disease control. Thanks to the pioneering work done by Kerala Agricultural University in this respect. After evolution of Panniyur-1, a long gap remains in the production of high yielding varieties. Evaluation of a few hybrids and pollinated seedlings from Pepper Research Station, Panniyur (culture No. 1171, 239, 141, 436, 331, 226, 434 and 1199) and selection No.84 from Pepper Research Scheme, Vellanikkara is envisaged in the multilocational trials and they are being tested along with standard recommended varieties. But it will take another seven years to recommend the superior genetic stock. In this regard, it is appropriate to quote the words of Dr. M. S. Swaminathan, former Director General of ICAR, while inaugurating the National Seminar on Pepper on 19th December, 1977. "Our effort should be to develop a research and development strategy which will help us to compensate for the past neglect of this crop and launch an era of accelerated advance in pepper production". In the light of the above statement the entire gamut of pepper research needs to be revitalised to achieve the projected targets of production by 2000 AD. Therefore the major stress should be on the following aspects:

1 Crop Improvement

1.1. Enrichment of germplasm bank and evaluation

As mentioned earlier, the centre of origin of pepper is in the Western Ghats. A very high genetic variability exists in its native home. An intensive survey and systematic collection of variabilities from this part are absolutely necessary. Such genetic materials have to be necessarily evaluated for direct selection, exploitation of locked up variations and also for hybridisation to evolve superior hybrids. Our selection programme has also to incorporate adequate emphasis on pest and disease resistance and quality attributes. It is worth mentioning that the wild species of *Piper nigrum* such as *P. colubrinum*, *P. obligyum* and *P. guineens* are reported to be highly resistant to the notorious pathogen *Phytophthora palmivora* which causes the deadly foot rot disease of *P. nigrum.*

1.2 Breeding programme

Controlled crossing has been in practice for quite some time and a direct result of it is the Panniyur-1 which was released in 1967. Few more hybrids are under various stages of testing. Vegetable propagation by cuttings makes it possible to fix the hybrid vigour in pepper. Hence dynamic cross breeding programme involving cultivated commercial varieties and wide range of primitive cultivars and allied species has necesarily to be intensified. Adequate importance has to be given to combine high yield and superior quality with genetic stability and resistance to pests and diseases. Pepper being highly heterogenous, cross pollinated and vegetatively propagated, the potential for exploiting the inherent variations is very high. Therefore, evaluation of large number of open pollinated seedlings of different cultivars for yield, yield components, quality and resistance to pests and diseases has to be intensified. The possibility of mutation breeding for exploitation of disease resistance can neither be ignored.

2 Crop production

The nutritional and cultural requirements of the crop have not been properly investigated. Pepper cultivation itself began on virgin forest soils after destruction of the forests. At present this ideal eco-climate and soil conditions are no longer available and this is the main cause of degradation in yields. In Malaysia, the cultivation is very intensive and as much as six split doses of fertilizers are being recommended resulting in very high yields. Therefore we have to evolve location-specific recommendations based on the nutritional and cultural requirements.

2.1 System of Planting

There are two distinct types of cultivation existing in our State:

a Pepper as a monocrop under full sunshine

b Pepper as an intercrop/mixed crop in arecanut, coconut and homestead gardens where sunlight is limited.

The most important requirement for plant growth is the energy from the sun. The photosynthetic efficiency of the vines under the two systems varies considerably. Hence detailed studies have to be carried out to identify the response of varieties to sunlight and various nutritional levels under the two systems.

2.2 *Support/standards for pepper vine*

As pepper is a climber, the need for a support is imperative. Moreover if it trails on the ground the induction of laterals or flowering shoots (Plageotropes) becomes limited. To be healthy and productive, pepper vine needs support to grow vertically. The traditional standards recommended in a monocrop are *Erythrina indica* and *Garuga pinnata* and both these live standards have their own advantages and disadvantages. *Erythrina* can easily be propagated vegetatively and it is quick and easily growing. Moreover, it is nitrogen fixing being a member of leguminosae family. The disadvantages are:

1 It is very susceptible to pests and diseases

2 It becomes fully naked due to leaf shedding when the vines require full protection from the sun during summer and are fully clothed during the rains when pepper requires sunlight. *Garuga* can be grown vegetatively and is much resistant to pests and diseases but is very slow growing, it does not catch up with the growth of pepper and provides less shade in summer.

Though dead standards have proved to give higher yield, the adoption of this practice becomes difficult owing to the high initial cost and lack of shade in summer. Therefore, search for quick growing, vegetatively propagated supports, preferably belonging to the leguminosae family and with dual or multipurpose use, have to be identified.

2.3. *Pruning*

Of all the requirements needed for a high standard of pepper culture, pruning skill is the most important because it is pruning that imparts the necessary stimulus for bud activity. In Malaysia, various definite pruning methods have been identified and adopted for the different agroclimatic zones (Raj, 1978). Therefore, more thought and work have to be bestowed on this aspect based on the agroclimatic needs, the system of planting and cultivars used.

2.4. *Cultural requirements*

Cultural practices best suited for good plant growth and yield and soil conservation methods have to be investigated upon.

2.5 *Water Management*

Requirement of water and the necessity of irrigation during critical stages of growth during flowering and bearing need to be emphasised. Effects of soil moisture status on yields of pepper and its influence on the incidence of soil borne pathogens like *Phytophthora* warrant a thorough search.

3· Production physiology

The physiological aspects of crop production and protection have not received adequate attention so far. Hence, more attention has to be given to these aspects.

3.1 Effect of environment on yield/yield components

The effects of sunlight, atmospheric temperature, soil temperature, relative humidity and rainfall on flowering and fruit setting have not been exploited and basic research on these aspects is highly essential.

3.2 Root pattern

The root pattern studies become a must owing to different systems of cropping followed and due to the presence of various crops in mixed cropping system with coconut, arecanut, coffee etc.

4 Pests and Diseases

Fungal diseases like foot rot (quick wilt) caused by *Phytophthora palmivora* and anthracnose (fungal pollu) caused by *Glomerella singulata* are the major diseases. The former is a very deadly disease causing destruction over 20 per cent of the plants annually. The major pests are pollu beetle *Longitarsus nigripennis* and shoot borer *Cyda hemidoxa*. Further, root nematodes like *Radopholus similis* and *Meloidogyne incognita* are also a serious threat in some parts of the State. Slow wilt or yellows of pepper vine is another major problem and the etiology of this malady is not fully known. Breeding for resistance against major pests and diseases is the only permanent solution to the problem but may take more time. Hence management of disease and pests is the urgent need of the hour.

4.1 Breeding for Resistance to Pests and Diseases

Breeding programme for important diseases like foot rot, anthracnose and pests like pollu beetle, top shoot borer and root burrowing nematodes has to be intensified. Screening of cultivars, exotic species reported to be resistant and wild species for disease resistance have to be continued and once the resistance located it can be incorporated into cultivated varieties.

4.2 Epidemiological Studies of Major Diseases

For proper and efficient management of any disease a thorough knowledge of the epidemiology is required. Therefore, the epidemiology of *Phytophthora palmivora* and *Colletotrichum gleosporioides* has necessarily to be understood.

4.3 Management of Diseases

For efficient control of the diseases a multidisciplinary approach involving agronomic, crop sanitation, biological and chemical methods of control has to be sought.

4.4 Integrated Pest Management

Integrated pest management system utilising biological and chemical methods of control should be devised for control of pollu beetle, top shoot borer and nematodes.

5.1 Quality and Post-harvest Technology

Pepper is an export-oriented crop and the market perference of the commodity depends on its quality. In our breeding programme quality of produce should receive adequate attention while evaluating hybrids and new varieties to be released for cultivation. Quality as affected by nutrition, agro-ecological conditions, maturity, fungal and other microbial infection also need to be studied.

5.2 Processing is one of the aspects which has received least attention and offers maximum scope for development. Till recently, India was exporting pepper in the raw form and in bulk and in the importing countries it was extracted for various end products for use in the meat and food processing industries. It is roughly estimated that fifty per cent of the imported pepper is used for extraction purposes in the developed countries. Of late, India has started exporting extracts of pepper like pepper oil, oleoresin of pepper and processed forms like canned pepper, green pepper, dehydrated green pepper and powder forms. Even now, about 95% of the export is in bulk and raw form. The latest survey conducted by the International Trade Centre (UNCTAD/GATT) also indicates the promising trend for quality products. A more meaningful approach in this line would be to develop technology for processing of pepper at the planter's level itself so that the whole circle of activities centres around the farmer. This will not only increase the revenue of the small and marginal farmers but will also create vast employment opportunities for the landless agricultural labourers.

Conclusion

Spices have traditionally played a significant role in world trade, and their economic importance continues to grow. Spice grinders and packers hold that pepper from various origin is interchangeable and that the determining factor in selection is price. Thus, the high prices of Malabar and Tellichery pepper makes its movement in the world trade slow. An answer to this problem can be achieved only by increasing the yields so that the high cost of production is reduced. Needless to say, the research on diversification of end products and quality attributes has also to be geared up well to meet the challenges of tomorrow.

With the known technology and proper extension work, pepper production can be enhanced to 60,000 tonnes/annum without an increase in the area. If we have to maintain the present status in the World trade, after meeting our domestic requirements, our production has to be increased by 2000 AD to 84,000 tonnes. This target can only be achieved by defining our research and production strategies on the lines mentioned above.

A dig into the past will only expose the negligence rendered to the research and development of this crop. If the same policy of the 20th century is being adopted, the name of India will vanish from the World Pepper Trade and on the more important side the present area under this crop will be eaten away by other cash crops.

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Research Needed to Meet the Challenges of 2000 A. D.

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By the dawn of the 21st Century, agricultural scientists would be facing several challenges, some of which have already caught our attention by now. The challenges can be grouped into:

Increasing crop production per unit area per unit time,

Enhancing the net income from the holdings which will continue to be smaller and smaller,

Finding alternate sources of food, beverages, etc,

Evolving agro-based industries,
Reducing the cost of Research.

Increasing crop production per unit area per unit time

Increasing the productivity by improving the genetic architecture (better adaptability to the environment, genetic resistance to pests and diseases, incorporation of higher photosynthetic, water use, fertilizer use efficiency, etc. and overall higher yield potential), tailoring the plant types to efficiently utilize solar energy, exploiting heterosis/hybrid vigour wherever possible, are some of the lines which will continue to be of importance.

Enhancing the net income from holdings which are becoming smaller and smaller

While the holdings continue to reduce in size, the need for generating higher net income from the holdings would increase. The obvious methods to tackle this problem would be:

Working out compatible crop mixes that can harvest the soil, ground water and solar energy efficiently.

Working out integrated farming systems involving crops/livestock/fish/ other sources of food like mushrooms.

Standardising low-cost technology with reference to pest/disease management, post-planting care and management, etc.

Developing post-harvest technology to enable the farmers to get assured of higher income. The processed and value-added products will not only free the farmers from the grip of the middle men (who exploit the farmers taking advantage of the perishable nature of the produce), but also yield multiplier effects on agro-based employment.

A change of outlook from higher harvest index to higher bio-mass production per unit area per time will be another logical solution.

Contingency plans will have to be formulated to tide over unforeseen pest/ disease, weather, labour, market and similar problems.

Crops/cropping patterns/farming systems will have to be allocated to the best possible locations/situations so that the cost of production would be low. For this, profit sensibility analyses would have to be conducted and "crop" suitability maps prepared. Legislative measures may become necessary to limit the "cultivation" to the profitable areas.

"Wholistic" or "system" approach would be required rather than individualistic approach. Useful data would have to be generated to make the farming systems viable and economic.

Basic and revolutionary changes may become necessary. From plantations that occupy the land for 100 years or so, midget/dwarf plants will have to be planted at closer spacing in the most suitable areas. Such plantations can be renewed after comparatively shorter life span. Similar to the "meadow orchards", these would enable us to answer soil problems, need for specialised labour for harvest, etc.

The role of agricultural scientists in the sphere of forestry will assume importance. Although they would continue as minor partners in traditional forest areas, the agricultural scientists will dominate non-traditional areas like agro-forestry, social forestry, community forestry, etc. The agri-sylvicultural and agri-horticultural systems will generate increased income from unit area per unit time.

Finding alternative sources of food/beverages/medicinal plants/plants that yield industrial raw material, etc.

Many useful plants have been "domesticated" in the past and are now important agriculturally. Areas like the Western Ghats region can yield several more unutilized plants which can be groomed as commercial crops of the 21st Century. Work on identifying medicinal plants, plants having insecticidal properties, mushrooms, etc. will have to be intensified.

Evolving agro-based industries

Agro-based industries offer scope for employing unskilled/semi-skilled labour in large numbers. Intensive efforts are required to develop industries that can effectively utilise our agricultural raw material/by-products.

Farm machinery

Although the likely population increase is expected to make available enough labour, labour-saving, drudgery-removing, efficiency-improving items of farm implements and machinery suitable to our terrain will have to be designed.

Utilization of bio-mass

Research aimed at utilization of materials like salvinia, water hyacinth, banana pseudostem, etc. will have to be intensified.

The present day digestors (for production of bio-gas) are reported to have low efficiency (about 30 per cent), which will have to be improved considerably.

Utilization of solar energy

Cheaply and abundantly available energy sources (sun, wind, water, etc.) will have to be harnessed and put to agricultural use. Work on these lines have already been initiated in several laboratories.

Research organisation

Regionalisation of agricultural research has already been effected. Multi-faculty-multi-disciplinary Regional Research Stations and machineries to test the technology so generated in the micro-zones/farming situations will be the rule of 21st Century. The National Agricultural Research Project has paved way for the realisation of this objective, at least partially.

Low-cost research

Research expenditure will increase tremendously if we continue to follow the present methods. Efficient utilization of data generated in our own Research Stations and elsewhere, developing generalised models and testing them for the changed situations (a new variety, a different location, a higher level of management, etc.) would considerably reduce the cost. Computers will have to be depended upon not only for analysing the generated data, but also for retrieving the extant information, working out generalised formulae, equations, etc.

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Prospects of vegetable cultivation in Kerala

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Introduction

Leguminous vegetables like dolichos bean, cluster bean, yard long bean, winged bean etc. are rich sources of protein. Carbohydrates are supplied adequately by tapioca, sweet potato, colocasia, elephant foot yam, larger yam and similar other tuber crops. Many kinds of sugars and acids are supplied by fruit vegetables. Mineral constituents like iron, potassium, magnesium, calcium, phosphorus etc. are supplied by most of leafy vegetables like amaranthus, chekkurmanis, water leaf, agathi, and cole crops like cabbage. Statistics on dietary deficiencies and resultant disorders speak of inadequate intake of vegetables in Kerala diet.

Vegetable cultivation as a source of additional income to the family has also to be still realised by many people. A major share of family expenditure goes for the purchase of vegetables, which are mostly preserved and sold in the market and which are contaminated by unscrupulous and unscientific application of plant protection measures. The long-term effect of such hazardous use of pesticides and fungicides if properly investigated, the data would be shocking both to the administrators and to the common public. This calls for greater emphasis on the concept of "producing vegetables for one's own need by one's own sweat".

The vegetable cultivation as a source of income to the State and as a source of employment to a vast majority of our unemployed rural and urban youth has also to be well realised. An organised vegetable industry would be a backbone of our State.

The warm humid tropic conditions of Kerala provide the most congenial and ideal climatic conditions to the cultivation of cucurbit vegetables like bitter gourd, snake gourd, ash gourd, bottle gourd, pumpkin, cucumber and water melon, leguminous vegetables like cowpea, dolichos bean, winged bean, cluster bean, fruit vegetables like chilli and brinjal, tuber vegetables like tapioca, sweet potato, and yam.

The under exploited and high potential vegetables like drum stick and curry leaf grow luxuriously in the soils of Kerala. The shade loving vegetables like water leaf, colocasia, and xanthosoma grow in symphony with tall canopied crops like arecanut and coconut. It would be interesting to note that the Wynad forests of Kerala gave birth to crops like brinjal, snake gourd, oriental pickling melon and dolichos bean. The whole proteinaceous crop, winged bean has a secondary centre in the warm humid tropic climate of Kerala. The nutritive perennial vegetable crops like drumstick and curry leaf are special crops of this land.

With the migration of a good number of people from Kerala to Arab and African countries, demand for typical Kerala vegetables has tremendously gone up. The prospect of exporting the typical Kerala vegetables would be at an all time high during the years to come. It is unfortunate that no vigorous attempt has been made to find out the market avenues and to co-ordinate a well conceived vegetable export programme, which would bring considerable prosperity to our land and to our people.

A few statistics on vegetable production

The 1981 census indicates a population of 25,403,217 in an area of 38,863 sq. km. of Kerala (Census of India, 1981 (provisional)). The present vegetable consumption excluding tuber crops is only 23 g per day per head (ICMR, 1979). This works out to 8.395 kg/year. Considering the consumption rates, the total consumption of vegetables works out to 2,04,865 tonnes/year.

The Indian Council of Medical Research (1979) conducted a detailed study on the average food intake and recommended food intake for Kerala. As per the above report, the recommended food intake is 100 g of leafy vegetables, 50g of other vegetables, thus making 150 g of vegetables per day per head. Considering the above recommendation, the vegetable requirement for Kerala estimates to 13,36,076 tonnes/year. The gap between the present day consumption and the present day requirement essential for a minimum nutritive diet is appaling (11.3 lakh tonnes). The gap itself is 5 times the present day consumption.

Formulation of strategies

The strategy formulation has to take care the following aspects.

1 A working plan for bridging the gap between present day consumption and present day requirement.

2 A working plan which takes into consideration vegetable requirement for another five years considering rate of increase in population.

3 A plan of work for excess production aimed at "foreign market". Foreign market means inter-state vegetable sale and vegetable for export.

4 A plan of action for making available inputs for the addtional production envisaged.

5 Developing research and extension infrastructure, which is farmer-oriented.

1 A working plan for bridging the gap between present day consumption and present day requirement

As indicated above, the gap in production works out to 11.3 lakh tonnes per year. The possible ways to bridge the gap are:

a) Increase in area under vegetables

The present area under vegetables excluding tuber vegetables like tapioca and sweet potato is only 13,274 ha (Bureau of Economics and Statistics, Kerala). The area under chilli is 919 ha. The area under vegetables works out to 0.65 per cent of total area sown under all the crops in Kerala. Obviously this is a very dismal picture. Considering the intake of vegetables as a proportion of total food intake (150 g out of 730 g), the acreage should have been at least 20.54 per cent of the total area under crops. Taking into consideration only of an additional production of 11.3 lakhs tonnes to fill the existing gap, an area of 1.13 lakh ha. has to be brought under vegetable cultivation. This estimate takes into account an average production of 10 tonnes of vegetable/ha/year for a total production of 11.3 lakh tonnes/year.

The cultivable waste land is estimated as 1.25 lakh ha in the whole of the State. In addition, 27,684 ha of land are kept as fallow. In many parts of Kerala, a large area remains fallow after the first crop of paddy. This land can be utilised for vegetable cultivation provided irrigation can be made available during the fag end of the crop. A scientific method of cropping involving raising seedlings in polythene bags during June–July and shifting the seedlings to pits prepared immediately after paddy harvest can save a considerable time involved in total vegetable production. In certain tracts, a second crop or paddy is taken during September–January and the land is kept fallow from January to May. This land can be profitably put under vegetables, especially cucurbits if farmers are advised and given proper guidance in vegetable cultivation. The aspect of increasing acreage under vegetables has to be studied still further.

Under the fragmented type of land holding so peculiar to Kerala and with the abolition of land lordism a good number of homesteads with considerable prospects for vegetable has come to stay. The concept of homestead nutrition garden, formerly called the "kitchen garden" has great relevance in Kerala. Possibly the nutrition garden type of vegetable cultivation may be the answer for increased vegetable production. Operational holdings according to size of holding estimates to 5,17,640 (below 0.04 ha), 9,78,551 (0.04—0.25 ha), 4,31,185 (0.25—0.50 ha), 3,68,066 (0.5—1 ha), and 2,67,833 (1—2 ha) (Census Report, 1981 (provisional)). The total number of holdings ranging from a size of 0.04 to 2ha works out to 25.6 lakh holdings. The experiments on layout and planning of a nutrition garden conducted at Kerala Agricultural University indicated a production of 1.324 tonnes of vegetables from an area of 0.04 ha. which is sufficient to provide the total vegetable requirement of a family of 10 members per year. Even if 50 per cent of the total holdings (12.78 lakhs holdings) come forward for laying out nutrition gardens, the present gap of 11.3 lakh tonnes of vegetable can be easily met with.

(b) Use of high-yielding and disease resistant varieties.

It has been estimated that 30 per cent of the total productivity of a crop depends on the genetic potential of the crop-genotype. The extent of damage caused by diseases like bacterial wilt in tomato, chilli and brinjal, viral diseases like mosaic in bhindi, pumpkin and cucumber, devastating insect pests like fruit fly in bitter gourd and snake gourd, fruit and shoot borer in brinjal and bhindi are the main constraints standing in the way of higher productivity of vegetables in Kerala. Curbing the above diseases and pests through evolving resistant varieties is the immediate need of the day.

(c) Breaking constraints in the availability of inputs

The inputs for vegetable production are (1). seed (2) fertilizers, especially compost and farm yard manure (3) plant protection chemicals (4) credit facilities for the purchase of irrigation sets, sprayers (5) regulated marketing facilities under the control of vegetable farmers' Co-operatives. (6) Farm Advisory Services (7) ready approach to research stations (8) storage facilities for short-term and long term storage (9) transport facilities for distant marketing.

Inputs:

(1) Seed:- Considering a seed requirement of 10 kg/ha the total requirement to cover 1.13 lakh ha to fill the present gap would be 1130 tonnes of vegetable seeds. Based on an average vegetable seed production of 1 ton/ha, a total area of 1130 ha has to be brought under certified vegetable seed production programme. Subsequently 11.3 tonnes of foundation seed has to be produced over an area of 113 ha of land and 1.13 tonnes of breeders seed has to be produced over an area of 11.3 ha.

The Kerala Agricultural University should provide technical assistance in the production of quality vegetable seeds.

Agency for production and distribution of vegetable seeds

The National Seed Corporation with the help of its sister organisation, State Farm Corporation produces vegetable seeds. The services of NSC can be utilised for the production, distribution and marketing of vegetable seeds in Kerala. If need arises, an organisation similar to Tarai Development Corporation in U. P. can be established in Kerala for the production and sale of quality seeds.

(2) Fertilizers:- The recommended dose of FYM is 15 tonnes/ha. There is need for 11.3 lakh tonnes of FYM for the envisaged production. The general fertilizer recommendation is 120:60:60 kg of N, P and K/ha. This means an additional requirement of 13,500 tonnes of Nitrogen, 6, 780 tonnes of phosphorus and 6780 tonnes of potassium.

(3) Plant protection chemicals: The usual expenditure for plant protection chemicals is Rs. 100/- per ha. This would in turn work out to 1.13 crores of rupees, as cost of plant protection measures alone.

(4) Credit facilities: The cost of cultivation for vegetables in general comes to Rs. 10,000 per ha/year. The total expenditure then would work out to 113 crores of rupees for an area of 1.13 lakh ha.

(5) Regulated market facilities:- At present, there is exploitation of vegetable farmers, both by middlemen and the traders. Being a highly perishable commodity, the vegetable farmer succumbs to pressure from unscrupulous middlemen. This can be checked only through regulated markets run exclusively by co-operatives of producers and customers. A system like Milk Co-operative Societies in Anand in Gujarat can be a good answer in this direction.

(6) Farm Advisory Services: With the use of high-cost farming technology, there would be tremendous pressure on the crop by parasitic diseases and pests. A scientific system of vegetable cultivation envisages an effective farm service as its back bone. A farm advisory service is the link between laboratory and the farmer. The transfer of information feedback to the laboratory, transfer of solved information to the farmer, etc. are the key roles of an effective farm advisory service. A farm advisory service is a source of information both to the farmer and to a vegetable scientist. The present T & V system with its skilled man power would be adequate to meet the future challenges.

(7) Ready approach to Research Stations: The vegetable research is highly dynamic. New innovations, both inside the counrty and abroad have to reach the farmer within the shortest span of time. This is possible only through contact between scientist and farmers.

(8) Storage facilities: Development of short-term and long-term facilities is an essential requirement. The short-term storage would save the farmer from exploitation from middlemen. Long term storage is important both to the consumers and to the farmers to stabilise the vegetable prices. Research has also to be intensified on storage of vegetables especially the cucurbits.

(9) Transport facilities: Transport facilities within the state has to be arranged in co-ordination with railways and private agencies associated with Farmers' Co-operative Societies. An efficient transport system has to be developed either exclusively for vegetable transport or along with transport of highly perishable items like milk and egg.

2 Vegetable requirement for another five years considering increase in population

The working plan to fill the existing gap has to be further modified taking into consideration the rate of increase in population. This has to be done annually and cumulatively once in five years. This would help in the timely arrangement of inputs so essential for the increased production. There has to be a planning and monitoring body to undertake this work effectively. The Department of Statistics in collaboration with Department of Agriculture can form a working cell for the purpose.

3 A plan of work for excess productive aimed at "foreign market"

No detailed survey has been made regarding scope and prospects of vegetable export. Sporadic attempt has been made by a few enterprising Keralites to explore the possibility of export to foreign countries, especially Arab countries and African countries, where a good number of Keralites reside. The preference for typical Kerala vegetables is obviously high there. The attempts to sell vegetables from Kerala to non-Keralites, especially the local residents and imigrants from other countries have miserably failed. This is due to lack of information regarding their preferences and taste. There is need for a very detailed study regarding prospects for vegetable export. Whatever is exported presently is only a non-significant fragment of the total possibility.

4 A plan of action for making available the additional production envisaged

The inputs as listed elsewhere, in this report have to be made available in time and in right quantity and quality. The agencies involved in the production and distribution of the above inputs have to be alerted. Appropriate incentives have to be thought of for the agencies doing good work.

5 Developing Research infrastructure which is farmer-oriented

Kerala, with its unique warm tropic climate provides an ideal set up for cultivation of about 12 major and 23 minor vegetables. The major vegetables are brinjal, bitter gourd, snake gourd, pumpkin, chilli, tomato, vegetable cowpea, bhindi, amaranthus, cucumber, beans and ash gourd. The minor vegetables are dolichos bean, drumstick, winged bean, cluster bean, clove bean, cauliflower, cabbage, raddish, carrot, water leaf, chekkurmanis, ceylon spinach, round melon, ridge gourd, smooth gourd, pointed gourd, coccinia, curry leaf, sword bean, jack bean, welwet bean and roselle.

Attempts on improvement of the above crops in terms of development of high yielding and locally acceptable varieties and formulation of high yielding agronomic recommendations are rather limited. A review of work done so far necessitates the need for a master plan for vegetable research, which is basically farmer-oriented, need-based and time-bound. This would help to identify areas of priority which would push forth time-bound results with minimum waste in resources.

Crops and Research needs

Twelve major vegetables, along with their problems are given in this plan. Only major problems are presented. It is quite possible that to deal with some of them, many experiments need to be conducted. To attack the major problem, such small projects can be conducted in the research stations of Kerala Agricultural University as student-thesis projects.

The crops are given priority in research, based on area under cultivation and economics of growing. It is not necessary that all crops are taken up for work at one time. A few of the major crops may be taken up at first according to the availability of staff and facilities. Only important problems may be taken up first.

CROPS	PROBLEMS
1 Brinjal	1 Evolving varieties for summer and rainy seasons.
	2 Resistance to bacterial wilt and phomopsis blight.
	3 Resistance to fruit and shoot borer.
	4 Chemical control of fruit and shoot borer and epilachna beetle.
	5 Chemical control of phomopsis blight.
	6 Agronomic practices.
	7 Heterosis and economics of its utilisation.
	8 Water management and weed control.
	9 Growth regulators for higher production.
	10 Seed production.

2	Bitter gourd	1	Evolving high yielding and locally acceptable varieties.
		2	Resistance to fruit fly.
		3	Control of fruit fly.
		4	Resistance to mosaic.
		5	Control of leaf spot and fruit rot.
		6	Agronomic practices.
		7	Heterosis and economics of its utilisation.
		8	Water management.
		9	Seed production.
3	Snake gourd	1	Evolving high yielding and locally acceptable varieties.
		2	Resistance to fruit rot.
		3	Control of fruit rot.
		4	Control of epilachna beetles.
		5	Agronomic practices.
		6	Water management.
		7	Growth regulators to reduce flower fall.
		8	Seed production.
4	Chilli	1	Clustered, deep red coloured dry chilli.
		2	Clustered, deep red and de-stalked chilli for export.
		3	Resistance to bacterial wilt, leaf curl and mosaic.
		4	Control of anthracnose.
		5	Growth regulators to increase yield.
		6	Agronomic practices.
		7	Water management.
		8	Weed control.
		9	Artificial drying and storage.
		10	Heterosis and its economics.
		11	Seed production.
5	Pumpkin	1	Developing medium sized varieties with higher carotine content.
		2	Processed products.
		3	Control of epilachna and aulocophora.
		4	Control of fruit rot.
		5	Agronomic practices.
		6	Growth regulators to reduce female flower fall.
		7	Water management.
		8	Seed production.
6	Tomato	1	Resistance to bacterial wilt and fruit borer.
		2	Control of bacterial wilt and fruit borer.
		3	Growth regulators to increase fruit set in summer.
		4	Agronomic practices.
		5	Heterosis and its economics.
		6	Weed control and water management.
		7	Seed production.

7	Vegetable cowpea	1	Development of long poded and stringless bush types.
		2	Development of long poded and stringless pole types
		3	Control of storage pests.
		4	Control of collar rot.
		5	Agronomic practices.
		6	Water management.
		7	Preservation techniques.
		8	Seed production.
8	Bhindi	1	Evolving high yielding varieties suitable for all seasons.
		2	Resistance to yellow vein mosaic virus.
		3	Control of fruit borer, shoot borer and red cotton bug.
		4	Agronomic practices.
		5	Weed control.
		6	Water management.
		7	Dehydrated bhindi for export.
		8	Seed extractor and storage structures.
		9	Seed production and problems of seed germination.
9	Amaranthus	1	Development of deep red varieties insensitive to fluctuations in temperature.
		2	Agronomic practices, with special emphasis on control of bolting.
		3	Water management.
		4	Weed control.
		5	Seed production.
10	Cucumber	1	Development of pickling melon suitable for the locality.
		2	Slices cucumber suitable for the locality.
		3	Control of epilachna beetle.
		4	Agronomic practices.
		5	Control of fruit rot.
		6	Heterosis and economics of hybrid production.
		7	Growth regulators in cucumber production.
		8	Processing of cucumber.
		9	Water management.
		10	Seed production.
11	Beans	1	Suitable varieties for February and September planting.
		2	Resistance to wilt and mosaic.
		3	Agronomic practices.
		4	Weed control.
		5	Water management.
		6	Processing of beans.
		7	Seed production.
12	Ash gourd	1	Development of medium sized varieties for the locality.
		2	Control of fruit rot.
		3	Control of epilachna beetle.
		4	Processing of fruits.
		5	Agronomic practices.
		6	Seed production.

Organisational set up

The Kerala Agricultural University is vested with teaching, research and extension on economic crops. With its vast scientific manpower, it is in a better position to organise vegetable research. The Department of Olericulture is exclusively established to cater to the teaching, research and extension needs on vegetables. The vegetable crop research should be taken up with the basic pattern of co-ordinated projects. The co-ordination should be given by the Department of Olericulture and working groups on each crop, consisting of persons from different disciplines either working individually or in combination within the group be formed. Each group should have a leader, who co-ordinates the works in the group and acts as liaison officer to the Co-ordinator. The Crop Co-ordinator can be from any of the participating discipline (according to majority of problems in the crop) and will be responsible for leading and representing the crop.

Location and area requirement

The Main Centre should be located at Vellanikkara, where soil conditions are excellent for many of the vegetables. As the programme develops and as the needs for improving cool season vegetables are felt, a Sub-Centre on cool season vegetables may be developed at Horticultural Research Station, Ambalavayal. Locating vegetable research at one place is most important considering effective management and supervision. This would also minimise duplication in materials and above all research efforts.

The research facilities and laboratories in the College of Horticulture and the proposed Central University Library would be sufficient for such a Centre. This includes land required for breeders seed multiplication programmes. The research stations under Kerala Agricultural University and farms under Department of Agriculture can be the testing centres for improved varieties and agronomic practices evolved at the main centre.

Establishment of a Service Centre in the Main Research Station

The activities of the Research Centre are not complete without a Service Centre to visiting vegetable farmers. The Service Centre should be able to provide improved seeds, recommended growth regulators in capsules, various publications on vegetables and guiding specialists to solve this problem.

Adequate scientific manpower has to be developed to strengthen the vegetable research.

Soil Science—Its Perspectives in 2000 A. D.

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Agricultural prosperity of any country is to a great extent dependent on the wise use of soils. By the turn of the Century, population is expected to double and this would mean at least a doubling in agricultural production to meet the increased food demand. Kerala with its limited land area offers very little scope for increasing the area under plough. Hence the only way open to us is to increase food production by intensive cultivation. The unique combination of climate, physiography and vegetation of Kerala provides a wide diversity in the soils. The fertility problems of Kerala are so complex and diverse that it is not possible to copy the result obtained by research in one soil type to another satisfactorily.

Energy input–output relationship in agricultural production

Essentially crop production is an energy conversion process in which the incident solar energy is trapped and converted to chemical bonded energy for the growth of the crop. Various cultural energy inputs such as fertilizers, water, pesticides and different management practices are introduced by man in order to enable green plants to produce more and more biomass. Critical analysis of the energy input-output relationship in any agricultural system is very important for successful crop production.

Necessity for soil productivity and capability classification

Soil management in 2000 A. D. should aim at intensive use of soils without impairing fertility. This calls for utilization of land and soil resources based on their potential productivity and capabilities. Detailed studies on classification of different soils in the above line will have to be made in collaboration with the soil survey wing of the Department of Agriculture and Land Use Board. Many valuable data available with them as well as with the University should be made use of for the purpose and many more are yet to be collected.

Importance of organic matter in soil productivity

Decline of organic matter in our soil is very fast. The major reasons being high temperature and rainfall characteristics of tropical climate which are conducive for the rapid rate of microbial decomposition. Deforestation and shifting cultivation further hasten this process. Deforestation is estimated to decrease the organic carbon level by 25 to 57 per cent from the top 5 cm depth and 17 to 30 percent from the next 5 to 15 cm depth in three years. Inclusion of crop that produce large quantities of crop residues in soil with wider C/N ratio in cropping system is one way of replenishment of organic matter to some extent. Land slides, land slips and soil erosion leads to loss of rich top soil which can be prevented to a certain extent by providing proper vegetative cover.

Soil constraints for rice production

Soil constraints to high yields of rice—the major staple cereal food of Kerala have become more obvious after the introduction of modern varieties. The failure of these varieties to perform better in many soils of Kerala has led to investigation which have uncovered soil inadequacies not recognized before. Economically viable technologies are available in some cases, but many more are yet to be devised. Viable practices should be implemented to reduce nutrient losses, increase their efficiency, remove deficiencies and toxicities of nutrients and also for the better management of water resources.

Site specific problems in different soils should be identified and reclammative measures suggested have so far evolved large number of cuitivars with good yield potential under ideal conditions. But we do have a number of adverse soil and environmental conditions which are difficult to reclaim permanently due to various economic and other reasons. It is better to adjust with such natural abnormalities and develop varieties which can tolerate these adverse conditions and give reasonably good yield under such conditions either by screening the existing varieties or breed them with the help of geneticists.

Selection of crops and varieties for medium and low-input conditions

Nutrient requirement of crops as well as varieties within the crops vary. There are varieties which express their full yield potential at high-input levels such as good supply of nutrients, better control of pests and diseases and under good irrigation systems etc. But the need for the future is to develop varieties which give fairly good yield under medium and low-input conditions.

Selection of cultivars with good capacity for foraging soil nutrients

Root foraging capacity for nutrients and moisture vary with crops as well as with varieties within each crop. Such crops and varieties should be identified by isotopic techniques and included in cropping sequence to gap the soil resources fully.

Importance of soil test—Crop response studies in agricultural production

Soil test-crop response studies should be given prime importance in all future programmes of fertilizer recommendations for all major crops. Such studies conducted in similar series appear to have wider applicability. In such studies there is provision for fertilizer recommendation for different yield targets according to the economic status of the farmer. Attempt should also be made to make fertilizer recommendations for mixed cropping, intercropping and for cropping sequence as a whole based on soil test-crop response studies conducted for the major systems followed in each series, so that the same can be followed in similar series seen elsewhere in different parts of the State. Computerizing the data so collected by these studies and field testing the results in different locations reduce the risk for fertilizer recommendation and adaptation. Moreover, such experiments conducted with cropping systems takes due consideration for the residual effect of fertilizers also so that the input cost on fertilizers can be reduced considerably.

Plant analysis—Methods of improvement

Standardization of plant tissue testing for all major crops of Kerala such as the index plant part are to be tested. Physiological age of the plant for sampling and analytical techniques to be used for each nutrient etc. require detailed research and further field testing for their adaptability. Critical nutrient content for maximum yield in the initial stages of growth for annual crops and different stages of growth for perennial crops are to be assessed in each soil series for modifying the recommendation suitably at occasions. Technology for rapid plant tissue testing is to be developed for *insitu* recommendation of fertilizers for crops.

Time-saving devices for chemical analysis and interpretation of data

Use of sophisticated equipments like atomic absorption spectrophotometer, Auto analyser, Amino acid analyser, GLC etc. reduce the time required for soil and plant analysis considerably.

Informations gained from soil and plant analysis, and soil survery in a soil fertility evaluation programme must be correlated with crop response and various input factors for successful recommendations. Bringing all these factors together necessitates simultaneous calculations. Statistical analysis can be made by using calculators but it is time consuming and tedious. To simplify this procedure, system analysis approach using computors are to be used in future.

Use of renewable resources for production

Attempt should also be made to rely lesser and lesser on non-renewable industrial inputs like chemical fertilizers and lean more towards biological input factors. Photosynthetic and water use efficiency of plants mainly depend on nitrogen supply. Research conducted elsewhere have shown that by genetic engineering, nitrogen fixing genes can be incorporated into plant cells. Such a technology if adopted in cereals would help in developing high yielding genotypes capable of fixing and utilizing atmospheric nitrogen without expending energy like symbiotic organisms. Possibilities for transferring such genes into a variety of bacteria present in the soil also exist which may contribute to increase the nitrogen status of our soils. Non-obligatory associative relationships have been found to exist in cereals and grasses especially in C_4 type of plants with free-living nitrogen fixing organisms like Azotobacter, Enterobacter, Beejerinekia etc. They feed on root exudates of such plants and fix nitrogen. Such organisms or their spores may be isolated and if used for seed inoculation they help to reduce the input cost on nitrogenous fertilizers if not totally but at least partially. Isolation of the spores of mycorrhizal group or fungi to inoculate suitable crops can increase their capacity to utilize unavailable resources of soil phosphorus. We have to conduct research in this line on crop specificity of these organisms etc. as a part of low cost production technology.

Pollution problems in crop production

Problem of pollution in Agricultural land and waterways is increasing rapidly with growing industrialization in Kerala. Use of different chemical amendments mainly of indigenous origin and also biological agencies for detoxification of industrial effluents as well as screening genotypes of crops which can tolerate heavy elements—the major pollutants of industrial effluents-need intensive research. Isotopic studies will help to study the intensity and extent of pollution by these effluents as well as their reduction from toxic concentration by using different amendments.

Importance of detailed clay minerological studies in efficient utilization of nutrient elements

More detailed studies on clay minerology of Kerala soils are required since all sufrace reactions in soils leading to efficiency of fertilizers depend on the nature of clay minerals present in the soil.

Probable toxicity of agricultural chemicals on beneficial microbial flora of soil

Agricultural production has increased in the last decades mainly through the use of agricultural chemicals like fertilizers, pesticides, microbicides, weedicides etc. But this development has got its own impact upon soil environment mainly on soil organisms and biochemical processes in soil related to soil fertility. Heavy metals of industrial effluents and micronutrient carriers also may be toxic for the beneficial soil organisms. Studies on the effect of continuous use of these agricultural chemicals on beneficial soil organisms need intensive research.

Efficient use of nutrients

More efficient management of costly fertilizers identifying the efficient period of absorption of each nutrient for maximum production of major crops, location of feeder roots of these crops for better placement of fertilizers need further research especially using radioisotopes.

Efficient use of indigenous fertilizer materials for reducing input cost

Low quality indigenous fertilizer materials must be put to better use for reducing the cost of fertilizers manufactured from imported materials. A number of agricultural and industrial wastes can be screened for their soil ameliorative or nitrification inhibitory properties. This is specially useful in Kerala with a wide variety of problem soils like acid sulphate, acid saline, saline, alkaline, ill-drained and sandy soils.

In the new strategy of agricultural production more emphasis is to be given in increasing food production per unit area in unit time making use of all advances made in agricultural sciences by 2000 A. D.

Novel Techniques of Rice Improvement

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Rice is the only major grain crop that is almost exclusively grown as human food. Indeed, rice constitutes half of the diet of 1.6 billion people, and another 400 million people rely on it for between a fourth and half of their diet. The increasing world population keeps the demand for rice ever on the rise. The FAO has estimated that to keep pace with the rise in population an annual rate of increase of about 3 per cent in rice production will be necessary over the remaining years of the 20th century.

Yields of rice were stagnant in most Asian countries until about 20 years ago. Genetic improvements and better farm practices rapidly increased yields in the 20th century. Today yields in Japan, North Korea, South Korea, Australia and US average about six tonnes per hectare. Yields in most countries have increased gradually over the last 15 years, but many farmers still harvest only about two tonnes per ha or even less.

The genetic key to these advances was the development of high-yielding varieties of *indica* rice. The traditional *indica* was tall and had a tendency to lodge. Most of the modern varieties are semi-dwarfs. These high-yielding varieties brought more grain to the market, but it also brought on increased problems with diseases and insects. But this problem also has been to an extent tackled with the breeding of varieties with insect and disease resistance. IR 36, a variety now grown in more than 10 million ha of the world's rice land lends testimony to this fact.

However, the scientists are far from satisfied with what has already been achieved. They fear that the rice yield has reached another plateau. There is unanimity in opinion that this barrier should be broken soon so that rice production will keep ahead of the growing demand. Thus, a vigorous quest is now on, the world over to find out some new technique, by which to push the rice yield level further up. Some of the new techniques that offer immense potential for future rice improvement are discussed below.

Genetic Engineering

Recent advances in bio-technology may offer new ways to improve yield. One is tissue culture leading to haploid plants. With such plants one san stabilize vital characteristics because two competing genes for the same characteristics are not present. Moreover, the technique reduces the time needed to get a new variety from 10 generations with conventional breeding methods to as few as three generations. The Chinese have employed this procedure to create new varieties of rice, wheat and maize.

Most of the research on the haploid technique has been done in Japan, China and the U. S. with *japonica* rices. So far this procedure has not succeeded with *indica* rice because the *indica* varieties do not grow a useful number of callouses. Much effort is being devoted to making the technique successful with *indica* rice.

Another promising technique is to modify plants by inducing mutations in tissue culture. Individual plant cells or pollen grains in culture can serve as mutable material that can be grown into whole plants. One advantage of this approach over the procedure that induces mutation in seeds and whole plants by irradiation or chemicals is that a particular trait can be selected at the cell level. Promising results for increasing the tolerance for salinity by rice plants have been obtained by this technique.

Among the many aims of genetic engineering the most ambitious goal is the incorporation of nitrogen-fixing genes into rice. The nitrogen-fixing system includes atleast 17 genes and it is too early to know whether the manipulation of such a large number of genes is feasible. If this endeavour succeeds, it is going to make a tremendous inpact on rice cultivation because by avoiding costly nitrogenous fertilizers, rice culture will become a more profitable proposition. Also, in areas where soil N is the yield-limiting factor, varieties with inherent nitrogen-fixing capacity will serve to boost yields.

Somatic hybridization has been one of the most significant developments in the field of plant tissue culture in recent years. Large quantities of protoplasts now can be enzymatically isolated and when cultured, regenerate a cell wall and divide to form callous which in turn can be induced to regenerate an entire plant. To date, entire plants have been regenerated in about 20 plant species of the genera *Asparagus, Brassica, Citrus, Datura, Nicotiana, Petunia* and *Ranunculus*. In rice, so far only roots have been reported to differentiate from protoplast-derived callous. In this connection, it is pertinent that not only rice but cereals generally pose a number of problems and cause disappointments. More basic and fundamental work regarding the culture requirements of cereals will lead to break-throughs in this field.

Hybrid Rice

The exploitation of heterosis on a commercial scale, in self-fertilized crops like rice was believed to be practically impossible till a few years ago when the success story of hybrid rice in China started pouring out. The hybrid rice research programme in China was initiated in 1964. In 1970, a Male Sterile wild rice plant was found in nature and was named Wild Abortive (WA). Its discovery was a breakthrough in hybrid rice breeding. Presently, more than 6 million hectares have been planted in China with hybrid rice and average grain yields of 10-12 tonnes per ha are being realized.

The IRRI has identified new cytoplasmic-genetic male sterile lines with better adaptability to the tropics than the Chinese lines V20A and Zhen Shan 97A.

Some of the new lines are being tested in various parts of India also. The IRRI has programmes to develop high-yielding cytoplasmic male sterile lines with good levels of pest resistance.

The success story of the hybrid rice programme depends on so many technical and socio-economic factors. So it is yet premature to say as to how far this technology will prove to be viable in India.

Remote hybridization involving rice

Experiments in China have led to the successful development of an intergeneric hybrid between rice and sorghum. Hybrids were first obtained in 1960 with rice variety 'Rinfang' as the female parent and the sorghum variety 'Henjali' as male. The cross was made by emasculating the rice flowers with hot water and pollinating them with sorghum pollen. The F1 plants were tall and strong with wide leaves. They were advanced till the F13 generation overcoming many difficulties when the genotype became more stable and was similar to that of the rice plant. The superior lines of rice-sorghum hybrid have large spikes and grains, resistance to leaf blight and drought, and have high photosynthetic efficiency. They have been put to production trials in China.

Conclusion

In addition to the conventional methods of rice improvement, new techniques have to be experimented with, in order to meet the challenges of the future. The potential of these methods and techniques is great.

The State of Science varies from country to country, from programme to programme and from institution to institution. To succcessfully apply these methods to rice improvement and to realise their full benefit, scientists involved in their development need to work hand in hand.

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Advances in Technology Relating to Agriculture During 2000 A. D.

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Agricultural production not only depends on the quality of seeds, fertilizers and crop management, but governed by effective utilization of the land, labour and water. The effective utilization of these resources involve careful planning and timely operation of the farming activities. Agricultural engineering plays a vital role in all activities of modern agriculture right from the land preparation till harvest and post harvest. Advanced techniques for better water management can be evolved. Fruitful research works on harnessing the bio-energy from bio-mass, solar and wind can be carried out by the agricultural engineering scientists. The concept of agricultural engineering in other parts of India has widened much and covers seven distinct branches, viz.

1 Farm Power and machinery
2 Soil and Water Conservation Engineering
3 Irrigation and Drainage Engineering
4 Post-harvest technology
5 Farm Structures
6 Dairy Engineering
7 Agro-Industries and Energy

This branch of technology in Kerala has been given very little attention by the planners. Kerala State offers ample opportunity for research, extension and education activities in agricultural engineering because of its unique farming practices, topographical features, high rainfall, diversity of crops and small holdings.

The equipments and machinery developed in other parts of the country or elsewhere in the world were developed with the objective of saving labour. In Kerala, the holdings are small, and the number of unemployed labourers is large. Selective mechanization is therefore inevitable. Accordingly, we have to develop our own package of small equipment, implements and tools which will do the work better, reduce human drudgery and at the same time will not substantially reduce the labour content involved in the operations. The agrl· engineers of the University can design and develop various cheap and economical agricultural implements and machinaries such as seed drill, bed and furrow former, cheap hand pump, groundnut decorticator, dryland weeders paddy thresher and winnower, power tiller-operated paddy harvester, etc. These equipments can be fabricated by the village artisans and can provide more employment and more income to the rural people.

The management of ground water reservoirs of Kerala requires detailed studies of ground water potential and hydrological formations in selected areas of Kerala. The potential source of ground water has to be tapped for making cultivation possible during dry months.

Kerala has very undulating topography with hills, hillocks and valleys, the valleys are mostly paddy fields. In rainy season, surface and sub-surface run off from surrounding hills drain into the paddy fields making these fields water-logged. During this season, drainage is the main problem in the paddy fields. Pilot projects can be undertaken to reclaim the areas. Surface and sub-surface drains can be installed to facilitate the drainage.

Soil erosion is the most serious problem on the hills which have very steep slopes. It is a conventional practice that lands having more than 40 per cent slope should be put permanently under afforestation and natural vegetation should not be disturbed. The recommended practice to prevent soil erosion is to construct Pueto Rico type terraces and pitch the downhill side with stones for stability. Since this method is very expensive, it becomes necessary to find out alternative and cheaper, but effective methods of construction of bunds. it is also possible to develop a combination of mechanical and agronomic methods, such as contouring, strip cropping, conservation tillage etc. In situations where vegetative practices and temporary structures are inadequate, permanent soil conservation structures, namely, drop spill ways, chute spill ways and drop let spill ways can be constructed. These structures have manifold functions such as water conservation, sediment control, flood control and drainage control. Suitable technology can be developed in this field under the auspices of the Kerala Agricultural University. Most of the double cropped paddy fields in Kerala lie fallow from January to April for want of irrigation facilities. This constitutes a very large area where an additional crop can be raised. Crops like sesamum, pulses, vegetables etc. can be grown profitably in these fields using border method of irrigation. This method has a number of advantages: (1) border ridges can be constructed by bullock drawn-A frame ridger or bund former or tractor drawn ridger (2) labour requirement in this irrigation method is greatly reduced as compared to the conventional check basin method of irrigation (3) Uniform distribution and high water application efficiency are possible if the system is properly designed.

The overall irrigation efficiency in the surface method or an average comes to only 25 to 60 per cent because of loss of water due to seepage, evaporation and deep percolation. The advanced methods of water application called sprinkler and drip methods of irrigation have spread throughout the length and breadth of India. In these methods of water application the disadvantages in the surface methods of water applications are rectified. The main principle of sprinkler irrigation is that water is delivered under pressure into a system of portable, light weight pipe lines with sprinklers mounted at regular intervals. Complete sprinkler, irrigation to suit almost all crops and a wide range of conditions can be developed. When properly designed and all its components selected in accordance with wind conditions, cropping patterns and soil properties, the sprinkler system can be operated at high irrigation efficiencies compared with gravity irrigation of the order of 65–75 per cent. The main disadvantage is the initial investment. It requires a booster pump for sprinklers to work. Drip irrigation is the most accurate and sophisticated method of providing water for growing crops. This method achieves a three dimensional differential spread of water maintaining low levels of soil water tension. Under highly controlled conditions of soil moisture, fertilizer, salinity and pest control, the drip method has a significant effect on crop response, timing harvest and quality of yield. Drip irrigation, because of high degree of control over application, has proved a great benefit to farmers on soils having a very low moisture holding capacity. Bigger crop yields can be obtained by drip method and reports from countries abroad indicate clearly that yield, quality and water–use efficiency ensure the application of drip irrigation will continue to increase all over the world. Pilot projects on sprinkler and drip irrigation methods can be initiated in the Kerala Agricultural University in order to study the feasibility of adopting these methods on large scale.

The rapid escalation in the price of oil and gas over the last 10 years and uncertainities about our energy future have stimulated much interest in energy conservation and alternative energy sources. Throughout the world engineers and scientists are developing new system to conserve energy and to produce and manage alternative energy sources. Much of the effort to–day has been directed towards the development and refinement of alternate energy sources such as solar, wind and bio-gas. The research on renewable energy resources can be initiated in Kerala Agricultural University. The multi-disciplinary research work can be carried out in bio–energy, solar energy and wind energy which will result in the development of low–cost energy devices for bio–gas, solar energy and wind energy resources. The low-cost knowhow can be improved so as to promote its application by rural masses so as to materialise the objective of the Kerala Agricultural University to uplift the down-trodden of the hilly and tribal areas. The studies will result in development of different models and designs of bio-gas plant, solar driers, water–heaters etc. The research carried out in some parts of India reveals that solar energy can be used for developing solar water heaters through flat place collectors, solar cabinet drier for vegetables, solar crop drier, solar cooker with automatic trackling device, solar still for desalinization of water, solar-turbine for conversion of solar energy into mechanical energy, solar–water heaters etc. Similarly, wind energy can be harnessed for developing different types of rotors. such as savinous type rotor, vertically mounted cup type, horizontally mounted cup type and so on. Wind mill acts as a scum breaker of bio-gas. The bio–gas plant is provided with savinous type of overlap wind mill to break the scum formation in the slurry of a bio-gas plant. This, together with heat exchanger of solar system, improves the bio-gas plant performance. The report further reveals that solar–powered pumping systems are capable of serving the irrigation needs of 0.5 to 1 ha of land area.

During the last 40 years, about 30 designs of bio–gas plants have been developed in the different parts of India incorporating certain distinctive features either in the digester or in the gas holder. Out of these designs, two are being adopted by the users in the various parts of the country. These are K. V. I. C and Janatha bio-gas plants.

An investigation on utilization of salvinia (African payal) for bio-gas production in the Agricultural Engineering Department of Kerala Agricultural University, reveals that salvinia contained 4.57 per cent total solids and 85.9 per cent volatile solids and hence can be utilized as a potential raw material for bio-gas production. The design of a proto type unit that can be used for household purposes shows that this requires 6 cu. m capacity to meet the daily fuel requirements of 7–8 persons using dried salvinia as the substratae daily, which can be obtained from drying 400 kg of fresh salvinia, Further research on bio-gas technology can develop (i) low-cost bio-gas burner to fit in the country oven (ii) Agro-engine with alternative to produce electricity (a) to light electrical bulbs (b) to run electrical fans.

Post-harvest technology has potential to creat rural industries. In Kerala, where 80 per cent population live in villages and 70 per cent of them depend upon agriculture, it has been experienced that food, feed, and fibre industries have shifted to urban areas. This has resulted in capital drain from rural to urban areas, decreased rural employment opportunities and increased the economic gap between rural and urban population. The farmer whose role is reduced to producer only can be made as producer-cum-processor again by evolving low capacity agriculture based rural industries which are technically superior and economically feasible. Post-harvest technology and processing of agricultural produce have to be developed in Kerala as to break the monopoly of the big manufacturers, who are at present exploiting the farmers. The clear demarcations can be identified as below which offer direct linkage between agriculture and industries.

(a) Farmer level agro industries:- This includes conversion of agricultural main products into utility commodities such as rice after milling paddy, oil after crushing oil seeds, dhal after processing pulses and parboiling after conditioning paddy and so on.

(b) Recent agro-industrial technology: Certain waste and by-products of agricultural materials render themselves into industrial or valuable products. Similarly, a few materials of recent origin like plastics indirectly help agriculture. Industries or workshops will be useful to repair or produce agricultural machinery. Such enterprises constitute agro-industries of recent origin.

The discipline 'Agricultural Engineering' has been gaining currency throughout the world especially in countries which laboured most to expedite agricultural production to cope with the increasing demands of the newly born. This is of paramount significance in India generally and Kerala, particularly. The manifold steps undertaken by the Government of Kerala and the multiplicity of schemes, devices and techniques envisaged and developed by the Kerala Agricultural University in this burning issue indeed is laudable. It will be a *fait accompli* to record that Agricultural Engineering Technology will monopolise the realm of agriculture by 2000 A. D. The moulding up of a sizable number of Agricultural Engineering personnel-educated, trained and equipped to take up self contained engineering projects by Kerala Agricultural University, would be a considerable consolation to this subtle problem.

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Computerisation in Agricultural Research

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Among the numerous developments that have taken place in our country in the recent years perhaps the most important is the advent of electronic computers. Computers infact have become giant brains on which large parts of modern society depend. The spread of time sharing computer system and lately microprocessors has brought computer power in the reach of more and more people. Gradually we Indians are marching towards an era of robotic revolution which might produce far reaching effects on our economy.

This new tool which was developed during the middle of the present century has reduced extreme mental activity in many areas of present day living. A computer is essentially be called a data processing machine. It takes data as inputs, performs logical operations and calculations based on set patterns called programmes and gives the output data in various forms useful to us. The programmes are written using a sequence of symbols called languages and their number and variety are increasing day by day. At present the most popular languages are Fortran, Cobol, basic and Pascal. The future of programming language is not clear. But they should be as simple as possible. A day will come when every body has to write his own programme and run it on a computer. So it is essential to develop programming languages that clearly aim to natural languages used for communication. In western countries there are micro computers in almost every house or have terminals linked to commercial organisations, bank, etc. through telephone line or some other methods of high speed communication.

The continuous and rapid technological advances in electronic data processing are being exploited in all research and development activities especially in agriculture and a stage is coming soon at which any research work, big or small, is essentially to be backed up by a computer system. Though late, Kerala Agricultural University has also felt the need for establishing a computor centre at its main campus, Vellanikkara with sub-centres at Vellayani, Pilicode and Mannuthy. At this juncture it is worthwhile to examine some of the benefits that can be expected through computerisation of agricultural research, especially in our University.

At present there are 24 research stations under Kerala Agricultural University dealing with research activities in the different areas of agriculture, animal husbandry, fisheries and allied sciences. There is every possibility of increasing the number of research stations in the near future. Large mass of data are being generated in these stations as parts of numerous research projects but most of them remain practically idle for want of adequate facilities for data processing and analysis. Even in cases where utilization of data takes place the extracted amount of information is quite negligible when compared to the potential. Thus there is a colossal wastage of resources, though indirect. A computer system with facilities for auxiliary storage shall be the first step towards proper utilisation of data. Frequently, routine methods of data analysis fail to show the full significance of the relevant data and highly sophisticated methods of analysis have to be tried. In such situations the modern electronic computers with their great capacity and speed offer themselves as the most efficient means of solving difficult, tiresome problems most accurately without any time lag. Thus with the help of the computer the researcher is able to extract maximum amount of information from the collected data. In agricultural research computer facilities can be used extensively in such areas as analysis of data from experiments and sample surveys, soil test-crop response studies, breeding and genetics, forestry, ecology, fisheries and agricultural economics. A brief description of the type of work envisaged in the different areas is outlined below.

Analysis of data from sample surveys

In the field of agriculture sample surveys serve as a very useful and handy tool for obtaining objective and reliable estimates of population parameters. In fact, sample surveys supply the basic data for any planned economy. At present there is no specialised agency for conducting sample surveys in our University. But in the near future there is an urgent need for the establishment of a separate unit exclusively for the conduct of sample surveys so that sample surveys can be designed and executed in the proper way. Large quantity of data will be collected in the course of large scale sample surveys such as cost of cultivation surveys, assessment and evaluation surveys, surveys for estimating crop loss due to pests and disease, surveys for pre-harvest forecasting of yield, tribal surveys, surveys for estimating acreage, production and yield rate of perennial crops, surveys for estimating catch of fish, surveys for estimating forest resources etc. Completed questionnaries can be coded and transmitted to punched cards or read automatically on to microfilm and then to magnetic tapes or floppy discs. These tapes are then processed by the computer to produce summary tables from which printed reports are obtained.

Analysis of data from Agricultural experiments

In certain experiments highly sophisticated modern techniques of data analysis are to be used. Then the research worker is compelled to use the computer. For example, in animal breeding trial the experimenter often has to deal with non-orthogonal data which require lengthy, combursome calculations. The computational burden can be greatly simplified and accurate results obtained by the use of an electronic computer. Similar is the case with analysis of data from mixed factorial designs with confounding, long term experiments, multifactor and multi locational trials, groups of experiments, response surface designs etc. New designs and techniques of data analysis in the case of multiple cropping experiments, manurial trials on perennial crops, agro-forestry experiments, etc. are likely to be developed in the near future. But the fruitfulness of all these developments would be realised only with the aid of a powerful computer system.

Computer applications in the field of genetic and crop and animal improvement through selective breeding have been fully appreciated by research workers. The factors which are basically responsible for producing genetic divergence have to be assessed in order to take advantage of divergence in breeding. The techniques of path-coefficient analysis and principal component analysis are useful for this purpose. Information on additive genetic variance and variance due to dominance is often required by Plant Breeders. Observations on several hundreds of plants especially from segregating families belonging to different generations are analysed to estimate these variances. The low productivity of animals and plants can be improved by devising optimum breeding plans and selection techniques. All these involve large scale data processing and refined techniques of analysis which can be done only with the aid of a computer. Another problem in genetic studies is that of classification of a group of genotypes into different clusters according to genetic similarity. Different multi-variate techniques such as Mahalanohi's D^2, Hotelling's T^2, canonical analysis, Method of Principal components, cluster analysis etc. are used for this purpose. All these involve complicated computations especially when the number of characters is very high and can be done only with the aid of a computer.

Soil test and crop response studies

There are a large number of soil testing laboratories in our State. Each laboratory conducts analysis of a large number soil samples every year. Such information can be properly utilized for mapping soil fertility status of the different regions of the State. Further soil survey data can be utilised for numerical reclassification of soil series into a manageable number of groups on objective basis. Different statistical techniques such as numerical taxonomy, method of principal components, cluster analysis etc. are employed for this purpose. All these procedures can be attempted only with the aid of a computer.

FORESTRY

Situations occur in forestry research where vast amount of data is available which require frequent repetitive handling according to a prescribed pattern. For example, calculations of timber volume of a species of trees or grouping of trees into different diameter classes. Similarly prediction equations and growth models have to be developed for the purpose of planning and policy making. A computer facility will certainly reduce the labour involved in all such procedures. Another technique which has immense use in forestry is simulation. A model can be programmed on a computer to initiate the activities of an actual forest enterprise and this model can then be operated in records of machine time. It can project the consequence of a policy that would otherwise take decades of real time to discover by growing and monitoring a forest.

Farm management and mathematical programming

The technique of mathematical programming has immense use for the analysis of complex problems related to resource allocation in agriculture. In such technique the major effort goes on the specification of the model. Once the model is assumed computation takes place using an appropriate software. Such models may involve a large number of variables. For instance a model of Eyvindson and Heady (1972) on regional planning in U. S. A. consists of 5000 equations in 5000 variables. The task of solving such a large system of equations cannot be thought of in the absence of a computer· Mathematical programming includes many techniques such as linear programming, non-linear programming, dynamic programming, parametric programming and stochastic programming. Basically all these techniques consist in optimising an objective function subjected to a set of constraints. Thus they have wide application in the field of resource allocation and planning. These techniques have also been used for fixing the best least cost ration for animals and poultry, the optimum combination of plant nutrients which gives maximum profit to the farmer with limited resources. The optimum land allocation among different crops etc. Dynamic programming technique have great applications in agriculture in such problems as equipment replacement, mutiple cropping and relay cropping programmes and scheduling of irrigation. Hiremath (1972) applied this techniques for optimal allocation of irrigation water of Krishna Raja Sagar Project so as to maximise the net return of crops of the command area. All these techniques are workable only in the presence of a computer.

Model building and forecasting

Another use of computer is in the development of montecarlo methods of simulation. These techniques are useful in mimicking a complex situation characterised by uncertainty and change over time. In montecarlo methods mathematical models are developed by the use of a set of random numbers generated with the aid of a computer. These techniques are used to provide approximate solutions to complicated problems involving several variables especially in the field of ecology, epidemiology and genetics. Another method which helps in the planning and forecasting when faced with uncertainty is Markov Process. Application of all these techniques presupposes the availability of at least a microcomputer.

DATA BANK

With the increasing complexity of socio-economic structure and the need for planned development there is a growing necessity of building a data bank for helping the decision makers to get quick, reliable and up-to-date information on agriculture and allied topics. Data from various sources could be brought together edited and stored in the proposed data bank for instant retrieval as and when required. Some of the data files which can be kept in the data bank include germplasm data file, data files of soil test and crop response measurements, toxic levels of insecticide preparations, directory of field trials and sample surveys, plant and animal breeding Statistics, Package of Practice recommendations etc. The data bank should be modified and updated dynamically.

Another use of computer is in the documentation field. It is estimated that about 2.5 lakhs of documents are produced throughout the world in the agricultural field alone. An effective documentation system is essential for preventing wasteful expenditure on repetitive research. Indexing and abstracting of documents become easy in the presence of a computer facility. Retrieval can be done within seconds. Search can be, made on subject categories, commodity categories and as text material contained in the data bank. One can even search for the places of occurrence of a single world like 'Statistics' and get the details. The word processing facility of the computer system helps in neat typing and duplicating. It is said that a single word processor can replace 8 typists and the real output is still larger.

COMPUTER GRAPHICS

The computer controlled graphic devices are sufficiently readable to permit direct use in reports eliminating laborious manual plotting and drafting. They help in producing a deeper understanding of a complex phenomenon. Programmes can be made for multi-dimensional plotting of data which help in the formation of clusters based on several criteria.

Automation and its consequences

Automation and similar other developments in computer technology have been fully accepted and exploited in developed countries. In India also since such machines have been locally produced one cannot refrain from using them. No doubt, automation will affect employment opportunities. But new avenues of employment will also arise as a consequence of automation. Thus the problems should be properly taken care of by proper reorganisation of employment potential.

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Agricultural Microbiology by 2000 A. D.

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Five broad areas of research are being identified in the field of Agricultural Microbiology for priority reasearch by 2000 A. D. and beyond. These are in the field of:

1 Biological nitrogen fixation
2 Mycorrhiza
3 Biogas production
4 Fermentation Technology
5 Bio technology through molecular cloning techniques

Research work has already been initiated in our University in the field of biological nitrogen fixation and myocorrhiza. However, there is much need for diversification of research in these areas by:

a) developing more crop specific and efficient strains of rhizobia suitable for the major grain and fodder legumes cultivated in our State.

b) Effective use of free living diazotrophs as an organic amendment for improving the fertility status of our soil.

c) A more detailed understanding of the phenomenon of associative nitrogen fixation of Azospirillum with cereals and grasses and developing suitable technology for improving the host affinity of this bacterium on par with the symbiotic system in quality and efficiency.

d) Establishment of a central laboratory for testing the quality of various microbial inoculants whether produced within the state or otherwise to check their quality and to prescribe the standards set forth by Indian Standards Institution and other statutory agencies.*

In the field of mycorrhiza, there is great need for the better understanding of the obligatory nature of the association between vesicular arbuscular mycorrhiza and certain crop plants; its effect in the uptake of P and minor elements and thereby its effect on crop productivity and finally the role of mycorrhiza on the incidence and control of soil borne diseases of both fungal and bacterial etiology.

* The scope of this laboratory can later be extended for checking the quality of marine and other export oriented food products for their microbial quality especially for testing the presence of coliform bacteria.

In the field of biogas production, the technology for gas production is fairly well advanced. What we need is to think of the ways and means for the fabrication of an economic, long-lasting and efficient digester and to improve the ratio of methane produced by suitable adjuvants with or without pre-treatment. In this connection, it is necessary to emphasise here that it is absolutely essential to establish a laboratory with ail the infrastructural facilities for the study of anaerobic methane producing bacteria involved in the biogas production. This alone will enable to understand the physiology of methane production by this bacteria and to develop suitable technology for improved methane production by altering the physical and chemical conditions and or through genetic improvement of the strains through molecular cloning.

It is time for us, if not late, to initiate research in the field of fermentation technology. To begin with, one may either adapt as such the existing technology for the conversion of various tuber starch to ethanol and later improving the same to more economically viable projects. The use of sweet potatoes and tapioca as raw materials for this purpose is worth consideration. Another area is the bio-conversion of cellulose into ethanol and or single cell protein for food and feed.

Finally, if we have to be abreast with the current trends in world research, we have to lay the foundation now itself for a bio-technology laboratory in our University. In the field of agricultural bio-technology this will enable to understand the nature of *nif* genes in various diazotrophs; its organisation in plasmids and/or in chromosomes and the possibility for the transfer of *nif* genes to a photosynthetic encaryotic system. Another area for research in this field will be the development of more efficient strains of diazotrophs by chemical, physical or biological mutation and or through the development of newer strains by the molecular cloning techniques.

One should also study the nature of plasmids is certain in plant pathogenic bacteria and understand its role in the expression of virulence and in the development of disease symptoms. The curing of such virulent plasmids for mild strains for cross-protection may also be explored. Then there is the exciting field of cloning super bugs of 'Pseudomonas' capable of controlling organic environmental pollution and in the prevention of the bio-magnification of the potentially harmful plant protection chemicals.

What should be done to achieve these projected targets and hopes by 2000 A. D?

It will be an immediate task of our University to strengthen the disciplines of Microbiology, Biochemistry and other related areas with P. G. teaching and research facilities along with the establishment of a bio-technology laboratory. This will ensure the right type of resource personnel and the required infrastructural facilities for a team work in order to achieve the targets identified and set forth for the year 2000 A. D.

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Need for Crop Genetic Research Centre for Kerala

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ABSTRACT

Genetics—the core subject among the biological disciplines is the most fascinating subject of study. Progress made in the fields of recombinant DNA technology, production of monoclonal antibiotics, tissue and cell culture, Protoplast fusion techniques etc. justifies genetics as a unique scientific discipline with wide application for human welfare. It is estimated that the world population will be eight billion in 2015 A. D. Only further advancements in the fields of crop genetics and biotechnology can provide food and shelter to this huge mass. It is however disheartening that this discipline has not received the attention it deserves in this part of the country. A *"Centre for advanced crop genetics and biotechnology"* should be started immediately with Co-ordination of such disciplines as Cell biology, Cytogenetics, Bio-chemistry, Physiology, Microbiology and Cell and Tissue Culture.

As the Late Prime Minister Smt. Indira Gandhi in her opening address in the XV International Genetic Congress stressed, "We need a vast array of trained and committed personel supported by appropriate facilities for the effective utilization of available genetic resources in plants and animals".

This proposed centre could also be vested with the responsibility of training personnel engaged in tropical crop improvement programmes.

The major advances during the last decade in the field of Genetic Engineering and recombinant DNA have placed genetics the foremost among the modern scientific fields. The significance of recombinant DNA technology in agriculture has not yet been fully appreciated by scientists working in the field of plant breeding and hence even today genetics has not gained the importance as it deserves. They also feel that if this most important field of crop improvement is identified and separated their survival will be in danger.

Kerala is unique in its genetic resources of plants and animals. Vavilov (1933) writes that "The Growing needs of civilized man and the development of industry make the introduction of new plants necessary. The vast resources of wild species, especially in tropics have been untouched by investigators". The native flora and fauna available in Kerala when fully explored would provide material for future break through in agriculture and animal husbandry.

The proposed crop genetic and bio-technology research centre can explore the rich flora and fauna of this area and add to the wealth of germ plasm needed for further exploitations, which can be effectively utilized for agriculture, animal husbandry, medicine and industries. For the same the following areas of study should be included:

1 Exploration and conservation on the flora and fauna—Microbes to tree crops.
2 Mechanism and application of DNA transformation—Pro and Eukaryotes.
3 DNA replication and repair mechanisms in relation to induced mutations.
4 Recombinant DNA technology in Eukaryotes.
5 Genetics of Nitrogen fixation—Symbiotic and non-symbiotic-and its regulatory mechanisms.
6 Bio-chemical and physiological genetics in Eukaryotes,
7 Genetics of defence mechanisms to various stresses including-pest and disease resistance.
8 Application of plant tissue/cell/DNA culture in agriculture and forestry.
9 Genetics of host-parasite relationship for herbal, insect and fungal pests.
10 Bio-chemical and molecular polymorphism etc.

Frankel (1974) has pointed out that genetic conservation is an evolutionary responsibility. To satisfy the full meaning of this statement, Swaminathan (1984) discerned three major groups of responsibility and classified as Professional, Political and Public.

Professional responsibility rests with well trained and expertised groups of geneticists, ecologists and conservationists. Political aspects concerned with the development of national policies which will help to accord priority to the protection of the environment, conservation of genetic material and appreciation of the dangers arising from genetic erosion and vulnerability. Above all the politicians must be committed to the cause of considering genetic material as a common human heritage.

The material worth of preservation can be classified following Swaminathan (1984) as cultivars, obsolete cuitivars, primitive cultivars/land races, wide species and weedy species closely related to cuitivars, wild species of potential value to man and special genetic stocks.

Consumer preferences and market forces limit the genetic uniformity of cuitivars in crop plants. Even then, only 150 plant spp with about a quarter million local strains satisfy the global calorie needs.

Wild species of potential value to men are not cultivated and serve as strong gene donor for various desirable attributes and hence should be Identified through exploration. Land races, weedy relatives and wild plants of cultivated forms promise gene pools for further unlimited improvement in the existing cultivars.

In order to provide structural support to the collection, conservation and utilization of plant genetic resources, the International Board for Plant Genetic Resources (IBPGR) was organized during 1974 by the Consultative Group on International Agrl. Research (CGIR).

Gene banks by *ex-site* and *in-site* techniques should be provided for all the available organism for timely utilization for human needs. The genetic systems operating through bio-chemical and Physiological reactions in these organisms have to be studied in detail. 'Wild genetic resources' should be preserved and maintained properly.

Genetic resource exploration and gene banks by *ex-site* and *in-site* techniques should be standardised and maintained in Kerala for:

1 Microbes:

These are valuable foods, fuels and yields a wide range of bio-chemicals. As pointed out by Kirsop (1983) gene banks for microbes should be maintained to utilize in bio-technologies for human welfare. Microbes important to agriculture, medicine, industry and environment can be identified and conserved in gene banks.

2 Blue-Green Algae:

They aid in atmospheric nitrogen fixation and enrich the soil fertility by their high nitrogen content. This also serves as a source of useful bio-chemicals and by genetic analysis on photosynthesis and respiration, the physiological genetic mechanisms operating in higher organisms can be fixed. All the types and species of blue-green algae available under tropical and sub-tropical conditions should be explored, identified and utilized.

3 Crop plant relatives:

The close, distinct and wild species of cultivated shrubs, spices and condiments, medicinal plants, aroids and bulbiferous plants are rich in the virgin forests available in Kerala. The exploration, identification and conservation of these plant species will provide food, fodder, feed and fuel, medicine and enrich the economic status of the country. Gene banks for crop plant relatives should also be started.

4 Forest genetic resources:

Tree formations of this plants are being lost at the rate of 11 million hectares every year and so far only 1 in 6 of tropical plants and animals has been given a scientific name (Swaminathan, 1984). Proper tree genetic exploration, conservation and utilization should be initiated to support agriculture, medicine and industry. For example, Neem-a tree with multiple use in pesticide formulations and fertilizer industries and other related tree crops should also be explored and studied in detail. Identification, conservation, utilization and multiplication of pollution resistant crops require special attention for human welfare.

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Sugarcane in Kerala by 2000 A. D.

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Sugarcane is cultivated in Kerala under a variety of agro climatic situations like the low-lying per humid flood-prone areas of the river banks of the erstwhile Central Travancore, the sub tropic humid conditions of the high range and the semi arid regions of the Palghat District. The soils under sugarcane ranges from highly acidic lateritic alluvium of the river banks, virtually organic soils of the high ranges and calcareous soils of the Palghat District in the Chittoor area. It is cultivated from sea level or even below MSL to as high as 5600' above sea level in the State. According to the latest figures, the crop occupies an area of 7000 ha with an average of yield of 60 tonnes/ha. The yield ranges from 30-40 tonnes in the flood-prone areas under neglected conditions to well over 100 tonnes/ha under well managed farms in the plains and hills.

As in the case of any other field crop, area under sugarcane is also subject to pressure for homestead as well as other personal uses. However, apart from this natural generalised phenomenon sugarcane cultivation and production have been baffled in the plains by a number of socio-economic factors like labour scarcity, mounting cost of labour, low remunerative price, out break of epiphytotic diseases like red rot and lack of sustained and sourceful effects to identify and rectify the maladies the crop faces. In spite of all these, a positive trend for increase in area and production has been noticed very recently. It has to be mentioned here that the crop has to sustain three sugar factories of the State which employ about 1500 people and large number of agricultural labourers and farmers.

It is estimated that by 2000 A. D. we may have to bring about a three-fold increase in area, two-fold increase in average yield and 25% increase in recovery of sugar to meet at least 25% of our minimum demand for sugar, jaggery and alcohol in the State. The crop serves as the sole internal source for jaggery production in our State by utilizing about 60% of the cane produced in the plains and 100% in the high ranges providing employment to the agricultural labourers and livelihood for the sugarcane farming community for about 6 months in an year and all through the year respectively wherever it is cultivated.

Authentic technological explorations in the field of sugarcane in this State were started only seven years ago. During this period, in addition to making specific recommendations we have been able to locate the barriers that limit the yield of cane in the State.

Sugarcane season in the present system of cultivation starts in December-January extending upto February-March. The crop faces an acute dry spell during germination and tillering phase from February-May, an overcast sky with less than 6 hours of bright sunshine during grand growth phase from June to

September and flowers in September-October which arrests further vegetative growth. This suggests lack of integration between plant and weather resulting in low yield.

Absence of varieties enolved to suit to the specific and peculiar weather pattern of the area contributes in multiple ways for the low yield in this area. The varieties evolved for the semi-arid regions naturally fail in the per humid monsoonic tracts. Over 1000 cultures specifically produced for this area are under various stages of evaluation which are expected to solve the above problems.

Experiments show that intermittant monsoonic floods of June–July, though last only for short spells of one to two weeks, are fatal to these varieties and the yield reduction is of the tune of more than one tonne per day of flooding. An average loss of 20–40 tonnes/ha can be considered natural every year. These lanky varieties fail to withstand the monsoonic winds and an average loss of 30–35 per cent in cane and 40–45 per cent in recovery is estimated from lodging under neglected conditions of cultivation.

Survey estimates from the sugarcane tracts indicate that 10-15 per cent of clumps of a plant crop and 15.30% of the clumps of ratoon crop are lost due to grassy shoot disease alone which could have been avoided by a well organised seed programme. We are fortunate that an aerated steam therapy unit to intiate the seed programme has been sanctioned to us by ICAR very recently.

Survey estimates have brought about the occurrence of red rot disease in Kerala for the first time and the crop losses due to this malady reach upto 100% in severe cases. After screening more than 300 types we have recommended two varieties for large scale cultivation.

Labour scarcity and mounting labour cost results in delaying and foregoing essential cultural operations. While the commodity price has remained almost stagnant, labour cost has registered a three-fold increase during the last few years. Partial mechanisation is not only the answer for this, but is expected to reverse the trend. Efforts are under way to procure these machineries.

Unbriddled ratooning – a product of high labour cost and a total lack of scientific know–how has been another cause of low yield of sugarcane in our State. Ratooning beyond two generations often leads to high incidence of diseases and low yield as low as 50% of the plant crop.

Fertilizer management which is considered to be the key for higher production has been rather totally absent in sugarcane production till the recent past. This lacuna is being bridged at present and experiments designed to find out the nutrient needs shall open new information in increasing production.

Irrigation - the vital component in sugarcane cultivation has not been given adequate importance even in areas where water is available. The water requirements of the crop under our weather conditions have to be thoroughly investigated so as to economise cost without deterimentally affecting production. Projects have been designed for the purpose and useful results will be available when the data are interpreted with weather parameters.

Having understood the barriers in the exploitation of high yield, we are at present in the threshold of a big leap forward.

The most important points in favour of a renovated technology in sugarcane production, the extension of area and processing are:

1 It is the most efficient transformer and build-up source of solar energy in biotic forms. It produces much more energy per unit area than any other cultivated crop. Physiologically designed to stand to the rigours of high temperature of tropics without any photo respiration, it is one of the most efficient cultivated plants in the process of absorption and utilization of Co_2 from air. When Co_2 concentration of 300 ppm limits the photosynthetic process in pulses, oilseeds and cereals like rice, sugarcane continues the process till the Co_2 concentration of air is exhausted to 5 ppm or even low. This attribute in sugarcane bestows the twin qualities of high water and fertilizer use efficiency and a high cost: benefit ratio.

2 Among all cultivated annual crops sugarcane alone can sustain large number of people in ancilliary industrial units.

3 It shall continue as the main source of raw material for distillaries which earn to the State revenue of crores of rupees by way of purchase tax, excise duty etc.

4 Ethanol from sugarcane, - a cheap resource, is to become sooner or later a suitable substitute or at least an accessory against the fixed resource of petroleum.

Scope for expansion of area under Sugarcane in Kerala

Attempts were made sometime past to introduce sugarcane in the Kuttanadu region, but ended in failure due to the low recovery of sugar. Many varieties with high sucrose content are now available with built in resistance to adverse conditions like acidity and alkalinity. Preliminary investigations in the *kari* soils of Thakazhi area have proved that sugarcane can be cultivated successfully in these areas and there exists much scope for expansion of sugarcane cultivation in Kuttanadu where monocropping of rice is in vogue. Crop rotation with sugarcane in these vast stretches will go a long way in increasing production of sugarcane as well as reducing the constant loss incurred by rice cultivators besides eliminating many pests and diseases of rice which often cause total loss to rice.

There also exists vast scope for introducing sugarcane in the rice fields of Wynad regions where a single crop of rice is taken. This view is in conformity with the successful results of sugarcane cultivation conducted at the Horticultural Research Station, Ambalawayal as also the vast area of more than 2000 ha in the high ranges of Idukki Dist. Thus a sugarcane belt can be generated in the high ranges of the State meant exclusively for jaggery production providing employment to large number of agricultural labourers and livelihood to farmers besides meeting our requirements.

Thus it can be seen that sugarcane will be an ideal crop for the State and is a potential answer to the farming community destined at present to marginal profits, provided plant types adaptible to our ecology are evolved and comprehensive location specific management practices are formulated.

As years roll out, profit sensibility will govern allocation of land under crops and it is more than certain that sugarcane with the twin advantages of high productivity and diverse utility as the base raw materials for industry will have the preference and precede over other crops in the beginning of the twenty first century.

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Cattle Breeding Strategy for Kerala—2000 A. D.

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Lying in the heavy rainfall tropical region, Kerala did not possess a cattle wealth to be proud of. In 1956, when this State came into existence, there was a population of 25.1 lakhs of cattle. From the records maintained at various stations involved in cattle breeding programmes, it can be seen that the native cattle of Kerala are small, producing 521–750 kg of milk for a lactation period of 290 days and that they were not recognised as a breed.

During the last three decades, as a result of massive developmental programmes, gloomy picture of this State with regard to cattle potential turned to be rosy. Today Kerala has 31 lakhs of cattle, out of which 14.5 lakhs are improved type belonging to crosses of either Jersey or Brown Swiss. During this period, per capita milk production increased to 116 g in 1982 from 41 g in 1956. This remarkable progress is not due to significant increase in number or land available for cattle.

Density of human, cattle and buffalo population in Kerala per square km and per capita milk production

Year	Human	Cattle	Buffalo	Per capita milk production (g)
1956	389*	65	13	41
1961	435	71	13	51
1966	493*	74	12	40
1972	555*	74	12	36
1977	623*	77	12	80
1982	654*	80	11	116

* Based on estimated figures

Cross breeding programme supported by improved managemental practice is responsible for this happy situation. In spite of this remarkable progress achieved in the cattle front, we have to work a great deal to achieve the target of 250 g of milk per capita daily production by 2000 A. D.

Retrospect

To evolve a cattle breeding strategy for future, it is necessary to consider in retrospect, at least in brief, what policies and programmes were implemented in the State, to enhance milk production potential of cattle. No policy for cattle improvement either for the entire country or State-wise was in vogue prior to 1951, but isolated, unplanned efforts were made such as free distribution of bulls, castration of scrub bulls and to a small extent disease control measures, eventhough the need for the co-ordination and proper guidance so as to initiate cattle development on all India basis was emphasised by the Royal Commission on Agriculture in India in its report as early as 1928.

During the First Five Year Plan initiated in 1951, cattle development did not receive much attention in the State plan and budget alloted to animal husbandry was meagre. No systematic attempts were made during the first plan period to improve the cattle type in the State. However, as part of cattle development, taken up on all-India basis, key village blocks and premium bull distribution schemes were implemented in this plan period. It was, however, realised in the second five year plan period, that programmes of cattle husbandry have to be diversified in order to cover all important aspects of cattle development. Steps were initiated to expand facilities of artificial insemination as a pre-requisite to cattle development and to intensify the disease control measures. Research programmes on various aspects of cattle development were strengthened. Co-operative Societies were organised with a view to generate interest in farmers, by providing necessary arrangements for breeding and feeding of cattle and marketing of milk. The cattle development schemes proposed were almost fully implemented.

During the Third Five Year Plan as well as subsequent plans, on going schemes were expanded so as to provide the benefits to more cattle owners. Development of dairying and distribution of milk were given special attention in the Third Plan, unlike the previous two plans. In Dairy Development, emphasis was placed on the installation of milk processing plants in cities and organisation of large number of Co-operative Societies to boost up the facilities for marketing of dairy products. Cross breeding was continued through A. I. Units, Key Village Blocks and Intensive Cattle Development Projects. A separate wing in the Animal Husbandry Department was organised to nourish the crossbred calves better by supplying concentrates at a subsidised rate, fodder slips and fodder as such. In order to provide satisfactory health cover, more veterinary hospitals and polyclinics were established and animal health camps were organised. Cattle development, looked after by one department in 1956, grown into many ramifications attended and managed by more than one organisation viz., Departments of Animal Husbandry, Dairy Development and the Kerala Livestock Development and Milk Marketing Board. Research programmes and animal husbandry education have been strengthened by the establishment of Kerala Agricultural University.

The policies for improvement of cattle laid down on all-India basis were adopted in evolving the breeding policy for cattle in the State. In earlier years, the policy was to breed the local, non-descript cattle with bulls selected from improved recognised breeds of this country and to upgrade them to the level of the improved breed. The objective was to evolve a type with improved milk production and good draft qualities. The bulls of Sindhi breed were considered suitable for Kerala having heavy rainfall and Murrah bulls were considered for the improvement of local buffaloes. In areas, where the demand for bullocks is high, the bulls of famous draft breed, Kangayam, were used.

When it was felt that enhancement of milk yield of non-descript cattle by crossing them with superior bulls of indigenous pure breeds is time consuming, it was considered to introduce exotic inheritance in native cattle through cross-breeding. A decision was taken at tenth meeting of animal husbandry wing of the Board of Agriculture and Animal Husbandry held in 1953 to conduct experiments on cross breeding in field conditions in hilly and heavy rainfall areas. The exotic breed chosen for cross breeding was Jersey and later on both Jersey and Brown Swiss. The introduction of Brown Swiss breed was made possible by the Indo-Swiss Project established in 1962 as a Joint Project by the Government of Kerala, Government of India and Confederation of Switzerland. The encouraging results prompted to undertake large scale crossbreeding. In the beginning of the cross breeding programme, there was hypothetical fear of segregation of genes in the F_2 generation diluting the gains obtained in the F_1s. Consequently, the approach was that of constant grading up to attain the level of pure exotic breed. The defect with this approach was deterioration in major economic traits beyond certain level of exotic inheritance. When it was realised that inheritance of milk production is largely determined by additive genes, inter-se mating of F_1s followed by selection is being attempted in this State. Simultaneously, it was found that both Jersey and Brown Swiss Crosses performed equally well in the field conditions of Kerala and the crosses of these two exotic breed did not vary significantly with regard to milk production (Mukundan and Mathew, 1983). The present breeding policy of the State is to limit the exotic inheritance to 50 per cent irrespective of the breed and to practice intense selection for improvement.

Strategy

Assuming that human population in Kerala may increase to about 330 lakhs by 2000 A. D. the daily requirement of milk would be 83 lakhs kg to meet the per capita requirement of 250 g of milk per day. There should be 16 lakhs of cows with an average production of 2280 kg of milk in a lactation period of 305 days. The intercalving period should be 15 months. The present production for a lactation in the field is around 1500 kg; but this cannot be taken as the real potential of the crossbreds as evidenced, by the paper of Jose *et al* (1984) who reported 2366 kg as lactation yield of Brown Swiss halfbreds in Indo-Swiss farms. Genetic improvement is no substitute for optimum nutrition and management. Genetic manipulation will produce cows of required idiotype only if appropriate environment is provided. Given environment better than what is provided now and assuming that under such environment, potential of the cows cannot be less than 2000 kg, what would be the genetic improvement by 2000 A. D.?

Selection of cows cannot be intense except for producing young bulls, but can be intense for the bulls for production of daughters and sons. Almost 95 per cent of the genetic improvement is obtained through the selection of breeding bulls at different stages. Initially the bulls are selected based on sire and dam and thereafter based on the performance of the daughters. Proper selection of bulls and their judicious use can lead to an average annual improvement of approximately one per cent in the population. This will increase the lactation yield to 2300 kg from 2000 kg during the next 15 years. This would satisfy our requirement of 83 lakhs kg of milk per day. The 16 lakhs of high producing cows would be available if the local cows are replaced by crossbred cows. Our aim should, therefore, be an improvement horizontally as well as vertically, which necessitates the application of modern technology for the proper results.

It is gratifying to note that Kerala has started a progeny testing scheme under field conditions. Many constraints are being faced by the programme during its implementation. At present, for every 100 inseminations done, only 14 female calves are reported as born and only 4 are available with complete first lactation records (Diener, 1983), mainly because of emigration of daughters or daughters and dams, by sale.

Varying levels of management adopted by the different farmers based on socio-economic and agro-ecological conditions affect the milk record. Even the milk recorded is not accurate as calves are allowed to suckle for the let-down of milk before milking.

For any selection and breeding programme, accurate recording system should be developed, to assess the trend of progress. Unlike in countries developed in dairying, the herd-size is small in Kerala. The number of average milking cow per farmer is only 0.9 and this situation is further aggravated by distances between the two cow sheds. However, the part-time recording done on contract basis now followed works well.

Taking into consideration of the conditions prevailing in Kerala, new methods have to be developed to evaluate the bulls and this necessitates constant as well as strong research base, with computer facilities. Expanding the project areas of progeny testing and bringing more cows in the recording system and entry of all female calves in a herd book would be helpful to overcome the present constraint of insufficient number of recorded daughters. Adjusting the data for environmental effects have been emphasised by Thomas *et al* (1983) and Diener (1983), analysing the data on Brown Swiss crosses reared in the field. An attempt has been made in the University to work out optimum interval for milk recording of crossbreds.

Buffaloes and goats

According to 1982 census, in Kerala, 4 lakhs of buffaloes and 20 lakhs of goats are available. Out of 1087 thousand metric tonnes of milk produced in the State, 10 per cent is contributed by Buffaloes and 7 per cent by goats. Programmes to improve these species will accelerate our march to attain the goal.

Application of modern technology for cattle development

In order to improve the efficacy of methods implemented it is necessary to adopt modern technology so that farmers engaged in the cattle husbandry will derive benefits of developmental programmes without loss of time. Computerisation, establishment of cytogenetic and immunogenetic laboratories and application of bio-technology are unavoidable for a speedy development of cattle.

(a) Computerisation:

In developed countries, computers have become an essential aid to cattle husbandry programmes especially in record-keeping and analysis. It is possible to store voluminous data which, otherwise will be lost or will not be recorded at all. Large data are necessary for meaningful interpretation of results obtained. Both storage and analysis of data are efficiently carried out by a Computer. Details of the cows as to their ownership, ancestors, progenies, mates, production, reproduction, disease etc. are fed to the Computer for retrieval when required. The efficiency of an extension worker will improve and he shall be able to advise promptly on various aspects, such as breeding, feeding, management and disease control.

(b) Clinical genetics and facilities for parentage control

Bulls for the progeny testing programme should be screened for any chromosomal abnormalities before they enter into the programme. Often, accuracy of the records with regard to pedigree becomes doubtful. Establishment of blood group or bovine leucocyte antigen laboratory will solve the problem of disputed paternity.

(c) Biotechnology

Artificial Insemination and Cryo preservation of sperm have enabled to reduce the number of breeding bulls and to obtain high selection intensity. The possibility of hormone induced superovulation, fertilization of these ova, collection of the resultant embryos and their transplantation to foster-mother have created opportunities for having more number of calves from superior cows. In many developed countries, embryo transfer has become popular. This technique, if adopted in Kerala, will bring about rapid genetic progress in cows. This technique also facilitates the conservation of germplasm which may likely to become extinct in due course.

Simple techniques have been evolved to control the sex of the calves to be born. A great impact in the economic front can be felt by the application of this technique. The large number of male calves to be born as a natural phenomena can be reduced with this technique.

Conservation of germplasm

Mass scale cross breeding programme will eventually result in the replacement of existing native stock of cattle. The small sized, disease resistant native cattle have been naturally evolved after hundreds of years. At a later date, if necessity arises for the introduction of native genes, steps have to be taken to conserve them before long. Frozen embryos of native cattle will not only meet the demand of germplasm but also will help to produce control population as and when required, in future to assess the genetic improvement through selection. Though the cryopreservation of embryo may facilitate the conservation of germplasm, it is necessary to maintain a farm of live animals as a precautionary measure to face man-made mechanical and electrical break down.

CONCLUSION

1 As a result of crossbreeding of native non-descript cattle with exotic bulls the per capita milk consumption increased to 116 g in 1982 from 41 g in 1956.

2 For a per capita milk consumption of 250 g the average daily milk production has to be 8.3 million kg.

3 To achieve the above target, it is necessary to have a horizontal improvement of cattle from the present 14.5 lakhs to 16 lakhs crossbred cows and also a vertical improvement from 1500 kg to 2280 kg milk in 305 day lactation period with an intercalving period of 15 months by an effective selection programme within the population accompanied by a rigorous improvement in management.

4 Taking into consideration the many factors affecting milk production, a method specially suited for Kerala has to be developed for evaluation of the bulls by progeny test, and superior proven bulls should be widely used for genetic improvement.

5 Screening of bulls for chromosomal aberrations and parentage control methods should be a routine practice.

6 Extending the milk recording to areas uncovered and computerisation of recording system would not only be an aid in selection but also would provide the plateform for implementation of effective extension services.

7 Embryo transfer should be popularised so that superior cows can be made to produce many offspring and unproductive cows can be used as foster mothers.

8 Steps have to be taken to conserve the germplasm of native cattle as live animals and also as frozen embryos and sperms.

9 An agency should be organised to co-ordinate various activities in the field of cattle development undertaken now by two Government Departments, KLD & MM Board and KAU.

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Poultry production—Shifting priorities in research

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During the last two decades the advances in poultry production that have taken place in this country, especially in the area of chicken production, is a text-book example of impact of adopting proper scientific technology for progress. The figures presented in Table 1 clearly indicate that 66% of the total poultry population is made up of improved birds capable of laying much higher than the desi/local varieties. It is also evident that 85% of total egg production in our country comes from these improved birds, consequently the per capita egg consumption which was 5.3/year in 1961 has risen to 19/year in 1980. The establishment of Random Sample Laying Test Centres by the Government of India in different agro-climatic regions created a competitive spirit among the poultry breeders in the country. This tremendously helped in improving the availability of superior hybrid chicks. In fact, the increased egg production had also opened up possibility of export of this commodity (Table 2). Realising the social role that poultry can play, higher outlay in V year plan had been made (Table 3). As a result the chicken population has increased, compared to other species of animals (Table 4).

Simultaneous efforts for making available balanced feed were also taken up to support the genetic improvement. Consequently the poultry feed production has also increased (Table 5). In the meantime, the Indian Standards Institution also prescribed standards for poultry feeds, houses and equipments in order that the real genetic potential will be fully realised.

During the past decade, there has been an awareness in the production of broiler chicken as well (Table 6).

Thus, it could be seen that due to introduction of modern scientific technology in chicken production such as adoption of better breeding techniques, innovations in intensive system of housing, making available nutritionally balanced poultry feed, better health cover and development of indigenous poultry equipment, the chicken production has transformed itself into an industry. But the major bottleneck in both chicken/egg production and chicken broiler production is the lack of organised marketing channel. Consequently the chicken farmers are left at the mercy of unscrupulous middlemen in the trade and the small and marginal farmers are squeezed out of business because of their inability to fight with the large sharks.

Further, from the commencement of poultry developmental activities, emphasis has been on chicken production, neglecting other species of poultry, especially duck and quail. It is only from the sixth plan period that some developmental efforts have been made on these species.

Where does Kerala Stand ?

The socio-economic profile of Kerala is very much different from the rest of the country. Population pressure on unit area, fragmentation of land holding, an eagerness to go in for commercial crops and an eagerness to investment that will result in quick returns have all been trends that we have been seeing around us during the last decade. Thus, any programme for the overall development of the State—be it agricultural production, animal production or industrial production—has to be tuned to these circumstances.

The consequences of the above development in so far as animal production is concerned, have been smaller land holdings where all farming activity has to be restricted. Thus, in so far as poultry farming is concerned the traditional backyard system for egg production seems to stay with us. This, does not preclude the development of large scale chicken farming. But this would be only very nominal. Thus, in so far as egg production from chicken is concerned our priorities should continue to be centering round developing technologies suited to improve production of egg from backyard units. This means developing a chicken that can survive and sustain the vagaries of the backyard environ but still provide economic production—not highest production.

For the reasons already stated, broiler production is picking up in Kerala. In fact there are more broiler farmers in Kerala than farmers raising chicken for eggs. Thus research is to be initiated for developing technologies for obtaining optimum production in these segments.

Kerala with a large coastal belt, back waters and ponds offers ideal situation for duck development. Kerala ranks 5th in duck population. This species, which has good potential for development, has been neglected both by scientists and planners. In a survey conducted recently by the Kerala Agricultural University, it was evident that none of the farmers are raising high laying variety of ducks and all of them are raising the non-descript local/desi varieties which are known poor producers. In another study, it was also established that the non-descript local/desi can be improved by appropriate breeding techniques while simultaneously attempting to test the efficacy of the exotic breed in our hot humid climate. Further, the nutritional, managemental and housing conditions of this species are less clearly understood when compared to chicken. Thus the Kerala Agricultural University should give higher priority for developing technology for duck production.

The experience in Hungary, Jawa and similar countries points out to the possibility of a joint centre of fish and duck. Kerala has potentials for both these species and they are considered in isolation. Developing appropriate technologies for a duck-cum-Fish centre will go a long way not only in augmenting the production from these species concurrently but also will help to increase the income of duck farmers in Kerala who belong to economically weaker sections. Further, the smaller land holding by Kerala farmer is another reason why the Kerala Agricultural

University should turn Its attention to the joint culture of fish and duck.

Japanese Quail, a wild species domesticated for egg and meat production has been introduced into the realm of poultry and possibly offers immense potentialities for development especially for the urban population which is increasing steadily due to rapid industrialisation. It is worth mentioning here that with larger share of income being spent by urban elite on non-food items, introduction of Quail could prove to be a source for supply of nutritious food at lower cost. The research information on this species is rather scanty.

One constraint for the large scale poultry farming in the state is the dependance for feed ingredients on the neighbouring states and possibly the easy spoilage of poultry feed due to toxins, because of the hot-humid climatic condition. This climatic profile also warrants intensified reasearch on shelter engineering.

Summary

The task before the Kerala Agricultural University in Poultry production research at the turn of the century is stupendous. The priority areas in Poultry Science research can be summarised as follows:

(1) Developing and refining a chicken that can survive and sustain the backyard poultry farming system to attain optimum production.

(2) Developing technologies for improving the economics of broiler production in the state.

(3) Concerted research efforts to bridge our lacuna in the scientific knowledge on duck husbandry practices.

(4) Innovative technologies for a duck–cum-fish centre.

(5) Generate scientific information on the husbandry of Japanese Quails.

(6) Research efforts on shelter engineering for different species of poultry.

(7) Nutritional and management studies to identify newer source of feed ingredients for poultry and also technological innovations to improve their keeping quality in the hot-humid climate of Kerala, and,

(8) Techno-economic survey on poultry production which can help future planning.

In order to pave way to effectively concentrate on the above areas of research, it will be only prudent if the Kerala Agricultural University establishes a Centre of Excellence or Centre of Advanced Studies in Poultry Science immediately to augment and co-ordinate the research efforts in the desired direction from now on itself.

Table 1

Growth of Poultry in India

Criteria	1961	1971	1980 (Est.)
Broiler population (million)	—	—	30
Layer population (million)	35	53	88
Desi Layer (million)	33	35	30
Improved hens (million)	2	18	58
Total egg production (million)	2340	5340	12,500
Egg from Desi birds (million)	1980	2100	1,800
Eggs from Improved Layers (million)	360	3240	10,700
Value of Poultry production (million) (rupees)	650	1755	6,630
Human population (million)	439	548	680
Per capita consumption of egg/year (numbers)	5.3	9.8	19

Table 2

Export of Eggs from India

Year	No. of eggs imported (in lakhs)	Value (Rs. in lakhs)
1976—77	21.00	8.60
1977—78	205.30	79.30
1978–79	28.30	14.00
1979—80	235.70	94.30

Source: Indian Poultry Who's Who 1981.

Table 3

Five Year Plan Outlays on Poultry Development

(Million Rs.)

	Second	Third	Fourth	Fifth	Sixth
Outlay	28.0	45.8	115.0	355	426.1

Table 4

Changes in Animal Population in India

	Population (1000 head)		
	1961/65	1977	Per cent increase
Cattle	175726	181092	3.05
Buffaloes	51873	60398	16.43
Sheep	40936	40352	–1.43
Goats	62334	70060	13.39
Pigs	5092	8732	71.48
Chickens	114582	143000	24.80

Source: FAO: 1976 and 1977

Table 5

Estimation of Poultry Feed Production by Organised Sector

Year	1978	1979	1980	1981	1982
Quantity (Tonnes)	450,000	540,000	636,000	600,000	675,000

Table 6

Broiler Production

Year	1971	1975	1977	2000*
Broiler (millions)	4	10	17	71.8

* National Commission on Agriculture

Animal Production and Management—Focus on Research to meet the Challenges of 2000 A. D.

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The primary objective of any Livestock enterprise is to achieve maximum productivity and profitability involving some application of basic scientific principles to suit the situation to perfection. These situations vary from country to country and even from region to region. We follow and perch systems of livestock production and management followed in other parts of the country especially temperate climatic region where the husbandry practices are far different and greatly advanced. The climatic, economic, industrial and sociological situation of Kerala is far different from what is prevalent in other parts of our nation. Livestock production and Management become successful only if it involves the integrated application of animal breeding, feeding, housing, organization and disease control in a manner economically suitable to the above situation.

Fields of research

MILK

We have to economically produce milk and to increase the per capita consumption of animal protein for the rapidly growing, poorly nourished population of our country.

India possesses about 18 per cent of the world's total cattle and buffaloes. This is equal to the cattle and buffaloes as Europe and USSR combined and the milk output is only 1/3rd of the world average. It is high time we have to think in terms of reducing the number of livestock and increase the output.

55 per cent of the milk in the country and 60 per cent of the milk handled by the organised sector/hotels are from the buffaloes. Buffalo population has shown an increase of 13 per cent comparing to only 2.1 per cent in the case of cattle in the country as a whole. Inspite of the fact that buffaloes constitue about 13 per cent of the livestock population, no attempt is paid to these species.

MEAT

Cattle, in the majority of the states and within the state by a large number of people, are not eaten. Hence there is no temptation to slaughter the cattle. But the breeding of heifers go on to produce milk for which we have strong liking. The price of milk is very high because the prize of meat is very low.

Due to high cost of milk it is willingly not given to calves and without milk, calves either perish or grow to an undersized, unhealthy, unproductive future generation with later maturity and poor production capacity. This is especially true in the case of buffalo calves eventhough no taboo exists in buffalo slaughter and it contributes about 60 per cent of the meat obtained from the livestock in the country.

Indigenous cows of the variety of *Bos indicus* lactate only if their calves are alive and at form. Therefore, calves must be kept alive during its dams lactation when the nutritional needs are most costly and thereafter they will be neglected to survive as scavenging or allow to die slowly.

Kerala is further blessed with hundreds of undernourished, unwanted salvage cattle, mostly old emaciated working animals of Tamil Nadu which ultimately ends up as meat for the people of Kerala.

At nowhere in the state or in the country livestock is maintained entirely for meat alone, inspite of the fact that many breeds of Indian cattle and buffaloes have contributed to the formation of world famous meat breeds.

GOAT

Kerala possesses 16.8 million goats contributing much to the rural economy of certain areas of Kerala especially in terms of milk and meat. Not much scientific attention is paid to it.

PIGS

We are yet to know the potentialities and the qualities of indigenous and graded pigs of Kerala, inspite of the fact that they contribute to a large extent to the rural economy of Kerala.

DROUGHT ANIMALS

It is estimated that investment on bullock and bullock carts in India is about 30000 crores and this if far more than the investment in any other source of energy[1]. In the context of world wide shortage of energy this source deserves more attention. While crores of rupees are being spent on more glamorous research and development programme the outlay on drought power is quite negligible.

ENERGY

It is estimated that our national requirement of oil and coal is about 33 million and 115 million tonnes respectively. We require imported oil for Rs. 6000 crores and Rs. 400 crores worth of coal for meeting our minimum requirement[2]. It is also presumed that Indian cattle can produce about 130 crores tonnes of cattle manure which can produce about 1690 crores cubic feet of biogas without losing the manurial value of the product. As energy, this gas is equivalent to about 86 crores tonnes of coal or 63 lakh gallons of oil. The importance of livestock in the current energy crisis can be well imagined.

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Challenges of 2000 A. D. and Kerala Agricultural University

1) A steady supply of water and electricity is the basic necessity of life in any organisation. Kerala Agricultural University should be able to provide both of these commodities at the earliest before thinking of taking any other projects.

We should be able to go for deep underground water and also Peechi water for its libitum use. Similarly, KAU should be able to purchase electricity from the Board and arrange supply through its own men and machinery.

2) Livestock of superior germplasm is the only way of increasing the milk production and per capita milk consumption.

For this purpose, the capacity of the present farms at Mannuthy and Vellayani should be utilised fully and increased to the maximum extent where an integrated effort of breeding, feeding, housing and all other aspects can be concentrated to the maximum. A dry stock farm in the Vellanikkara main campus is also suggested to utilize the space and facilities and at the same time the same at Thiruvazhamkunnu can be closed down. Lakhs and lakhs of rupees KAU is investing at Thiruvazhamkunnu now can be utilized elsewhere.

3) Introduce buffaloes for production of milk. The surplus female calves and the male calves may be utilized for the study of meat potentialities of this class of animals.

4) Increase the capacity of the pig farm to the maximum without changing the infrastructure. It can take at least 3 times more pigs than what it holds now. More scientific studies should be made on indigenous and graded pigs of Kerala. It is economical to introduce minipigs in KAU. This suits well to the socio-economic pattern of the rural millions of Kerala.

5) Establish climatic chamber and controlled environmental studies for large and small animals. As the superior germplasm is increasing in our stock, environmental response varies leading to production loss. Large scale basic and applied study in this field is needed taking into consideration the tropical hot humid climate of Kerala.

6) Large scale introduction of rabbit for meat should be taken up.

7) Introduce bio gas units in every campus as an additional source of energy.

8) To be in touch with the latest developments in the field of livestock production and management, regular training programmes for teachers/research workers should be introduced in collaboration with other developed countries.

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Animal Production and Management—Focus on Research to meet the Challenges of 2000 A.D.

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The principal animal products of mass consumption are milk, meat and eggs. Although meat is obtained from all species, the reliance on milk is mainly on cattle in the state. An analysis of the pattern on the changes in the population and productivity of livestock and poultry and some of the reasons influencing the changes may give some broad indications to the areas of emphasis in research needed to meet, at-least partially, the desired levels of supply of animal products in Kerala by the end of this century.

CATTLE

The rate of growth decelerated around the mid Sixties to 87,000 every quinquennium from the earlier 2.2 lakhs. The estimated total cattle of around 34 lakhs, consisting of 29 lakh females and 5 lakh males by the end of the century, is an increase by only about 3 lakh heads over the present, but an increase by 10 per cent in the proportion of females to total cattle and by about 20 per cent in the proportion of crossbred females to total females, taking this latter proportion to 70 percent of total females. These modest gains are reflections of tendencies towards qualitative rather than quantitative changes, but being projections carry with them the present productive and reproductive performances. In these compositional changes, there are good reasons to believe that immigration into the state will be a potent factor to be reckoned with, if adequate steps are not initiated to improve matters. Under the circumstances even with the anticipated increase in the proportion of crossbred cows the current productivity levels will ensure an increase of only about 1.5 lakh tonnes in the present output of milk from cows, a contribution of about 13 g to the per capita per day availability. Similarly, the comparatively high survival rates observed among female calves, may, partly, be due to misclassification in the lower age groups rather than to the apparently high reproductive rates (as computed from Census data), since field studies have indicated much lower reproduction rates with fairly long calving intervals.

Based on the trends in the breedable cattle population and proportion of crossbreds envisaged in 2000 A.D. if the proportion of in milch cows can be increased by 10 per cent an estimated 10.5 lakh milk yielding cows will be available in the state. Working on an average 1500 kg milk per cow per annum, which is a reasonable and attainable target, the total annual milk production from cows can be doubled (about 16 lakh tonnes). But the capacity to carry so much stock, besides other livestock, in the light of meagre feed resources needs serious consideration.

The research focus would, therefore, appear to be necessary on:

1 Intensification of efforts to increase fertility rates (increasing the proportion of in-milk to totai breedable cows),

2 Enhancement of productivity per cow from less than 1000 kg milk per annum at present to over 1500 kg.

3 Augmentation of feed resources possibly by utilisation of agro-industrial by-products and tapping forest resources.

4 Improving the management practices to reduce the morbidity and mortality rates among cattle and thereby containing the cattle population within manageable limits, and,

5 Exploration of ways and means to enhance meat output from cattle.

BUFFALO

The trend in buffalo population is one of decreasing with an anticipated population of around 3.5 lakhs by 2000 A. D. There is a net immigration of 1.25 lakhs animals per annum in the state. In the light of the declining population, it would appear that a sizeable proportion of animals are slaughtered, although this is not fully reflected by available slaughter data. As a species contributing over 10 per cent to the total milk production, buffaloes are a potential source for milk and they also contribute over 25 per cent of the meat production in the state. Studies have revealed that the mortality rates among young animals are high. Very little effort seems to have been made in improving this species which is a premier dairy animal in the country. If the present buffalo vs cow trend continues the contribution by way of milk and meat by this species is likely to diminish by the end of the century.

Research focus to increase the rates of survivability, fertility and production possibly by introduction of superior germplasm appear to be necessary. Exploitation of the ability of the buffalo to convert coarse feed materials also need emphasis.

GOAT

In spite of the official statistics of about 3.25 lakh goats being slaughtered per annum in the state, the population trend indicated an increase of about an equal number every five years demonstrating the fairly high rates of reproduction in goats. Based on this the population in 2000 A. D. is expected to be around 27.5 lakhs. Although its contribution to the total milk production is estimated at about 8 per cent during 1979. its importance lies in the supply of meat. This species contributing over 15 per cent of the meat production in the state. It is to be considered whether this high anticipated population is indeed desirable from the points of view of: (1) carrying capacity of the state, (2) consumer preferences for meat and (3) the research support available for making goats efficient milk/meat producers. Goats as meat producers have to compete with the beef sector as the disproportionate sex ratio among young calves would indicate. It would, there–

fore, be desirable to focus attention more on improving the technical efficiency of goats as milk producers, particularly in the context of enhancing the living standards of economically vulnerable groups.

POULTRY

At the present rate of growth, poultry is expected to cross the 20 million mark by the end of the century, ducks contributing 3.5 per cent to the population. The total egg production reported was 980 million during 1981. About 1300 million eggs are expected to be produced by the end of the century with current productivity estimates, which may raise the per capita availability by only four eggs from the present 39 per year for a population of three crores. It is desirable to increase the productivity of poultry to make available more eggs as well as meat. Keeping a target of 50 eggs per person per year (1500 million eggs per annum) introduction of high yielding varieties among both fowls and ducks and other technological changes are called for. The recent trends in favour of the broiler industry which may gain momentum towards the end of the century should be taken note of in designing research programmes.

OTHER SPECIES

The population of pigs fluctuated within narrow limits for the past several years around 1.3 lakhs. Demand for this species appears to be fairly steady and their technical efficiencies can be said to have remained fairly stationary. Unless there is a breakthrough in the technology of pig rearing accompanied by increase in domestic and export demands the future of pig development would appear to be rather hazy.

Tapping new sources like rabbit, deer, quail, etc. for harnessing new germplasm and to cater to the need of changing tastes and income of people should also receive serious attention in the coming years.

The concept of production by the masses has come to stay and it is inevitable that the technology of livestock production is appropriately designed to meet the challenges of 2000 A. D.

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Animal Disease Management – Problems and Priorities in the Research Efforts in Future

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A population of cattle with low productivity and relatively good resistance against many infections was in existence in the country. Over the past three decades, our endeavour has been to improve the productivity of livestock by the qualitative improvement of the germplasm. India has about 1/6 th of the cattle and half of the buffalo population of the world. Anticipating a 10 per cent increase in cattle population every year, by 2000 A. D., according to National Commission on Agriculture (NCA, 1976), there will be an increase of 71.8 million cattle. It is expected that by the implementation of the ICDP Projects there will be 30 million cross-bred high yielding cows and 18 million buffaloes by 2000 A. D. In effect we will have a huge livestock population dependent upon limited feed. If rigorous culling and disposal of unproductive cattle with a determined mind is not done it will be a difficult task to manage animal disease problems in the future. The plan of action should be to reduce the cattle population, improve the quality of livestock by providing better animal health coverage. According to the FAO report, the extra food required to meet the current short fall could certainly be provided if the annual loss due to animal diseases are effectively controlled.

Contageous diseases:

Contageous diseases like Rinderpest, Foot and Mouth, Anthrax, Ranikhet disease etc. were the important diseases that threatened the livestock industry in the country. By systematic vaccination programmes it has been possible to control most of these diseases and the situation, as far as these diseases are concerned, has become manageable. But we cannot be complacent about this. Rinderpest, one of the dreaded cattle diseases, was brought under control by launching a systematic vaccination programme in 1954. Over the last three decades, by the implementation of Rinderpest eradication programme, it was possible to achieve the goal to a great extent. But the recent resurgence of Rinderpest in many of the states has caused a setback in this programme. This should be an eye opener for us. If we do not regularly monitor and take appropriate action at the right time, the control programme will culminate in complete failure. As far as this disease is concerned detection and destruction should be the strategy and a final thrust should be made to wipe out the disease by systematic vaccination.

Like Rinderpest in cattle, Ranikhet disease is an important disease that threatens the poultry industry, which is fast developing in our country. Recently, this disease which was under control has again made its appearance in a large measure in many states. This is a serious situation and the problem seems to be different. As far as this disease is concerned the strain involved in the present outbreak has to be studied and if necessary a revaluation of the efficacy of the vaccine used has to be made and an effective vaccine has to developed to stamp out the disease.

Foot and Mouth is another disease which hampers the milk production programme in the country. As per an estimate made in 1966 about 3.2 crore rupees are lost by way of this disease. A conservative estimate now would be ten times more. The control of this disease should be given top priority. A National Institute for Foot and Mouth Disease for regular monitoring of the disease prevalence and typing the strain and assessing the efficacy of the vaccine should be thou ght of.

A beginning has been made to control Rabies in the state. According to the Pasteur Institute (Coonoor) report, every year 15,000 people die of this dreadful disease for which no cure has been identified. In the future years, due to demographic concentration and increase in the dog population, an increase in the disease can be anticipated. A concerted effort should be made to control the disease as recommended by the Pan American Health Organisation. The strategy should be to develop an oral vaccine and chemosterilisation of dogs to control the dog population besides other routine measures to control the disease.

There are other infectious diseases like Brucellosis, Johne's disease, Tuberculosis, etc. which were prevalent in the country for the past many years and even now they are prevalent in most of the farms in spite of improved health cover. The strategy to control these diseases should be directed to stamp out the disease by detection and destruction. This is an urgent necessity and requires immediate policy decision including legislative procedures.

The NCA has pointed out that the loss by way of Mastitis alone was 52.9 crore rupees in1962. The Dairy industry has developed very much in the country since then and high yielding cross-bred cattle have increased in number and mastitis is one of the diseases that cause great havoc. Abortion is another clinical syndrome which considerably reduces the productivity of livestock. These diseases with multifactorial etiology have to be taken up on priority basis as national projects for research. Unless these two problems, which are going to cripple the livestock industry in the future, are properly investigated and controlled no livestock production programme can be sucessful in the country. As the WHO has programmed to have health for all by the year 2000 A. D. an effort on the Animal Husbandry sector should be made to have livestock free of contageous diseases and parasitic infections at least by 2000 A. D. These diseases if not controlled will definitely limit and even preclude the development of available animal industry in the country.

Changing disease pattern

The control of epidemic diseases, introduction of crossbred animals with good genetic potential and changing environmental factors have all caused a gradual change in disease profile. The disease manifestation is an outcome of the interaction between ths host, the agent and the environment. These factors are variable and the disease manifestations are also bound to vary. The change in these factors sometimes may be so rapid and extensive that an outbreak of a disease occurs before the host adjustment can be made. A non-pathogenic organism may develop pathogenic character and a pathogenic organism of low virulence in cooperation with a non-pathogenic acquire utmost virulence. Mucosal disease and delta hepatitis in humans are all examples of such situations. Further, knowingly or unknowingly man accelerates the process of change in the environment by his actions. Urbanisation, industrialisation, deforestation and indiscriminate use of insecticides are some of the factors which accelerate the process of environmental change. The import of animals from other countries, intensive system of management now adopted and lack of good management associated with high stocking rate may bring in specific disease problems. The gradual change from a fodder oriented livestock production to concentrate based livestock management has also caused new diseases to emerge. The introduction of high yielding varieties of crops which are very much susceptible to pests has contributed to cropping up of new disease problems. Mycotoxicosis can be cited as an example for this. Similarly the usage of pesticides and the residual effect on livestock health have to be investigated and these aspects have relevance in the years to come. These changed situations have to be recognised and programmes for research should be planned accordingly in future.

Emerging diseases

Communicable diseases are becoming less common and manageable but those associated with toxic, carcinogenic and teratogenic materials in the environment are assuming increasing importance. It is very necessary to monitor the disease occurrence and to identify the new diseases. Cancer was not considered as a problem of importance in livestock, particularly in cattle. Even now, this view is held by many. The emergence of ethmoid carcinoma in cattle in an endemic form should be viewed with concern by scientists concerned with animal disease problems. The changing situations should be understood and cancer and related conditions affecting various other organs have to be anticipated and a comparative oncology centre dedicated to cancer studies must be thought of to solve the fundamental and applied problems in this field.

Mycotoxicosis is an important problem and its carcinogenic, immunosuppressive and teratogenic effects have far reaching effects on livestock health. Among the toxic substances from 100 or 200 known toxigenic molds only about a dozen have been confirmed to cause naturally occurring diseases. There are a group of field disease syndromes that are considered to be of mycotoxic origin. These have to be investigated giving priority.

Animal disease surveillance

There is no effective machinery at present to monitor and document the prevalence of animal diseases in a systematic manner. An Animal Disease Surveillance Service has to be organised consisting of a disease reporting unit, laboratory unit and data processing unit. A well organised ADSU net work will go a long way in predicting and projecting priority sectors in animal disease control programmes. When the concept of disease free zone has been accepted and implemented this has more relevance. An animal disease data bank should provide the basis for all animal disease research and control activities.

Animal disease diagnosis

Only by organising animal health cover programmes to their complexities and making them accessible to all can the objective of disease diagnosis be attained by 2000 A. D. The health cover infrastructure has to be strengthened and this requires development of diverse range of human resources with a massive increase in the training and use of paraprofessionals and targeting of animal disease research on the new priorities. Further, at every step we must include full community participation to ensure that our services are relevant, to ensure that they are used and to ensure that they are understood.

The efficiency of diagnosis has to be improved. The existing facilities are inadequate. An efficient animal health delivery system has to be developed. A net work of peripheral, district level and state level laboratories should be established to meet the requirements. As our Prime Minister has stated, the service must begin where animals are and where problems arise. The animal health service of the future should not want the animal to come forward when illness strikes but instead go out to see animals to improve their health. The present approach of treat and diagnose the disease has to be changed and the strategy should be to diagnose every disease and treat them. At the grass root level, where the Veterinarian comes into contact with animals the effort should start. What should be planned is to develop a diagnostic kit for the Veterinarian. Even now, techniques are available but it should be made into a package, easy to handle and carry. Innovations have to be made in the diagnostic techniques available and research should be directed to develop new, simple and rapid diagnostic techniques. The peripheral level laboratory should be established at the taluk level with all the facilities for disease diagnosis and the middle level should be in the districts. The latter institutions, besides the diagnostic services, should also undertake research work to certain extent. At the apex of this net work of laboratories there should be a central institute for animal diseases research. This centre will co-ordinate the activities of the laboratories and will monitor and evaluate the work of other centres. At this institute species-wise and discipline-wise specialists to undertake research on animal diseases of a fundamental and applied nature should be available. Considering the importance of poultry industry it would be desirable to have a full fledged wing/institute separately for poultry diseases. This institute will ensure the technical manpower requirements to implement the programmes and should impart regular training in disease diagnosis for the technical and paratechnical staff. This institute should establish close liaison with national and international agencies. According to NCA, by 2000 A. D. there should be one Veterinarian for every 5000 cattle unit and he will be able to manage routine animal disease problem provided he is properly trained and equipped for the purpose. A well knit communication channel should be established with different centres working in the field at the national and international level. Informal and structural collaboration should be established and collaborative teams involving many scientists should be formed to tackle problems in animal disease research. A network approach in research reduces cost, avoids duplication and boosts efficiency.

Ecological strategies to prevent animal diseases

The health related ecological strategies may be applied to (1) detect and predict problems before they affect the animals (2) prevent potential animal diseases and (3) combat existing problems. Under this category, placement of indicator organisms in suspected areas of environmental contamination, introduction of competitive species to control vectors of animal disease etc, may be thought of. Research should be undertaken to develop suitable ecological strategies to control parasites of livestock.

Prevention of diseases

For the prevention of diseases vaccination is an important strategy. At present every state has got a vaccine production centre and vaccines are also produced by private agencies. This is a welcome trend. In Kerala the institute for vaccine production was started in 1959. But in spite of taking up measures to improve it, it has not been possible to cater to the requirements of vaccine. The goal should be self sufficiency in vaccine requirements of the state. The prophylactic vaccination has to be developed into an effective tool for controlling the diseases in future. Top priority should be given to develop new vaccines and to improve the quality of the existing vaccines. The knowledge gained in the field of immunology and immunoprophylaxis is voluminous and the knowledge that is going to accrue in future is very great and there is ample scope for developing new vaccines. The gene splicing technique can be advantageously made use of for developing effective vaccines. An optimal control strategy should be developed for the control of parasitic infections and a special time bound research should be undertaken to develop vaccines against parasites. On a priority basis research should be undertaken to develop diagnostic antigens and simple rapid methods of diagnosis should be made available.

Implementing agencies

Two types of research will be required to strengthen animal disease research; one aimed at generating new knowledge and second aimed at applying the existing knowledge. A multidisciplinary, multisectorial approach is the only solution for solving the problems. There should be a close liaison between the State Department of Animal Husbandry and the Departments of the University.

National and international contacts and cooperation is a must. Cooperation with national and international institutions associated with animal disease research should be considered as an important framework for the research structure. The implementation of the programmes envisaged will involve huge amount and funding should be sought from all national and international agencies. The farming community has to be persuaded to cooperate and invest in disease control activities. This implies that a benefit-cost analysis will have to be made to justify the approaches made. International and national funding agencies should be approached for funding and the research resources should be pooled and effective utilisation of the available funds should be made and an efficient net work of animal disease research and control programme should be built up.

The plan of action to be drawn up to manage animal disease problems and to undertake research on animal diseases in future can be summarised as follows:

1 Systematic reduction of cattle population to improve the productivity by assuming adequate nutrition and efficient health cover for manageable livestock.

2 A systematic programme to control contageous animal diseases with the aim of developing a cattle population free from contageous diseases by 2000 A. D.

3 Development of a network of diagnostic centres with a central institute with all infrastructural facilities and technical man power to undertake research on animal diseases.

4 Develop a diagnostic kit to be used by the field Veterinarians for on the spot diagnosis.

5 Establish an institute for vaccine production to plan and organise research for improving the existing vaccines and to develop new vaccines for other diseases.

6 On priority basis research to be undertaken on mastitis, abortion, mycotoxicosis, viral pneumonia in goats, cancer research, residual effect of pesticides, metabolic diseases etc.,

7 Immediate action should be taken to control tuberculosis, Johne's disease, and Brucellosis by systematic diagnosis and stamping out procedure.

8 An animal disease surveillance unit and data documentation centre on animal diseases to be established.

9 A concerted effort should be made to control parasitic infections giving priority for development of vaccines and planning ecological strategies to control parasitic infections.

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Animal Health Care Programme–2000 A.D.

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FAO emphasises the need for considerable increase in livestock production between the years 1980-2000. The animal production in India is largely carried out by small unorganised farmers who have neither the knowledge nor the appreciation of the concept of production so as to assess the viability of such activity. In Kerala, land is limited. The size of holding is likely to drop further in the coming years. Even the small holding will not be compact for any viable economic agricultural operations. Therefore, there is wide scope for the livestock enterprise as a subsidiary occupation for the large unemployed and underemployed sectors in our state.

Breeding, feeding, management and health care are the cardinal pillars in the success of Livestock production. Today, our state is fortunate to have a good number of crossbred-animals and is one of the leading states in India, with excellent breeding facilities to achieve genetic improvement in cattle. Unfortunately, the feeding condition is still poor and it is not relevant to discuss that point here.

Majority of farmers in Kerala are literate and progressive. They need guidance, assistance in socio-economic direction and timely, ready-hand technical help to improve the skill in management practices.

The proverb, 'Health is Wealth' applies to animals too. Maintenance of optimal health is an important aspect to enable the animal to reach its production potential. Financial losses due to the most common animal health condition is estimated to vary between Rs. 2 to 6 crores in a district (Buch). The mortality was considerably low, but morbidity is more concerned.

Common disease problems

The health problems can be classified as systemic, i. e., affecting different systems of the body; Metabolic disturbance, i. e., mostly a problem related to improved production ability of superior animals; and specific, i. e., disease caused by parasites, bacteria and virus etc. The problems concerned with reproductive efficiency also need special emphasis.

Present system of health care

Health care of animals is traditionally provided through Veterinary Hospitals, Branch Veterinary Dispensaries, First Aid Veterinary Centres and Camp Dispensaries. Central and State Plan Programmes enhanced the number of such Institutions. Our state adopted a policy of minimum one veterinary hospital in each Panchayat. Most of the Panchayats fulfilled this target. Now there are veterinary polyclinics established with a view to make available modern facilities in health care. Kerala had gone one step ahead with the introudction of 'Disease Free Zone' programme to eradicate contageous and communicable diseases that affect the livestock including pet animals. Further, we have achieved the target of veterinarians per unit of Livestock recommended by the National Commission of Agriculture and it is anticipated by the end of 2000AD to reach near the ratio of developed countries. Inspite of all these advancements, there are lack of facilities to the farmers, especially in rural areas. There is also a dearth of qualified veterinarians in the state to fill up the existing vacancies. As a result, the farmers in remote villages depend still on quacks who would do more harm than good to the animals in distress.

The programme of health care is mainly managed by the State Animal Husbandry Department. Other Departments like K.C.M.M. Board, Dairy Development Department and K.L.D. & M.M. Board also share minor responsibilities. Kerala Agricultural University is mainly concerned with Education, Training and Research to enable animal production systems and the undertaking of Animal Health Care.

Programmes for Health care

1. Prophylactic cover

Specific diseases can be prevented by vaccinations. Most of the vaccines and biologicals are produced by Central or State Biological Institutions and private and public companies. Important concern is the quality control. A National Institute to standardise the biologicals should be set up immediately. The requirements should be met in self-sufficiency by large scale production in limited number of Institutions to minimise the expenses. The Contageous Diseases Act which was formulated long back may be modified to meet the present need. Financial assistance and Livestock Insurance should be granted only on the basis of strict prophylactic measures, to have a better control programme.

Disease surveillance and monitoring will help the eradication programme. Endemic chart, schedule of vaccination, efficient disease investigation system and diagnosis are essential for the effective health cover.

2. Infrastructural support

Systemic disturbance needs timely and efficient attention. In Kerala, diversified topography, hills, valley and backwaters and scattered distribution of farmers with limited number of animals minimise the utility of Institutional Health Care Service. Present day prohibitive cost on Transport system limits the scope for Institutional Service.

Provision of Infrastructural facilities to farmers in the form of education for better management practice to prevent diseases, training of farm youths for first aids, developing para veterinary force, channelization of health service through mobile units with routine visits, and ready availability of emergency units, specialist units and investigation units are needed to handle the problems.

3. *Role of Kerala Agricultural University in coming years*

The responsibility of the University lies in Teaching, Research and Extension Education programmes for agriculture and allied subjects, meant for the betterment of farmer and the community as a whole. By imparting teaching, sufficient technical hands with competency can be created to meet the needs of coming years. The research should be streamlined to meet the challenge of felt problems in the field. It should be selected on priority basis for field application.

Extension Education programmes should aim at the transfer of technology from Lab to Land. Modern media of communication such as T. V. and Video can be used for educating farmers.

Improved animals with increased production potentiality is a stress and hence will be more prone to health hazards. They need programmed health cover.

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Perspectives of Fisheries Research in Kerala

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Blessed with an extensive coastline of 590 km Kerala is the foremost state in the country in marine fish landings. In 1983 the total marine fish landings of Kerala were 3,93,000 tonnes. But it could not reach upto the record landings of 1976 which was 4,07,923 tonnes. During the period 1977–82 our marine landings fluctuated between 0.18 and 0.37 million tonnes showing that the oceans, which were once considered to be an inexhaustible storehouse of fishery wealth, are not going to give an unlimited harvest for ever. This suggests the necessity for increasing the production from our water bodies, rather than increasing the rate of exploitation alone. When we think of increasing fish production we have to concentrate our efforts on our inland water bodies, which alone are amenable to easy management measures leading to higher fish yield. Thus, fisheries research in Kerala Agricultural University in the coming years should be oriented towards improving the fish production from our inland water bodies. As for the marine fisheries of our coast, there are a number of other agencies like the Central Marine Fisheries Research Institute to look after its developmental needs.

Kerala has got an estimated 0.35 million hectares of inland water bodies comprising of the sprawling estuaries, a number of reservoirs, rivers, tanks and ponds. However, we still continue to be far backward in the field of inland fisheries development, while many other states in the country like West Bengal, Tamil Nadu and Andhra Pradesh have achieved significant results in this field during the past few years. The total inland fish catch of the state in 1983 was only 27 thousand tonnes, while it was 306 and 178 thousand tonnes respectively for West Bengal and Tamil Nadu. Evidences are there to show that our inland fish production can easily be increased 5 times if efforts are made in this direction. Hence our goal should be to improve the inland fish production of the state, intensifying research in the following priority areas :

1 Development of fresh and brackishwater aquacultural practices suitable to the state.

2 Seed production of the cultivated species of fishes and prawn under controlled conditions.

3 Integrating aquaculture with livestock and agriculture.

4 Organic recycling in aquaculture.

5 Commercial production or ornamental fishes.

6 Increasing the fish yield from our reservoirs and rivers by performing research in population dynamics and conservation and improvement of fish stock through ecosystem management.

7 Fish nutrition and feed technology.

8 Development of better strains of cultivable fish and prawn by advancing research in genetics and hybridization.

9 Investigations on fish diseases and development of control measures.

10 Development of new piscicides and weedicides.

11 Waste utilization in aquaculture.

12 Evolving new systems of culture for intensive production of fish from the available water bodies.

13 Development of frog culture technology.

It is estimated that about 0.24 million ha of brackishwater area is available in the state of which more than 50 per cent is suitable for taking up fish and prawn farming. So we have to concentrate on formulating suitable package of practices for converting these water bodies into production units. Research work initiated in this field has already shown highly encouraging results and we have to further develop the technology for large scale field adoption.

The mainstay of our aquatic products export is shrimp. In 1982 shrimp contributed to 300.98 crores of the total earnings of Rs. 342.24 crores. The prospects of increasing its harvest from the sea is very limited. So if export is to be promoted prawn culture in the coastal areas on a large scale is the only solution. Further, some of the brackishwater fishes like the mullets, pearlspot and milkfish are esteemed table fishes. But now these have become rare commodities in the market as the natural resources have undergone severe depletion due to various reasons. As such, we have to think in terms of producing these fishes under culture systems.

The giant fresh water prawn, *Macrobrachium rosenbergii*, is the most important species of freshwater prawns in Kerala, for which a lucrative fishery once existed in the Kuttanad region. Because of its high export market, the stock was over fished, which resulted in a serious depletion in its fishery. As its culture is very lucrative, and as it can bring forth the much needed foreign exchange to the country, development of a viable technology for its culture should receive the first priority in any fisheries development programme meant for Kuttanad.

While planning research in aquacultures, special attention should be given to develop aquaculture systems which can be of relevance to the problem areas like the punja fields, kari and kole lands and pokkali paddy fields.

Development of aquaculture primarily depends on an assured supply of quality seed. Among the present constraints and uncertainties of aquaculture, insufficiency of the stocking material is the most pronounced one. In the freshwater side the main requirement will be the seed of Indian and Chinese carps and some of the well known cultivable air–breathing fishes. Though the technology for breeding these fishes is known, there is urgent necessity to perfect the technology isolating the pituitary hormone and making it available in readily usable form to the farmers is an important area for future research. Low-cost simple hatchery designs may be developed for transfer to the farmers. The technology of seed rearing of air-breathing fishes needs to be further developed. Short and long–term preservation of fish sperm and fertilized ova can be an area for interesting research.

Commercial production of the seed of the giant freshwater prawn will be yet another task before us in the coming years. The commissioning of the Thanneermukkom bund across the Vembanad Lake preventing saline incursion has adversely affected the natural propagation of this species. The prospects of collection of its seed from the wild is bleak. As such hatchery production of seed is the only way to support its commercial culture. The technology of Macrobrachium seed production, especially mass production of live food for the larvae, requires adequate research support for perfection of the technology.

The seed production scene is a dismal one as far as brackish water species are concerned. Our prawn culture is chiefly dependent on the penaeid prawns, *Panaeus monodon* and *P. indicus*. While the seed of *P. indicus* is abundant along our coast, the reverse is the case with *P. monodon*. Further, because of the wide fluctuations in the quantity and time of availability of the seed, the natural resources may not be a dependable one for culture operations. Hence, we have to develop technologies for bringing these prawns to maturity under controlled conditions and breeding them. Perfecting the technology rearing of penaeid prawns is yet another necessity to commercialise their seed production. Worse is the case with important brackishwater fishes like the milk-fish, grey mullets and narimeen. Neither the seed, if these fishes are available in commercial quantities along our coast, nor any viable technology is available for their controlled breeding. Seed production of these fishes will be an important area for future research in the University.

Future course of research in fisheries must give an accent to integrate fish culture with livestock and agriculture aiming towards intensive use of land and water resources. Farm animals' excreta fertilize agriculture farm and fish pond. The green vegetation and the other agricultural products are used to feed livestock and fish. The pond humus is reached back to agriculture farm as manure-complete integration. This system has the prospects of high production of fish at a low cost. Further, it will give a great boost to the idea of rural development through Integration of fish culture, animal husbandry and agriculture and open a new vista for rural employment as well.

Direct use of organic wastes as fish feed offers a great scope in aquaculture. It has been found that some of the fishes directly feed on cattle dung, duck and poultry droppings and even fish excreta. Rearing of such fishes and animals together in suitable combinations will help in the maximum production of fish flesh from these wastes with the minimum loss of energy and time. Hence, this field may be subjected to further studies with a view to find out more species of fish which can be used in this system. Location of suitable fish species which can feed on the stubbles after the harvest of paddy may revolutionise the paddy-cum-fish culture programme.

There exists great scope for establishing a system of paddy-cum-fish culture especially in low-lying parts of the state where the fields retain sufficient water during monsoon. Such a system will be particularly relevant in the low-lying paddy fields of Kuttanad and the Kole lands, where multi-cropping of a single crop would give way to mixed cropping of paddy and fish or prawn. While evolving paddy-cum-fish culture systems special attention should be paid to locate species of fish and prawn suited to each locality and varieties of paddy suited to this system. The chief constraint in adopting paddy-cum-fish culture is the use of pesticides in paddy fields. It is essential to carry out research on the effect of commonly used pesticides on the cultivated fish species with a view to select suitable pesticides and species of fish for the system.

Today the export trade in aquarium fish in the world is estimated to be of the order of Rs. 3,000 crores. While the share of East-Asian countries in this trade is to the extent of 70 per cent, India's contribution is absolutely negligible-hardly a lakh of rupees per annum. India has excellent possibilities to export tropical fish. The potential is estimated to be of the order of Rs. 100 millions. With the vast resources, suitable climatic conditions and abundant intelligent manpower, Kerala can certainly play an important role in this trade, if adequate research support is given to aquarium fish culture and breeding.

A lot of technical; skills need be developed in fish breeding by modern methods. New varieties may be obtained by hybridisation. Development of fish breeding occupation and export trades would depend to a larger extent on the production of live food like brine shrimp, water fleas, insect larvae, oligochaetes etc. and hence technologies will have to be developed for the commercial production of these organism and preservation of surplus stocks by quick freezing or freeze drying methods. Similarly formulations of dry fish food and their packaging will also require research support.

In addition to culture fisheries, proper attention should be paid to conserve and develop the capture fisheries resources of the state. We have 24,137 ha of reservoirs and the area will be increasing in the near future. It is needless to mention about the potentiality of these water bodies for increasing our fishery wealth. The average production from our reservoirs is estimated to be only 5 kg/ha/year. There is ample scope to get a ten fold increase in the yield rate if proper developmental measures are adopted. In reservoir research the efforts should be to study the ecological principles, trophic structure and functions and ecological energetics placing due emphasis on eco-system oriented approach and manipulation of stocks with a view to get the optimum sustained fish yield.

Unlike the rivers of the Gangetic plain, our rivers are not blessed with natural populations of major carps and hence the fish harvest from our rivers are negligible. It will be worthwhile to try to introduce new species of commercia importance like the major carps in our rivers so that they will establish there and give a sizeable harvest in the course of time. Development of sport fishery in the streams of our high ranges also warrants special attention.

The major input in any intensive aquaculture system will be the feed. The success of the culture system both in terms of production and economy, will depend to a larger extent on the effectiveness of the feed given. Therefore, it is essential to take up research on fish biochemistry, fish nutrition, digestive physiology and related aspects with a view to provide adequate and broad-based support for aquaculture system. While the conventional fish feeds like oil cake and bran give highly encouraging results in freshwater fish culture, these have not been found so effective in brackish water fish culture. Thus, thorough investigations are needed regarding the nutritional requirements of cultivated brackish water fishes.

The prohibitive cost of conventional feeds will be a hindrance to the development of aquaculture. So it is high time for us to turn to non-traditional plant and animal sources for the formulation of fish feed. Analysis of proximate composition of locally available fish feed ingredients will enable us to formulate cheaper balanced diet for cultivated species of fish and prawn from these raw materials. The formulated feeds will have to be tested for their acceptability, intake, and conversion efficiency for the cultivated species.

Evolution of new species through genetic selection and hybridization will be an important step in the development of aquaculture in the coming years. Adequate attention should be paid to the selection and maintenance of pedigree brood stock for seed production. We should be able to produce new varieties of cultivable fish with faster growth rate and ability to survive the stress under intensive culture systems. A special reference may be made here of the most popular fish of Kerala, the pearlspot. This excellent table fish shows a poor growth in culture systems. It will be worthwhile to try to improve the growth rate of this fish through genetic selection or hybridization.

The outbreak of disease will be natural in any intensive culture systems and its proportion is bound to increase as we further intensify our aquatic production systems. Hence, detailed investigations may be carried out on fish diseases and control measures may be developed.

Suitable piscicides to control the unwanted fishes in cultivable waters is an important requirement in aquaculture development. The popular piscicide 'mahua oil cake' is now an expensive item because of its limited availability. Efforts should be made to locate suitable piscicides, which can be economically used, by screening some of the locally available plants and plant products. Similarly, research should be carried out to formulate new weedicides and algicides to control the undesirable plants in our fishery waters.

We should be able to monitor the ecological changes taking place in our aquatic ecosystems and to formulate suitable measures to control these or to modify the culture practices accordingly. There is an immense threat of industrial pollution to many of our inland water bodies. Research should be carried out on the specific effect of these pollutants on our aquatic wealth. Acidity is a common problem in many areas of the State, particularly in the coastal belt. We should develop standard methods to control it. Development of suitable systems of aquaculture for acid-prone areas like the 'karilands' can be one of the important targets of our research.

In view of the heavy demand on conventional fertilizers generally used in fish culture, attainment of high fish yields through maximum utilization of available nutritive ingredients of waste waters will be a step towards the rapid development of aquaculture. Possibilities of utilising domestic, agricultural, municipal and industrial wastes in aquaculture may be explored. These organic wastes may be studied in detail to ascertain their biodegradability, nutrient value, biochemical impact on recipient waters and toxicity to fishes and fish food organisms. Apart from wastes, waste waters also may be given adequate attention. It has been found recently that jute retted waters can be profitably used for fish culture. Similar studies to utilize coconut retted waters may be taken up in the University.

Whatever may be their extent, our aquatic resources are limited and non-elastic. In order to increase the fish production to meet the demand of both domestic and export market we have to think in terms of maximum utilization of the water bodies for fish production ensuring complete control over water quality by the use of biological filters, aerators and the like.

India is the largest exporter of frozen frog legs in the world. The frog leg industry in the country, as in other countries, is explicitly based on the capture of frogs from the wild, and 120 to 150 million frogs belonging to only three species are killed annually for the export. To replenish the loss of populations through capture and to build up the commercial frog wealth of the nation for augmented export drive, it is essential to develop technologies for culture and seed production of commercial frogs. Kerala with its ideal climate and ecology will be highly suited to develop frog culture industry. Hence the University may take up research on a priority basis to evolve a suitable system for frog culture.

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New Horizons in Aquaculture

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INTRODUCTION

Aquaculture, that is, growing of aquatic organisms under controlled conditions, is practised through the ages in certain parts of the world. But major portion of fish to man's diet still comes from the capture fisheries, by way of hunting and gathering from untended wild stocks. These resources are dwindling fast compelling us to rely more and more to aquatic husbandry. Aquaculture has the potential to produce large quantities of low cost protein rich food as well as luxury products for human consumption.

Aquatic medium provides a three dimensional growing space and production in aquaculture has surpassed that achieved in terrestrial agriculture and animal husbandry. This has been made possible through polyculture of fishes inhabiting different strata of water column or by hanging strings of molluscs from floating structures, both making use of the entire water column. Three dimensional or multistorey gardening incorporating trees, bushes and low growing plants, has been developed; but it has achieved widespread commercial application only in aquaculture.

Aquatic animals too have certain advantages for use in husbandry. As the density of the body of fish and crustaceans is nearly the same as that of the water they inhabit, they need not expend energy for supporting their weight and this savings of energy can be diverted for growth. Further most cultivable fishes and invertebrates, being cold blooded animals expend more energy on thermo-regulation and this property would also enhance their potential growth rate which is more plastic than that of higher vertebrates. It is stated that accumulation of flesh in the body of carps per unit of assimilated food is one and a half times as rapid as chicken and twice as rapid as cattle.

The world production through aquaculture has risen to over 6.0 million tonnes. Considering the pace at which development in aquaculture takes place this can be doubled within five years and a five fold increase may be possible by the end of this century. Although, the potential for development is vast, in many developing countries including India, this tends to remain a part of mere subsistence farming. During the past decade aquaculture has made encouraging progress by producing significant quantities of food, income and employment. Significant changes have occurred in the general concept of aquaculture. Traditional practices governed by local conditions and needs which are not intensive are being changed fast and many countries are now turning to semi-intensive and intensive systems. Aquaculturists now are more aware of the impacts of environmental factors on the production and productivity of the systems and are exercising greater control over the environments and stocks even in semi-intensive system. Even in culture systems where natural food is relied on, fertilization of the ponds and improved systems of management are adopted to increase production. Stocking with seed produced in hatcheries by artificial propagation, supplementary feeding with formulated feed and aeration by mechanical devices are resorted to in many cases. Even in developing countries, where the tempo of development was of a low key, there is now an awakening as they wish to increase their foreign exchange earnings by way of export of high valued species which are of high demand in developed countries.

There are opportunities for greater expansion in view of the fact that extension of area under aquaculture is easily possible as well as developments in technology in many areas are pouring in.

Expansion of area under Aquaculture

The area under aquaculture now is estimated to be around 4 million hectares. Atleast a five-fold expansion of this area is quite feasible, if the necessary investment and governmental support become available. In South-East Asia alone, there are 6 to 7 million ha of cultivable area. Although complete conversion of area for aquaculture is not advocated as they are important nursery grounds for many economically important varieties, development of atleast ten per cent of the area would both be possible and advisable.

In India around 1.6 million ha of freshwater ponds and tanks, 2.6 million ha of lakes and reservoirs and about 6.2 million ha of brackishwater areas covered by open estuaries, creeks, canals, tidal flats, saline swamps etc. are available. The main rivers including the tributaries totalling about 27,000 km in length and a network of canals and irrigation channels extending to over 1,12,000 km are also available. Of this extensive areas only a small portion is put to use for any aquaculture activity. The extension of area under aquaculture is on the increase both in freshwater and brackishwater sectors. Mariculture as such is still in its infancy and it may take some more time before it is taken up on a commercial scale.

As far as Kerala is concerned there is immense scope for expansion in both fresh and brackishwater areas under aquaculture. We have 44 rivers, having an area of about 85,000 ha, extensive areas covered by lakes, and backwaters having an area of 3,42,600 ha, reservoirs having an area of about 24,137 ha and ponds of about 3,300 ha. The area under aquaculture is limited to a few hundred hectares of freshwater ponds and few thousand hectares of reservoirs and about 5,500 ha of pokkali fields where the traditional prawn culture is practised with certain technological improvements.

Recent Technological improvements in Aquaculture

Improvements in technology are there in all fields of aquaculture, directed towards intensifying production and diversifying the methods. Besides, identification of new organisms is also on. The fact that annual yields range between a few hundred kilograms per hectare and over 200 tonnes/ha shows what improved technology together with provision of essential inputs would achieve in terms of increased production. The improvements in technology have already shown the possibility in increasing the average production at least two to three times in unit area or unit volume of water, in a relatively short period of time.

Significant technological improvements in the field of aquaculture have been felt in the following fields.

1 Patterns of culture—Polyculture
2 Fish culture in cages and enclosures
3 Off-bottom culture of mussels, oysters and seaweeds
4 Integrated farming of crops, livestock and fish
5 Hatchery production and rearing of seed
6 Transportation of seed
7 Transplantation of organisms to new areas
8 Hybridization and genetic improvement
9 Artificial upwelling.

1. Culture Patterns—Polyculture

Various patterns of culture are prevalent in the aquatic medium. Stocking different varieties of fishes which occupy different strata, was in practice in China. This system of pond management called polyculture or composite fish culture is based on the principle that if fishes of different feeding habits are stocked together so that all the ecological niches available in the pond are utilised, there will be increased production. This concept has been put to practice so effectively now in India, wherein species such as Catla (*Catla catla*), Rohu (*Labeo rohita*), Mrigal (*Cirrhinus mrigala*) together with common carp (*Cyprinus carpio*), Silver carp (*Hypopthalmichths molitrix*) and Grass carp (*Ctenopharyngodon idella*) achieving a production of more than 8,500 kg/ha/yr with only modest supplementary feeding. In Taiwan *Mugil cephalus* is combined with carps such as big head, silver carp, grass carp and common carp in addition to milk fish *Chanos chanos*, Tilapia and sea perch *Lateolabrax japonicus* for achieving a production of 5,000 to 7000 kg/ha/year. Production of fish and prawns from brackishwater ponds has been substantially increased in countries like Philippines using the principle of polyculture of prawn *Penaeus monodon* and the fish *Chanos chanos*. The same is being adapted in India also in brackishwater fish farming wherein fishes such as *Chanos, Mugil* spp., *Etroplus suratensis* and prawns such as *Penaeus monodon*, and *P. indicus* are cultured together.

2. Fish culture in cages and enclosure

Fish culture in cages and enclosures are outstanding examples of technological advance in aquaculture. Culture of fishes in cages and enclosures have existed for many years particularly in Asia and the Far East. Modifications in their design, materials used, installation and operation together with the use of floating pelleted feed have made these into technologies that are capable of being introduced with much success in other regions. Cage culture of cat fish, salmon (*Salmo* *salar* and *Onchorhynchus* spp) and trout in USA and Europe, of yellow tail *(Seriola quinqueradiata)*, eel (*Anguilla japonicus*) and Kuruma shrimp (*Peneous japonicus*) in Japan, and of milk fish *Chanos chanos* in Philippines are commercial scale high intensity operations now. Introduction of cage and enclosure culture has helped in achieving marked increase in production of trout and salmon in Norway. The yellow tail fish production in Japan comes mainly from cage culture. In Philippines there is marked increase in the culture of *Chanos* in pens. It is reported that within a period of five years five thousand hectare area of Laguna de Bay had been occupied by pens producing about 7,500–10,000 tonnes of milk fish per year. Culture of fishes in enclosures (pens) is an age old practice in China. The massive introduction of synthetic fibres such as nylon, vinulon, polyethelene etc. which are durable materials for construction of enclosures, will give a boosting to culture in the net enclosures.

Cage and pen culture systems are only in the experimental stage in India. There is great potential for development of cage culture systems in our reservoirs, lakes and irrigation canals. In Kerala the potentiality is more as we have got extensive back waters, lakes and reservoirs suitable for the purpose.

3. Off–bottom culture of mussels, oysters and seaweeds

Culture of shell fishes such as mussels, clams and oysters in the bottom of intertidal and sub–littoral areas was prevalent in many European countries and in U. S. A. The introduction of off-bottom culture methods such as pole culture; 'rack' and 'tray' culture, raft culture and long line culture, especially the latter two methods have revolutionalised aquaculture. Floating rafts are used in the culture of mussels *(Mytilus edulis)* in Spain and in the culture of edible as well as pearl oysters in Japan. A variety of floating rafts constructed either with timber or recently with steel are used in Spain. A raft having a size of 25 x 15 m having 816 ropes of 8–10 m hung from that can produce 60 tonnes of mussel yielding 23 tonnes of meat. About 64 per cent of the area used in Japan for oyster productions is covered by rafts. Rafts for oyster culture in Japan are of 16 x 25 m size. They are made of bamboo poles lashed together with wire in two layers at right angles to each other with the poles 0.3 to 0.7 m apart. The rafts are buoyed by hollow concrete drums, tarred wooden barrels or specially constructed styrofoam cylinders.

The long line system consists of horizontal lines attached to a series of wooden barrels or metal drums providing floatation and the ends of each line are anchored by two anchors. Strings of seed oysters are suspended from these lines. This system is practised in off–shore areas as it can withstand rough seas.

In India, these modern methods together with the 'rack' and 'tray' methods are practised in the culture of edible oyster *Crassostrea madrasensis* and the pearl oyster *Pinctada fucata* by the Central Marine Fisheries Research Institute at Veppalodai and Tuticorin. Mussel culture using floating rafts has been conducted at Vizhinjam and Calicut in Kerala, Kovalam near Madras and Karwar in Karnataka by Central Marine Fisheries Research Institute, achieving production upto 150 tonnes per ha using brown mussel *Perna indica* and green mussel *Perna viridis*. A pilot project has been initiated at Vizhinjam in Kerala by the Kerala Fisheries Department. Experiments on the rope culture of seaweeds which had been conducted at Mandapam camp using agar yielding plants like *Gracilaria*, and *Gelidiella* and algin yielding plants like species of *Sargassum* and *Turbinarta* are quite promising yielding about 3.5 kg of seaweeds per metre of rope per year. Thus sea-farming is likely to establish on a firm footing by the turn of the century in India.

4. Integrated farming of crop, livestock and fish

Integrating fish culture along with agriculture especially with paddy cultivation and with livestock are age old practices in Asia, especially in China, Malaysia and Indonesia. But it is only recently that aquaculture has been recognised as a means of recycling organic wastes to protect the environment, as well as contributing to fish production.

As a consequence of 'green revolution' owing to the introduction of high yielding varieties of paddy which require large amounts of toxic insecticides, the interest in fish culture in paddy fields has declined. Very recently there is renewal of interest with the introduction of high yielding varieties of rice with inbred resistance to insects and insect transmitted diseases developed by International Rice Research Institute at Manila, Philippines.

Many developing countries are adopting the system of fish farming in association with duck, pig or cattle raising so as to utilize the wastes for fertilizing fish ponds. Duck-cum-fish farming which is an efficient means of recycling duck droppings has become widespread in many East European countries like Czechoslovakia, Hungary, Poland and Romania and now been introduced in Central Africa and Nepal.

If properly planned, coordinated and integrated expansion and improvements in this field of integrated farming may assist greatly in achieving the aims of rural development such as providing protein-rich food as well as generating job opportunities.

5. Hatchery production and rearing of seed

Hatchery production of seed now being accomplished in the case of many cultivable organisms such as oysters, prawns, lobsters and fishes is a technological improvement of much importance. Successful maturation of shrimps in captivity in the laboratory by eyestalk ablation is a breakthrough of considerable significance. Similarly controlled reproduction of oysters and hatchery production of oyster seed is another important step in oyster farming, particularly owing to the fact that collection of oyster spat from natural source is decreasing due to environmental degradation and importing seed has become very expensive.

The Chinese carps, the Indian carps and the grey mullets (*Mugil* spp.) which generally do not breed in confined waters of the culture systems, have been induced to breed by the administration of pituitary hormones. Induced breeding by pituitary injections or adjustment of photo period has become a recognised practice in fish culture now and a number of cultivated and cultivable fishes have been bred experimentally.

Hatcheries for the production of carp seed have been established in large numbers both by governmental agencies and private entrepreneurs in India, mostly in north-eastern states like Bengal, Bihar and Orissa. Recent introduction of circular hatcheries (Chinese hatcheries) had given a big boost in the production of carp seed in India. Few experimental hatcheries for marine prawns, and the fresh water prawn *Macrobrachium rosenbergii* have been started. Establishment of a chain of hatcheries for carps and prawns as envisaged, will help the development of aquaculture in Kerala, as dearth of seed is a major problem here.

6. Transportation of seed

Transportation of seed in polythene bags filled half with water and the rest with oxygen has helped to replace the fragile earthernware hundis and other forms of containers used for transportation of fish seed earlier. Oxygen packing also has got certain limitations as the cost of transportation is high when large numbers are transported to distant places by air.

A breakthrough in the efforts to find a method to dispense with water was found out recently. It has been observed that by bubbling 50 per cent oxygen and 50 per cent carbon-di-oxide in the water in which the fishes are kept, the fishes are anaesthetised. This effect is stated to last for about 30 hrs., during which period the fishes can be taken out and transported without water. Once they are immersed again in water within 30 hr period the fishes wake up within minutes. This finding when perfected will surely revolutionalise the fish seed trade.

7. Transplantation of cultivable organisms to new areas

Transplantation of cultivable species to new areas has become so widespread in recent years. Although it is unavoidable for rapid expansion of aquaculture, there is considerable controversy as new introduction may have adverse effects to the local fauna and flora. Indiscriminate introductions continue in many parts of the world. But introductions made selectively and after critical study of all relevant environmental and behavioural informations had helped the development of aquaculture. Introductions of the common carp to most parts of the world and other Chinese carps such as silver carp and grass carp to many countries including India, have helped aquaculture development. So is the case of *Tilapia* transplanted from Africa to many countries. The recent introduction of the giant fresh water prawn *Macrobrachium rosenbergii* to Hawai has helped the efforts of aquaculture development there. Transplantation of Indian major carps such as Catla, Rohu and Mrigal from north Indian rivers to many south Indian rivers and reservoirs has helped the development of riverine and reservoir fisheries in the region.

In Kerala, in most of our reserviors major carps have been introduced, but nowhere they have bred naturally, may be that stocking has not been done systematically. Introduction of carps if done in a systematic way, in one or two rivers joining the Vembanad lake in the south and also in the Vembanad lake in the Kuttanad region, may help the establishment of the carps in the Kuttanad area by way of their natural breeding and autostocking, resulting in the development of the fisheries of the area.

8. Hybridization and genetic improvement

Hybridization has been performed in a number of cultivable organisms, both intraspecific and inter-specific mainly for hybrid vigour and for production of sterile and monosex hybrids. Inbreeding depression is a phenomenon which is quite evident if individuals of the same brood. ie. brothers and sisters are allowed to mate. For combating this, cross breeding is encouraged. Mating unrelated individuals while producing seed in the hatcheries helps to improve growth rate, viability, etc. Interspecific and more distant hybridizations are performed in fishes for combining certain specific qualities of different species. Thus in India a hybrid of *Catla catla* and *Labeo rohita* had been produced to combine better growth of Catla and the small head of Rohu. Hybridization for obtaining sterile and monosex hybrids has been performed in Tilapia in order to prevent the breeding of this fish in culture ponds.

Genetic improvement by way of selective breeding for better growth and adaptation to environmental characters of the culture systems, and better resistance to diseases, is being done in many cultivable organisms. This field is of immense practical application. Selective breeding has been done in common carp, certain trouts, salmons, cat fishes and in the lobster *Homarus americanus* for faster growth. Selective breeding is also performed for disease resistance in common carp and the salmon *Salmo salar*.

9. Artificial upwelling

Raising algal cultures by bringing nutrient rich cold water from the depths of the ocean, for feeding shell fish is another technological achievement which one can hardly overlook when the future of aquaculture is considered. An experimental system that has been set up at St. Croix in the Virgin Islands of U. S. A., brings cold nutrient rich water from below a depth of 870 m pumped continuously into two 50,000 litre (1 m deep) onshore pools. The pools are inoculated with laboratory grown culture of diatom *Chaetoceros curvisetus*. The production of algae in these pools is quite high being of the order of 6.4 MT of algal protein/ha/yr. When compared to a production of 0.71 tonne/ha/year of Alfalfa, currently the greatest producer of plant protein, the production in this system is quite impressive. The algal culture from the pools is pumped into tanks where clam *Tapes japonica* is grown. The clam feeds by filtering and remove upto 90 per cent of this algae and grows so fast and reach marketable size. The production of clam in this system is significantly high.

This system is practicable in areas where within short distances from the coastline there is steep increase in depth, so that cold nutrient rich water can be pumped up economically. Besides using this pollution free and relatively disease free cold water for aquaculture, it can be used for a multitude of purposes such as generation of electricity (by using temperature difference between surface and deep water through OTEC-Ocean Thermal Energy Conversion System), large scale air-conditioning systems, for cooling nuclear power stations and for production of freshwater by recovering moisture through the use of condensers, provided wind systems carrying humid air is available. Thus, this innovative, at the same time controversial, idea is likely to prove to be a technological advancement of significance in aquaculture development as well as generation of electrical energy. In India such a system may be feasible if established in any of our islands like Andaman and Nicobar where the sea is comparatively deep very near to the coastline.

Thus considering the possibility of expansion of the area under aquaculture in future and also the impact the technological improvements can bring about, one can reasonably predict a five-fold increase in global aquaculture production by 2000 A. D., although the rate of increase may not be uniform in individual countries and individual systems of culture.

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Role of Home Science in Rural Development by 2000 A. D.

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Abstract

Rural Development in India is a strategy designed to improve the quality of life of 70 crores of people (75–80 per cent of the total population) living in rural areas, in our country. Of this, 30 crores are female population.

An assessment of the rural development programmes implemented in our country during the last three decades clearly indicates that women, by and large, remained on the periphery of developmental efforts and their actual roles and participation in the development process are not well appreciated. These programmes are not well coordinated and suffered from lack of staff and income generating activities, supervision, technical guidance, in-built short comings and lack of concurrent monitoring and evaluation. Generally a 'top-down' approach with a sense of half heartedness and disinterest, is shown in the execution of these programmes. Problems of women, like illiteracy, under employment, low nutritional status, lack of participation, etc. are not considered, while planning various developmental programmes for women.

Development programmes implemented should be administered more scientifically, by stressing the need for recognising the real problems of vulnerable group in preparing inventory of pertinent environmental elements, and in the implementation, monitoring and evaluation.

Home as the social unit determines the course and measure of social change and is affected by current social and economic problems. Therefore, while planning developmental programme to eliminate these problems, the impact on the homes has to be taken into consideration. The development of women being the self development of a society, their importance also is to be stressed while planning developmental programmes in Home Science.

In the next 15 years the developmental programmes in the field of Home Science must be stressing the proper exploitation of available resources, forecasting of finance, need for effective consumer organisation, imparting scientific knowledge about the latest arrival of household utility agents, conservation by reduction in waste, recycling material etc. etc. Participation of women in the implementation of these programmes is also a factor to be stressed.

In these programmes, care must be taken to create new employments, and to improve nutritional and educational status of women. If these programmes are

implemented with determination and dedication, this will definitely help to improve the physical well being and quality of life. This will also indirectly enhance their productivity and their activity to contribute to national well being.

Development can be defined and operationalised in terms of programmes that are designed for the betterment of socio-economic conditions of people. After more than a decade of relative neglect rural development has again emerged near the top of the agenda in our development policy. Conviction of such a need for a change in strategy and commitment to specific action-oriented programmes of rural development has probably never been greater in our country than at the present time, because this is an important bridge head, on which new understandings can be built and from which new programmes can be launched. In view of this it will continue to be at the top of the agenda even in the first few decades of the 21 st century.

Rural transformation or rural development in India is a strategy designed to improve the quality of life of 70 crores of people living in nearly 6 lakhs of villages covering about 75-80 per cent of the total population in the country. Of this, rural women constitute nearly 80 per cent of the female population and about 40 per cent of the total population.

Home-Science programmes in the present Rural Development Schemes

The Balwant Rai Mehta Study Team in 1957 had suggested that the programmes implemented under Community Development Projects and National Extension Service should focus more on economic, family and childcare activities. But an assessment of the rural development programmes implemented in our country during the last three decades clearly indicates that women by and large, remained on the periphery of developmental efforts and their actual role and participation in the development process are not well appreciated.

Home Science in our Rural Development programmes has so far formed only a very small segment. Broadly the areas of attention received from this discipline have been to improve the status of women in rural areas as home maker, to promote nutrition education, to develop local leadership and to promote women's participation. The most serious draw-back to these Home Science programmes was the lack of appreciation of the participant role of rural women. Her status in these programmes was only that of a beneficiary and not of a participant. Little attention was paid to her as an economic being, which she very much is, in a rural family. The linkages between the various components of Home Science programmes planned under these developmental efforts did not take correct shape. The Home Science programmes also suffered from lack of staff, supervision, technical guidance and concurrent monitoring and evaluation. Many of these programmes did not provide any income generating activities which might have been an incentive for women to participate.

Developmental projects suggested as solutions to the socio economic problems of women are often imposed on them from outside and from above, without any appreciable degree of women's participation from below. This 'top-down' approach together with, a sense of half heartedness and lack of interest in the execution of most of the programmes leads to the failure of the programme. Only by examining women's need and roles the real effects of development and their causes can be decided. These programmes also suffered from in built short comings. For example, it was based on the assumption that women in rural areas form a homogenous group which is not correct. The traditional roles of women are not identical in all strata of society. The illiteracy of women also limited their capacity to absorb technological informations imparted through these programmes, to improve skill and efficiency. Part of the efforts at providing some kind of skill and training have often been shots in the dark not matching employment requirement. For example, massive effort at training has been made in 'tailoring' which has never been able to promise full-time work and decent earnings to a majority of such trained women.

Women have not benefitted much from the technological advances made in the wake of the green revolution and dairy development. Because of this, they are gradually being dislodged from their original employment status in agriculture. For example when crop processing was mechanised and the use of weedicide became wide-spread, women were ignored. The most unfortunate situation is that job losses for women are not regarded as seriously as job losses for men. Thus, excluding women from the efforts aimed at the transfer of technology not only results in under-utilisation of potential 'man power' but also reduces the impact of technological advancement as women still continue to do some of their traditional activities without the advantage of new knowledge or the acquisition of new skills.

Programmes implemented for the benefit of women in agriculture have so far formed only a very small segment of development efforts in India. The development programmes were started and carried out on a very small scale and these programmes did not grow during the subsequent plan period either in dimension or in coverage. In short, even with net improvements in production the proportion of the families below the poverty line did not go down significantly even if one were to take the most favourable of the several conflicting assessments on this score. However, these defects are currently rectified in the Seventh Plan approach.

Women need special attention

The report of the Committee on the Status of Women in India, released in 1975 during the International Women's Year also threw much light on the problems of women. In pursuance of the recommendations of the world conference held at Mexico for the International Women's Year, a national plan of action, warranting concerted action on the part of the national Government to improve the status of women, was planned. Even though these developments are good signs of the increasing awareness of problems of women and their status in society, we are still far from a true and full recognition of the vital role that women have to play in rural areas. Another important aspect often ignored is that the problems of women in Community Development are not to be treated as problems of an individual but of husband and wife as a social and economic team. Moreover, it is to be recognised that women play a decision making role in families in that they determine the family expenditure pattern and savings and are largely responsible for the improvement of the nutritional status of the community. Due recognition is to be given to women as home-maker, partner in food production efforts and as wage earner, while planning development programmes in future.

What can a Discipline of Home Science do in Rural Development

Real problems that confront the community are to be recognized to keep us abreast of the real issues at hand. The vulnerable groups affected by these problems are to be identified. Inventory of resources, attitudes, beliefs and pertinent environmental elements that contribute to the existence of the problems are to be prepared and alternative solutions subject to trials, assessment and reformation to achieve the most desirable goals are to be formulated. Processes and operations involved in goal setting, implementation, phase monitoring and output appreciation are to be evaluated. Thus the development programmes are to be administered more on scientific lines.

Home—The first target

The home has been instrumental in determining a nation's moral and material progress ever since civilization began and continues to be the corner-stone of human development. By catering to the physical, emotional and spiritual needs of the members, the home gives meaning to life, provides a suitable environment for the growth of children and cultivates and refines the quality of citizens. A good home builds character, ensures happiness and directs the individual and community towards better living.

Being the basic social organisation, home ultimately determines the course and the measure of social change. This may act either as a change resistant or as a change facilitating agent. Therefore, the current socio-economic issue will in their turn affect the homes. For example, problems such as malnutrition, energy waste, environmental pollution, consumer fraud etc. which are among the nation's most intense social concerns, all will bear on the homes. Certain other problems like population explosion, feeding large families, maintaining health of children and mothers, the high rate of infant and maternal mortality, lack of facilities for recreation etc., will also affect the normal functioning of a home. Therefore, whenever a developmental programme is planned in future, its impact on the homes has to be taken into special consideration.

Women comes next

Development of women, is the total self development of a society and her development should be both endogenous and exogenous. It is endogenous in the sense that women concerned should ask or aspire for their own development. It is more psychological, sociological and cultural than economic. It is exogenous in the sense that the social system as a whole in which women live should be such that it enables the women to be at their best economically. In fact the system should have no institutional rigidities or distortions that impede the onward progress of women.

The programmes to be planned under the discipline of Home Science in future, must be stressing the importance of better management of a home and better treatment for women. Resources needed for better management of a home are of two types, human and non–human. Human resources are time, energy, interest, abilities, skill, knowledge, education and aptitude. Non–human resources are money, material goods and community facilities. The proper utilization and management of these resources are the basic principles of the 'Science of Home'. Human resources may differ from individual to individual, depending upon inheritance and training of an individual. Our women should have a good knowledge of all these resources and are to be made aware of the utility and importance of each one of them so that they will be able to manage their home in a better way through intelligent economic and scientific training of the process of using these resources. Moreover, the major challenge of this decade is to exploit the environmental or non–human resources to the fullest extent possible and to conserve the available resources before we outrun the nature's bounty. In addition, our women can be helped to meet the future demands of life by developing the knack of forecasting and careful planning of one's finances. Training our women to acquire the ability to clarify these family goals, to see each piece of the day's work in relation to time, energy and money available in order to run the family and to take the right decisions in the right moments are some of the major aspects to be stressed in rural development programmes around 2000 A. D.

Imparting required knowledge in making wise purchases for the amount spent, with special reference to aesthetic satisfactions and serviceability, the need for informative labelling like ISI, need for effective consumer organizations for safeguarding the interests of consumers, imparting the scientific information about the latest arrival of various household utility agents, etc. can be instilled in the home maker, so that she will have first hand knowledge about what is happening around her. Besides these aspects, a discipline of Home Science is to develop values that embody frugality and conservation either including reduction in waste, recycling materials, adopting intermediate technology, becoming more labour-intensive, prudent use of resources and volunteering a simple life. Problems relating to home and women in the field of child care and family planning and morale of the family members including functional literacy and gainful employment cannot be knit into a comprehensive programme of rural development without providing efficient participation of women and this can be dealt well by a discipline of Home Science.

Participation by women in development means involvement of women in project implementation. This participation is both necessary and desirable because it gives recognition to women. It will also top creative imagination, inventive ingenuity and inner potentials of women. This may improve their learning, decision making and action capabilities. Participation by women will also ensure utilization of local resources, capabilities, skills, talents and organisations. In short, it helps building local leadership and initative required for the mobilization of women.

These are some of the factors which determine the degree of women's participation in development programmes. These factors combine and interact with one another, independently or jointly to influence the level of participation in development.

Inhibited participation by women may be due to embarassment, shyness, defect in self image and socialisation. Restricted participation may be due to narrow interest, limited opportunities, curtailed choices of participation, confliction goals and roles. Participation can also be diminished due to the inability of women to identify themselves with the project, perceive the individual benefits or economic value, take risk, make sacrifice if necessary and cooperate with others for collective gains. The participation can be impoverished due to difficulties in developing mutual trust and confidence and sustaining contacts and relations with development agencies. The participation may reduce due to competition, rivalry, conflict, risk, uncertainty, misunity and threat. Thus participation of women in the developmental programmes is influenced by so many complications and the challenges before the discipline of Home Science for the coming 15 years is to go in depth into these problems, probe them, find out means of solving them and train them in proper ways to ensure better participation from our rural women because education plays an important role in shaping the leadership pattern. The leadership pattern may have an important bearing on the degree of women's participation in the decision making process and on the sharing of the benefits of development which is the most important form of participation as the equity aspect of development is directly proportional to the educational status of the women.

Employment, health and education were identified as major areas of concern. Therefore, a national programme of rural development, including a mix up of activities to create new employments, to improve the health of human beings, education and expand communication and improve housing, is to be taken up. The only way to bring a meaningful change is by ensuring in a peaceful way, effective family welfare measures, improved food supplies and nutrition, together with basic services such as health and education, which when attended with a measure of determination and dedication, will not only directly improve the physical well being and quality of life of the rural poor but also indirectly enhance their productivity and their ability to contribute to national economy. Constructive programmes on some of these lines are to be taken up by the discipline of Home Science.

Problems requiring immediate attention

1. The community activities are greatly affected by the living condition of the people living in the area. Remedial schemes applicable to the solutions of attendant problems are to be worked out to improve the well-being of these people.

Improving human health is a unique challenge. Controlling diseases by providing preventive health care and better nutrition is itself a major solution. Now the environmental sanitation and personal hygiene do play an active role in this aspect. Rural homes in India continue to be under most unhygienic conditions.

There are no sanitary facilities in villages and even in big cities, it is common sight to find human excreta, urine, sputum and all sorts of rejected refuse lying open in the atmosphere. Such habits are a constant source of contamination of food and drinking water. Vegetables and fruits are still sold on the road side near open drains leading to dangerous contamination. Unclean foods are sold to the public through restaurants etc. These unsanitary conditions naturally lead to constant ill-health and sufferings due to communicable diseases. Moreover, recent investigations have clearly shown that the synergestic action between poor environmental sanitation and malnutrition is responsible for the heavy tall amongst the infants and child population of this country. The possible reasons for our failure in preventing these conditions, inspite of all health plans and schemes, may be that the society at large has been unreceptive and ignorant in matters of health protection. The women in the family are to be educated in basic hygiene and teaching them the responsibilities towards making a strong and healthy home is the first step in solving the problems of ill-health. This is an area of neglect by health workers who concentrate more on medical care and immunisation programmes.

2. The income of rural families is to be augmented by providing the women subsidiary occupations which should be in harmony with agriculture. These occupations include rearing of dairy cattle, poultry farming, bee keeping, fruit and vegetable cultivation. sericulture. goat and sheep rearing, fisheries, piggery, etc. This may function as a key to the creation of more employment opportunities and increased income generation for the rural family.

3. Introduction of production improvements and mutually reinforcing programmes to provide better nutrition, improved water supply, basic sanitation and practical education and health programmes must be essential components of development programmes.

4. Increase in the rate of transfer of people out of low productivity agriculture and related activities, into more rewarding pursuits at a greater speed is required. An important fact of employment oriented development strategy, especially when we consider the capital source and labour surplus nature of the Indian economy, is appropriate technology for the maximum use of available 'man power', in addition to productive utilisation of local resources. In other words, increased investment in programmes for productive employment so that the existing 'man power' resources sould be profitably used. This weak link between human resources and natural resources for their mutual exploitation is to be strengthened.

Conclusion

Great changes are to take place in awakening a consciousness among women about the factors discussed above. However, it is always better to light a candle than to cause the darkness while there is a dismal picture before us. I know that the Home Scientists of our country have a long way to go to attain the goal. Still, the little in-roads that have been made and the little success in the midst of failure are worth mentioning.

b) Education

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Improvement in Teaching

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The success of any establishment is dependent on the quality of its products and therefore the accomplishments of our university should be judged from the field performance of our graduates and the research output. The quality of teaching and research depends on the depth of understanding and the innovative skill of the teachers or scientists. The teacher has a vital role in making the process of teaching more effective. It is the responsibility of the teacher to guide and inspire his students, to enrich his discipline and to inculcate values which are in consonance with our cultural heritage and objectives of the university. In order to do justice to his profession, the teacher has to be actively involved in educational innovations leading to improvement in teaching. At the same time sufficient institutional support by assuring infrastructural facilities, encouragements, academic freedom, etc. has to be provided to make the process of teaching and learning more effective. Improvement in teaching is naturally related to improvement in research and extension. However, only a few important aspects which are directly related to teaching efficiency are dealt with in this paper.

1. ROLE AND RESPONSIBILITY OF TEACHERS

1.1. Norms of professional ethics

Every teacher is expected to maintain certain norms of professional ethics and the society has a right to demand those standards from him. The University Grants Commission is of the view that the norms of professional ethics should be evolved by the teachers and followed in a voluntary sense rather than as a part of condition of service (Anon., 1981 a). Amongst its essential features, it is suggested that a teacher is expected to:

1 Uphold the dignity of the university and work towards the realization of its aim and objectives and keep the interest of students upper–most in his mind ie., *esprit de corps.*

2 Conscientiously perform his academic duties such as preparation of lectures and demonstrations, assessment, guidance, invigilation, extension and research.

3 Participation in extension programmes, NSS, physical education and other extra-curricular activities in keeping with his interest and attitude.

4 Assess the work of the students impartially.

5 Avoid inciting students against other students, colleagues or administration.

6 Express his free and frank opinion in seminars, conferences, etc. towards the contribution of knowledge.

1.2 Involvement in educational innovations

Improvement in teaching is mainly a function of the teaching community. This can be achieved only by the constant involvement of teachers in educational innovations. Restructuring of courses, system reforms, practical orientation to courses, preparation of text books and practical manuals, utilization of library facilities, use of teaching aids, etc. should be followed as a continuous process. Many such innovations in the past reached a dead end because of the apathy of the teacher.

1.3. Introspective analysis

Every teacher should ask himself whether he is satisfied with the results of his teaching. He should assess his performance by following any one or more methods of self evaluation. The objective of such an assessment, in the final analysis, is to motivate the teacher to improve teaching; the assessment should serve as a feed–back. Moreover, by such an assessment the teacher can watch whether the desired changes have been brought about in his students—their knowledge of the subject, comprehension of the issues and finally the ability to apply the acquired knowledge towards solving problems.

The evaluation may be effected by a study of the educational product or by the method of mirroring. Studying the educational product involves collection of answers from students in a pretested questionnaire at the end of each course. (A typical proforma for course and teacher evaluation has heen evolved in the College of Horticulture). Mirroring one's teaching is accomplished in several ways. The simplest is to ask a colleague to sit on one's class and to frankly appraise the strength and weakness he observes. Opinion of a few selected students can also be gathered. The audio or videotape recording of one or more class sessions is also a means of mirroring the performance of the teacher in class rooms which is now followed in United States (Perlberg, 1976).

1.4 Teachers' organisations

Kapur (1981) has emphasised the role of teachers' organisations in raising the standard of education. Teachers' organisations should work as professional organisations and should concern themselves seriously with the quality of education and teaching. It should ensure a high degree of accountability among members of the profession instead of shielding the incompetent and the dishonest. Since discipline is self imposed in teaching community, the professional organisation of teachers should have the courage to take action against erring members who participate in campus politics and who do not exhibit the required standards of the profession. A few black sheeps, though form only an unscrupulous minority, can destroy an institution. If teachers show fearlessness through unity in their ranks they can face the unsocial elements among teachers, students and politicians and improve standards of education.

1.5 Teaching methods

The students attending a course are of diversified background and training. Their attitude, aptitude, life and learning styles differ. Therefore, the teaching methods in general, and approach to individual students in particular, are to be evolved by the course teacher depending upon the situation realised by close student-teacher interaction. Various aspects of teaching methods suitable for different situation have been reviewed in seminars on teaching methods conducted by the Kerala Agricultural University and other universities/organisations (Anon. 1979 a; 1979 b; 1981 b; 1982 a; 1982 b). The newly entering student should be given sufficient orientation to the system of teaching and evaluation and as far as possible undergraduate classes should be handled by senior and experienced teachers. The scheme of evaluation of a course should be notified in the class well in advance. Classes should be punctual. To the extent possible, teaching aids like overhead transparencies, models, slides, photographs, videotapes, charts, posters, specimens, pictures, tape recorded talks of eminent scientists etc. may be used. Discipline should be maintained, but freedom for creativity should be assured. Dictation of notes should be dispensed with and cyclostyled lesson plans may be distributed in advance. Overloading of the students should be avoided. Examinations should be properly distributed and conducted without giving chances for malpractices. A question bank may be constituted for each course. Both objective type and short answer type questions may be included. The evaluation should not be liberal as otherwise it will place the hardworking students at a disadvantage. The correct answer to the questions should be discussed in the next class and the answer papers should be returned to the students promptly. Conduct of supplementary examinations should be discouraged. Evaluation of practical records should be done regularly. Special care should be taken to see that the offering of repeat courses is not taken easy.

2. SYSTEM OF EDUCATION

2.1 Advantages of internal evaluation system

The internal evaluation system (trimester) currently followed in the Kerala Agricultural University is definitely superior to the traditional system. The advantages are :

Since the students are continuously evaluated through periodical tests, they become more regular and serious in their studies. Students can take courses according to their requirement, choice and capabilities. The chances and risk factor inherent in the traditional system on the part of the students are eliminated. Course teacher has a great degree of freedom to teach according to his talents. The effectiveness of teaching can be conveniently and reliably assessed.

2.2 The limitations of the internal evaluation system

1. The students normally learn only what is taught in the class and do not go into the greater depth of the subject through additional reading. In other words, they become grade oriented rather than subject or knowledge oriented. They are normally not required to retain the knowledge of a particular course beyond a trimester.

2. The courses are not fully completed, sometimes, due to various reasons. In order to maintain the time schedule the teachers are often compelled to drive desperately to cover the syllabus without going deep into the topic. Such lapses are often not brought to light since the course teacher himself is the paper setter and examiner.
3. Success of the system completely depends on the sincerity and integrity of the teacher. In the event of indifference on part of the course teacher and lack of proper assessment by competent authorities the system may deteriorate.
4. The system requires more infrastructural facilities to complete the course in a short period of time especially for practial training programmes.
5. Students' unrest, undesirable academic environments and disturbances will affect the system drastically, since not much time will be left to adjust the classes lost by such disturbances.

2.3 Semester system of internal evaluation

Some of the above limitations can be overcome by introducing the semester system of education since it gives adequate scope for coverage of subject and greater attention to practical training programmes. It provides better scope for making up the time lost due to unforeseen interruptions during studies. Some of the agricultural universities who had earlier adopted the trimester system have now switched over to the semester system. (Report of Randhawa Review Committee, ICAR, 1978).

3. INSTITUTIONAL SUPPORT

3.1 Selection of Teachers

A teacher should possess high academic qualifications, mastery of the subject matter and capacity to interpret it clearly, intelligently and in depth, skill and enthusiasm in lecturing, ability to maintain discipline, fairness, kindness, high moral standards and impartial and secular approach. Obviously, all scientists or extension workers may not be efficient teachers and all teachers may not be good scientists or extension workers. Therefore, it is evident that the quality of teaching can be improved by identifying good teachers and assigning the teaching work only to such selected teachers. The concept of integration of teaching, research and extension implies that every teacher has to carry out teaching, research and extension activities. But, definitely the proportion of involvement in these three activities should be determined based on the talent of the individual. The integration of teaching, research and extension should be effected at the departmental level rather than at the individual level.

3.2 Review of academic regulations

There should be a continuous process of reviewing the undergraduate and postgraduate regulations of the university and modifications effected to remove the bottlenecks experienced by the teachers and students in the process of effective teaching and learning. The university may even constitute a cell of experienced teachers to formulate proposals for the revision of academic regulations based on their observations and the general consensus. These proposals can be placed before the academic bodies and implemented from time to time. Many points which require immediate attention of such a cell have been brought to light during the teaching methods seminars organised by the university (Anon. 1979). But, unfortunately, no remedial measures are attended to till date on the recommendations of these seminars. Certain salient points which considerably strain the standard of teaching are given below.

3.2.1 Repeat courses

The teaching and learning process effected through the repeat courses, as practised today, is far below the satisfactory level because of the inherent disadvantages associated with such courses. The teacher loses his enthusiasm when his lectures are to be attended to and appreciated by only a limited number of (often one or two) poorly graded students who are already exposed to these lectures. The students will be disinterested in these lectures since the topic covered will be mere repetition of things once studied. Consequently, classes become mechanical and ineffective. Moreover, since the class hours overlap with the class hours of the regular courses, in many cases, tha repeating courses are strenuous to the teacher and to the student. The evaluation will be usually liberal and attendance not properly watched. Therefore, every attempt should be made to reduce the frequency of occurrence of such repeating courses by reducing the pressure which forces the student to register for repeat courses.

3.2.2. Supplementary examinations/tests

At present, if a student is unable to attend a regular examination/test, supplementary examination can be conducted, when the absence from the examination is on account of being deputed at the time of examination for the activities of the university/college or if the student is seriously ill at the time of examination. Though these provisions are made originally to help the deserving students, they are highly misused to the extent of students developing habits of evading regular examination and ask for supplementary examination with false claim that they were seriously ill. Regulations have to be modified suitably to curb these unhealthy tendencies.

3.2.3. Conduct of examinations/tests

The effectiveness of teaching and learning also depends on the proper distribution and conduct of the tests or examinations. For various reasons, proper distribution of tests/examinations is not always followed and, in general, the students are rather free in the first half of the trimester and over-burdened with tests/quizzes in the second half. The mid-term and final examination weeks followed in certain colleges appear to be helpful in this regard. The dates of mid-term and final examinations should be declared in advance and included in the trimester calender and the conduct of these examinations on the dates specified in the calender should be made obligatory as per the academic regulations. Effective invigilation during these examinations should be assured to avoid tendencies for malpractices.

3.3 Overlapping of trimesters

A new undersirable phenomenon which has recently come into prevail in our university is the overlapping of trimester timings. One may wonder to note that there will be two, three or four current trimesters with different timings running in each college and the number of such trimesters in the university may be more than a dozen. It has become practically impossible to remember the beginning and end of the trimester, since they vary with courses and years of study and consequently the significance of "registration day", "last day of the trimester", etc. has been lost. Workload of the teacher has been unnecessarily doubled during the overlapping periods. Students repeating courses cannot attend classes with regular students, thus increasing the need for separate repeating courses out of proportion. Laboratory facilities are also highly insufficient during the overlapping period. The net result is the deterioration of the standard of instruction. It is high time that the university should work out and strictly implement a uniform timing of trimesters for the entire university or atleast for a faculty.

3.4 New trends in teaching and learning methods

Recent trends in teaching and learning have taken the forms of programmed instructions, computerised lessons, taped instruction and other versions. The students in other developing countries are already familiar and conversant with such kinds of approaches and their reading, listening and assimilatory behaviour through self questioning and discussions are at a higher order (Sree-Rangaswamy, 1981). In our country, we are yet to introduce such approaches and to utilise students both as learners and resources. We may presume that by the turn of this century such changes may take place in Kerala Agricultural University. Meanwhile we can reformulate our current practices to improve the learning situations effectively and then try to partially substitute our full time lecture atleast with any one of the approaches appropriate to specific situations.

3.5 Help to remain up-to-date or faculty improvement

The teacher must be given all help to remain up-to-date in their subjects. The following methods have been used:

1 Facilities to go for higher studies in the field of specialization.

2 Facilities to attend summer institutes relevant to the subject he is teaching.

3 Facilities to attend conferences/seminars/workshops of professional organisations.

4 Facilities to attend meetings of professional organisations.

5 Facilities to write text-books and monographs.

Some universities give their teachers sabbatical leave ie., leave with full pay for one year after every five or six years of service. The teacher can spend this time at an advanced centre, learning advanced topics or doing research.

The performance of our university in helping teachers to remain up-to-date in their subjects has been good and we may presume that such an approach will be continued during the years to come.

3.6 Training in audio-visual aids

All teachers must be given training in the use of audio-visual aids viz., charts,models,films, film strips, film projectors, slide projectors, overhead projectors. Teachers should be specially trained to make their own transparencies and slides. At present many teachers do not make use of the aids even when these are available because of certain unfamiliarity with these.

3 7 Providing adequate infrastructural facilities

The effectiveness of teaching and learning also depends on the infrastructural facilities available at the institution especially, library, laboratory facilities, Instructional farms, glass houses, workshop, darkroom, culture room, sample processing, storage facilities, etc.

3.7.1. Library

A resourceful library with well selected up-to-date text books, periodicals and journals is an integral part of the teaching system. It holds a unique position in that it contributes to the academic excellence and research competence of all segments of the university academic structure. The library should be kept open uninterrupted for atleast 12 hours a day including sundays and holidays. If it is open only during class or office hours, its use by students and teachers will be sharply limited. The need for a good library has been stressed in the recommendations of the Second Workshop on Agricultural Universities (Anon, 1965) and the norms and requirements for the functioning are available in the Final Report on the ICAR and Agricultural University Libraries (Anon, 1969).

The library facilities in the colleges require further improvement. At present the teachers and research scholars have to depend upon the libraries of other agricultural universities for work of an advanced nature. It is high time to evolve a strategy for providing library service to the entire academic community of our university. Setting up of a full fledged central library at the main campus of the university will definitely help the research scholars and teachers in expanding their vista of knowledge.

3.7.2 Laboratory and other facilities

For every professional course, practical training is more important than theoretical knowledge. But often practical training programmes suffer due to want of adequate laboratory and related infrastructural facilities. In the College of Horticulture, recently, the laboratory facilities have been considerably improved. But farm facilities, green/glass houses, processing and storage facilities etc. continue to suffer. Earnest efforts have to be made to improve these facilities so that practical training programmes are made more efficient and effective.

3.8 Assessment of teachers

At present there is no in-built device for the proper assessment of the work of a teacher and as this situation continues, the role and responsibility of a teacher would remain on paper. In the absence of such an assessment sincere teachers fail to get recognition and reward which they deserve. Assessment can best be made by one's peers in the discipline concerned. But it should be noted that a group of visiting peers will not really be in a position to assess the teacher. While students' response or opinion should be a guide to the teacher for improving his teaching methods, the assessment of the teacher should not depend upon the students' response alone. Some yardsticks that can be used for assessing the teacher are (1) his reputation as a teacher as revealed by student reaction survey and opinion of his colleagues including the head of department; (2) quality of research publications, the impact his research has created in his field and the frequency with which his papers are quoted by other research workers as judged by the experts; (3) number of research students guided by him; (4) contribution to extra-curricular activities of the students; (5) participation in extension and administrative work of the University; (6) number and quality of books written by him; (7) participation in national and international academic conferences and honours received by him; (8) the patents received and consultancy work done for the university; (9) new courses developed and taught by him; and (10) his conduct and behaviour with students, colleagues and administration.

Some universities have instituted distinguished teacher awards which encouraged good teaching and a person with this award may even get a promotion inspite of mediocre research record. While grading, nobody wants to be at the bottom of the list and every teacher makes an effort to improve his teaching. But it is cautioned that grading of teachers is a difficult and sensitive task and if not done scrupulously it will tell upon the initiative and morale of sincere teachers.

In many universities, there is a great deal of frustration among teachers; because, criteria of assessment for promotion purposes are not clearly laid down in advance. The teacher does not know whether he should give more attention to teaching or research or scholarly studies or to extra-curricular activities. The teachers have a feeling that at the time of selection, criteria will be adjusted to suit the candidate whom the authorities want to favour. As such, the teachers spend a good deal of time for pleasing extraneous work at the cost of academic work. Though our university has, by and large, succeeded in acting impartially in this respect, it will be better to lay down the promotion policy of the university and in the formulation of this policy students and teachers should be actively involved. The policy may be revised every 4 or 5 years, if warranted, based on the experience gained and in consultation with students, teachers and eminent educationists. Thus, the desire for personal promotion should be exploited to ensure best teaching for students.

3.9 Teaching and research

It is imperative that teachers should stay on the frontiers of knowledge and one important way of doing this is to do research. In order to do research, one has to read the current literature which will help the teacher to up-to-date his knowledge in the field of specialisation. But the research contribution of a good teacher will be much less than that of a fulltime researcher. Of late, in our universities research has acquired greater prestige than teaching. Because, it is more rewarding than teaching and therefore many teachers gradually lose interest in teaching. Due weightage should be given to teaching in the selection/promotion policy of the university. At present when a Professor gets a higher position, mostly he becomes a research administrator and his duties and responsibilities never allow him to continue to be a good teacher. Therefore, it is necessary to provide sufficient number of higher positions in teaching sector as these are available in the research sector in order to avoid the brain drain from full time teaching to full time research. Definitely, in an agricultural university much emphasis should be given for research but it should not be at the expense of teaching.

3.10 Work load of teachers

Many teachers of the university feel that one of the important constraints in teaching is the heavy work-load forced upon them due to lack of planning and foresight. During recent times, the university has launched many ambitious research and extension activities, obviously with very good objectives. But this unplanned proliferation of activities without sufficient personnel and infrastructural support have diluted the quality of teaching and research considerably. Heavy workload is also resulted from overlapping of trimesters and occurrences of a large number of repeat courses. The work-load of the teachers should be properly assessed and regulated. Also, there should be proper distribution of work-load among the teachers. Criteria for assessing work-load of teachers under trimester system of education have been discussed elsewhere (Jose, 1979). Teaching more than two courses by a teacher in one trimester should be discouraged. Due weightage should be given for practical programmes and the number of students attending the course. The participation of the teacher in extension and other activities should be regulated by the head of the department so that classes are not affected by such programmes.

3.11 Curricular reorganisation

Curricular reorganisation and restructuring of courses should be attended from time to time to keep pace with the advancement in various branches of science. The curriculum may also need revision to suit specific teaching and learning situations. It should be sufficiently strong to achieve all the cognitive objectives of education viz., knowledge, comprehension, application, analysis, synthesis and evaluation. Courses should be restructured incorporating more and more fundamental principles, whenever necessary, since applied science has to be developed out of the advancement in basic sciences. New supporting disciplines may become essential in line with developments in a particular branch of science.

3.12 Academic freedom and university administration

For good teaching and learning peace should exist in educational campuses. Students and teachers should not be used for political purposes. There should be sufficient freedom to teachers and academic administrators to act impartially as otherwise it may demoralise the teachers resulting in erosion of values. No teacher should be forced or tempted to compromise on his principles and he should not be deprived of any opportunity on account of this.

The administrative procedures followed in our university require reorientation. Often, teachers feel that the administration is particular about the rules and regulations and the goals are often lost sight of. Such an approach makes different persons function in isolation and try to follow the procedure and remain uninvolved in the process. Every one tries to maximise adherence to rules and regulations, without realising the ultimate objectives for which the whole exercise is undergone. The university should make an earnest effort to simplify the administrative procedures so that the goals of the university are rescued from the clutches of unnecessary official procedures.

3.13 Service and living conditions

The ultimate aim of any individual is a better living and teachers are not exceptions. The university should see that teachers get decent conditions of service and reasonably satisfactory scales of pay. The teachers should be attracted to live in university campuses by developing campus facilities for shopping, schooling, entertainments, medical care, post office, teacher's hostels, canteen etc. so that a good deal of their time even after the office hours can be utilised for the benefit of students and the institution.

3.14 Quality of students

Teaching cannot take place unless learning takes place simultaneously. Teachers can succeed only if students have a keen desire to learn. If students are motivated to learn well, the teachers will be motived to teach well. Fortunately, we are getting good quality students at the undergraduate level. Selection of students for post-graduate courses followed at present is also quite satisfactory. But we should see that the tempo is not lost during the years to come.

4 A CASE STUDY

Before I conclude I would like to quote some observations made by Nair (1981) in his studies on the management of scientific personnel of Kerala Agricultural University with reference to the objectives of the university, which are relevant to this context.

Majority of respondents felt that teaching work interferes with research and extension functions. Those representing scientists in the governing bodies of the university usually accede to the proposals of the authorities. Emphasis given to research in the recruitment policy induces complacency among teaching staff. The majority felt that administrative sections are dominating over other sections like teaching, research and extension. Seventy four per cent of the respondents are frustrated in the administrative complexities and 82 per cent felt that the administrative functioning is more procedure-oriented than result-oriented. Over 66 per cent of the respondents were of the view that administrative personnel are unresponsive and insensitive to the needs of the scientist. The majority (82 per cent) voted that there is no sound machinery for impartially evaluating the performance of scientists. In the selection process and in recognising achievements, research is given an upper hand.

Many of the above findings corroborate the views already discussed in this paper.

ABSTRACT

The role and responsibility of teacher, the system of education and institutional support are the important factors involved in the improvement of teaching. From the teachers' side, professional ethics, educational innovations, self evaluation, functioning of teacher organisations and teaching methods require special attention to improve the standards of teaching.

The system of internal evaluation (course credit system) is superior to the traditional annual system of education. In the internal evaluation system, the semester system appears better than the currently followed trimester system and hence a change to the semester system is suggested.

The aspects identified and discussed under institutional support are selection of teachers, academic regulations, overlapping of trimesters, new trends in teaching methods, help to teachers to remain up-to-date, training in audio-visual aids, infrastructural facilities, assessment of teachers, work load of teachers, teaching and research, restructuring of courses, living facilities, administration, and quality of students. Observations from a case study relevant to this subject have also been cited.

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Educational Methods in Agriculture

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Purpose of Agricultural Education

Agricultural education aims at the production of graduates in agriculture and post graduates in the different disciplines relevant to agriculture. The agricultural graduate has to play a pivotal role in the national Development programmes. He has to be a true friend of the farmer, helping him to solve his problems and to increase production from the farm. For this purpose he should have a sound knowledge of scientific agriculture and the confidence to meet the challenging problems. He has to function as an effective leader of an agricultural community. The primary objective of an agricultural university is to mould graduates having the above accomplishments and therefore training the graduate is the most important academic programme of such universities. The P. G. programme on the other hand is meant for generating scientists in the different disciplines for research and teaching in the agricultural universities and crop research stations. An agricultural Post-graduate has therefore to develop capabilities for leadership in the persuit of science.

System of Education

Education is the combined process of teaching and learning. At the University level, the primary object of education shall be to arouse in the students a desire for knowledge and not merely the transfer of knowledge. The success of an education system depends upon the quality of instruction and the depth of understanding. Considerable thought is given in the present days on the effectiveness of our education system. The student gains knowledge through hearing, seeing, and practising. A sound education system should enable a student to develop an analytical approach to problems. It should also allow a proper evaluation of the students.

The trimester system adopted for agricultural education at the University level in this country signifies a radical change in the educational outlook. It is a change from the examination-oriented traditional system to a teacher-centred programme. It motivates a student to learn, to develop inquisitiveness and to apply knowledge to problems in life. Flexibility of the curriculum and internal evaluation are the major advantages here. The uncertainty and lethargy so common in the traditional system are largely eliminated in the trimester system. However, the efficiency of the system at the under-graduate and post-graduate levels needs a critical appraisal.

The teachers

The most important element in maintaining standards in any academic system is the teacher. In the trimester system, great trust is placed on the teacher because the teacher who offers a course is responsible for evaluation also. The system can function efficiently only in the hands of a set of dedicated teachers of high professional standards. Lack of seriousness on the part of the teacher often leads to mismanagement of the course. Success of the system thus depends on the experience and integrity of the teacher. Qualified, experienced and devoted teachers are therefore absolutely necessary for maintaining a high calibre of teaching.

The work-load of teacher in the trimester system is very high on account of continuous internal evaluation. The efficiency of evaluation naturally depends on the number of teachers available and the time they are able to devote. Teacher evaluation by various methods thus becomes an integral part of the trimester system.

The Under-graduate Programme:

Education at the Under-graduate level comprises of class room teaching, practicals, field training and evaluation. The most important part is the preparation that the teacher goes through before beginning a course. Then he prepares a course outline, lesson plan and lecture outline. These materials are made available to the students in advance so that they can come to the class well prepared to receive the lectures. The lecture system is still the most popular technique for class room instruction but dictation should be avoided at any cost. The use of teaching aids and a discussion to conclude each topic can elevate the standards of instruction.

Laboratory and farm practicals depending on the nature of the course have to be designed as an integral part of the instruction programme. They help the students to assimilate the scientific principles and to build up a sound knowledge in the subject matter. The practicals for a particular course have to be planned in advance. The topic should be so distributed that each practical goes along with the concerned theory topics. Individual practical classes also have to be planned in detail in advance so that the time available is fully and effectively utilised. The planning and conduct of practicals can be properly done with the aid of a practical work manual. Practical records have to be maintained by the students regularly and evaluated by the teachers. A student : teacher ratio of 10:1 is optimum for proper communication in practical classes.

An agricultural graduate has to develop capabilities to practice scientific agriculture. This demands confidence which can be acquired only by doing things. The work experience and field training programmes help the students to develop their capacity to plan farm operations for various crops. The field training programme needs considerable strengthening even at the expense of one or two additional trimesters.

The trimester system envisages continuous internal evaluation of the progress of the students. This serves as a stimulus for systematic study habits.

The students remains alert and active throughout the course of study. The teacher shall announce the scheme of evaluation at the beginning of the trimester and adhere to the schedule as strictly as possible. The questions shall be balanced instead of being too simple or too difficult. The final examination shall include critical notes and mini essays. Practical evaluation deserves a higher credit and has to be done mostly in practical classes. *Viva voce* has to be included wherever necessary. Valuation should not be very liberal.

The Post graduate Programme:

There is provision for flexibility of course work at the Post-graduate level. Greater importance should be given for instructional courses in the M. Sc. programme. Diversity can be provided by selecting courses from relevant minor disciplines. The course work in the Ph. D. programme should be formulated in such a way that the candidate becomes a real scholar in the chosen discipline. Minimum number of courses prescribed shall not be the guide line. Any number of deficiency/ supporting courses have to be included from the major as well as minor fields. The academic standard can be kept high through a series of discussion classes. Seminars and term papers have to be frequently included in the programme. Practical exercises have to be thought provoking action programmes.

The research programme at the Masters level shall be for attainment of methodology whereas at the Doctorate level it shall be for making valid contributions in the basic or applied aspects of the major discipline. Specific credit equivalents are prescribed for the research programme. There should be provision to admit a lower number of credits at the end of the trimester based on the work turn over than the number for which the candidate registered at the beginning of the trimester. The supervising teacher and the advisory committee shall evaluate the progress of research as the project advances.

Course evaluation by course teachers and project evaluation by advisers shall be done regularly in each trimester. Practicals, seminars, term papers and *Viva voce* have to be given higher priority in the scheme of valuation. The system of failure in a course shall be dispensed with. Those who secure less than the minimum prescribed, may be graded as 'E' meaning course completed with a grade point of Zero. Such students shall have the option to repeat and improve the grade. Qualifying examination is meant to test the proficiency of the candidate in the course programme. The external examiner in the examination committee may be substituted by the Head of the Department. The final thesis viva, however can be conducted with an external examiner in the committee.

Prospects:

Educational methods have to be dynamic to meet the requirements and challenges of the changing standards and situations. In this University we have completed nearly 12 years after changing over to the trimester system. As a teacher with experience in both the systems at the UG as well as PG levels, I feel that we have to change over to a system with provision for internal as well as external evaluation at the undergraduate level. The suggestion can be substantiated as follows:

i) Subject continuity and sequence is difficult in the trimester system.

ii) Field practicals are also difficult in a short period of 3 months.

iii) Indepth study is difficult because of the too many and too frequent evaluations.

vi) Practically very little time is available for discussions and library work.

v) Complete absence of external evaluation.

vi) The course teacher is relaxed because no outsider is involved in evaluation.

vii) Students take examinations easy because of the total internal evaluation.

However, at the Post-graduate level the trimester system may continue.

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The Veterinary Student in 2000 A. D.

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The student in Veterinary Science in 2000 A. D. should be moulded as an ideal citizen, who can easily fit in the social and cultural set up of our society at that time. It is true that we are aiming at the creation of scientific talents to meet the requirements at a time when science and technology might have expanded to unbelievable extent. But basically, the graduate should be an ideal human being who has developed his desirable qualities, and can sensibly understand the problems of the society. So we should give sufficient importance to the welfare activities of the students, so that they can develop to full extent their desirable qualities like,

1 Leadership abilities

2 Talents in sports, arts and literature

What is to be done for this?

We should not neglect the inborn talents of an youngster just for the sake of producing a professional graduate. The students should be given full freedom to use and develop their talents. The best talents should be spotted out at the very beginning of their course and all facilities should be provided for their proper development.

Facilities to be provided

1 Proper residential facilities for all students

Hostel for all the students provided with all latest amenities including common halls in all floors with television and video, Telephone booths in wings, Hostel Doctor and Ambulance ready round the clock.

2 Boarding facilities

Vegetarian and nonvegetarian foods to choose from, quantity of milk, meat, etc. should be at international standards. A dietician to supervise the nutritional requirements.

3 Physical education

Physical education should be compulsory for all. A pass in physical fitness test should be a requirement for completion of the degree programme. A sports complex is to be established at least at the University Headquarters. Full time coaches for different disciplines of sports and a specialist in sports medicine have to be appointed.

4 Cultural activities

A full-fledged students centre for the students union activities—An auditorium to seat 1000, fully air conditioned, and with latest audiovisual equipment on the stage—Instructors in different arts, yoga and meditation have to be provided.

5 Additional facilities to be provided

i) facilities for advanced coaching in any form of arts or sports selected by the students,

ii) Opportunities to visit developed countries,

iii) Interclass, Intercollegiate and Inter-University Sports and cultural meets to be organised regularly so as to give ample opportunities for the students to test their abilities.

6 Incentives to attract the best talents

i) Grace marks of 5 per cent for the best talents in sports and arts

ii) Exemption from attendance requirements

iii) Scholarships from University for the best sportsmen and artists

iv) Opportunity for the students teams to visit various Universities and cultural centres in developed countries.

How to find time for these activities?

1) Suitably modify the system of education

2) Reduce the number of examinations

3) Reduce the number of courses or subjects in the curriculum. It may be difficult to reduce the courses in view of the increase in volume of scientific literature in 2000 A. D. But this can be conveniently overcome by introducing two branches of study:

   i) Veterinary Science, and (ii) Animal Science.

   After the first two years of courses in fundamental and common subjects, the students can choose either the degree course in Veterinary Science or in Animal Science. This choice can be either by option by the students themselves or by selection before admission. Thus we can find sufficient time for the students for their extra and co-curricular activities.

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Agricultural Engineering Education

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Our task by 2000 A. D. will be to augment agricultural production of food and fibre to meet the escalating tonnage requirement by the efficient utilization of inputs and natural resources in this highly populated state where average space per farmer is decreasing, while causing least ecological imbalance and creating increased employment opportunities.

The solution to this is to evolve and encourage the appropriate types of farming and cropping system that are labour intensive and turn out increased production and net return per unit area, time, and inputs. Agricultural engineering has a major function in this.

Engineering inputs to better equipments, structures and power sources, better land, water, and energy management, and post-harvest technologies essentially reduce the risk of crop failure and losses and increase resource productivity. Agricultural machinery and implements are rightly known as 'input of inputs' as without this input the benefit trom other inputs viz. labour, livestock, seeds, fertilizer, water, energy, etc. are not realised to the fullest extent possible. Besides field observations have shown that appropriate mechanization, while making agricultural operations easier, faster, and economical helps to raise land productivity and increase intensity of production activities so that employment potential of the total system does not diminish, and infact in certain situations it may show a definite increase. Mechanization of lift irrigation is an example.

At present Kerala is passing through the Ist stage of mechanization which is the 'start of agricultural mechanization'. Only a few machines are in use. This is the period of experimentation, research and education in terms of development and use of agricultural machines. Inadequacies of the existing machines are identified and thought given to as to how they can be improved. By the turn of the century we should be entering the 2nd stage which is the 'progress in mechanization' in which we should be manufacturing small machines such as pumpsets, dryers, ėtc. The transition to 2nd stage is hastened because the drudgery and hard work associated with agricultural operations are driving the literate rural mass away from farm work. More over, the envisaged industrial and educational developments by 2000 A. D. will only make this problem more acute. Agricultural engineering education by now should be oriented to cater to the needs of manufacturing unit and mechanized farms. This stage is expected to last for about 20–25 years. 'Total mechanization' can be envisaged in the 3rd stage. These stages are decided in somewhat arbitrary manner.

For a developing country to successfully apply the principles of agricultural engineering in their farming system several related services are to be developed.

Some of them are farmer education, training of agricultural engineers and technicians for education, research, field work and industries, and establishment of sales and service centres.

Foundation of agricultural engineering education in this state was first laid by establishing the Department of Agrl. Engineering in the College of Agriculture, Vellayani, at the time of its inception in the year 1955. Till 1979, agricultural engineering education was limited to the few agricultural engineering subjects taught to the under-graduate and diploma students in agriculture. The base was further widened by starting Master's Programme at College of Horticulture, Vellanikkara, in 1979. However, to meet the challenges offered by the 1st, 2nd and 3rd stages of mechanization the state should be training agricultural engineers and technicians in adequate numbers. At present the Department of Agriculture implements the T & V programme through 378 Agricultural Development Units (ADU). These units are functioning without the support of agricultural engineering personnel and therefore the benefits of engineering components in modern agricultural technology are least realised. Similar needs exist in Agro-Industries, Banks, Department of Soil Conservation, Kerala Agricultural University, etc. for agricultural engineers.

Kerala Agricultural University should take up the lead and formulate courses to offer Bachelor Degree Programme in agricultural engineering so that by 2000 A. D. the Faculty is fully developed to meet the challenges.

Agricultural engineering education in the state will have to be organised at four levels:

i) Farmer's level.
ii) Technician's/Mechanic's level
iii) Graduate level, and
iv) Post-Graduate level.

It is generally agreed that a graduate engineer should be able to clearly understand and execute the agricultural engineering projects. The course curriculum should be so designed to give more emphasis to the computer-oriented mathematics and to the fundamentals of agricultural crop and animal production and engineering practices. The College of Agricultural Engineering shall be so located to facilitate strong and constant interaction between the students of biological sciences and engineering.

Post-graduate programmes should aim to produce highly competent development project planners and managers. They should also be capable of becoming good teachers and researchers.

Besides the two fields of specialization, viz. Farm Power and Machinery, and Soil and Water Engineering, at Post-Graduate level further expansion into the fields of Alternative Energy Sources, Crop Processing and Structures, Dairy Food Engineering, and Bio-Engineering will help to further the benefits from the agricultural sector in Kerala.

c) *Extension, Administration & Finance*

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Fisheries Extension

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Extension is the vital link connecting technological development with production. However, in the the field of fisheries, extension has been one of the weakest links. This is mainly because there has been no proper extension system for the transfer of technology. The little works on extension that has so far been carried out are confined to popularisation of composite fish culture in inland waters and selective stocking of prawn in the brackish waters. Mechanisation of the fishing crafts and gears, introduction of the synthetic twines, and cryopreservation of marine products are high-cost technologies adopted by the marine sector. However, the beneficiaries are mainly the well-to-do entrepreneurs. The majority of the fishermen still apply the age old practices of using country crafts and gears. They cannot afford to practise the capital-intensive modern mechanised fishing methods. The fishermen are very backward due to the prevalence of a number of socio-economic constraints. The low-productive traditional technology of fishing and an unorganised and highly exploitative marketing system have been instrumental in their economic backwardness. The poor organisation of the fishermen, their educational backwardness, highly seasonal nature of their occupation, heavy financial indebtedness, lack of saving mentality, restricted ownership of fishing implements, and inadequate institutional support have made them economically and socially backward. Therefore, any programme aimed at the development of the fisheries sector should be comprehensive and integrated, backed by strong research and extension support.

PRESENT STATUS OF FISHERIES EXTENSION IN KERALA

When the research function was transferred from the Department of Fisheries to the Kerala Agricultural University, the surplus staff with the Department were assigned extension duties. They could not be given any special extension-oriented training to discharge their duties effectively. Their work was confined to conducting film shows in the coastal villages in order to educate the fishermen in the modern methods of fishing, sanitation, cultural practices, etc. besides participating in exhibitions. However, such activities have only very little relevance to the large needs of the fisheries sector. The extension wing could neither keep the fishermen and the industry appraised of the technological developments in the field of fisheries nor help the fishermen to avail themselves of the welfare programmes envisaged for them by the Government. However, small beginnings were made in the right direction especially in the field of culture fisheries. Demonstrations of Composite fish culture were organised throughout the State. Fish seed were produced and supplied to the farmers at subsidised rates. Inland Fisheries Development Corporation was established in order to give better thrust to this developmental area. The

Fish Farmers' Development Agency in Kerala has done good work in the wider adoption of rural aquaculture. The Kerala Agricultural University and I. C. A. R. Institutes like C. M. F. R. I. and C. I. F. T. as part of their regular extension work and under the ICAR sponsored Lab-to-Land Programme offered technical advice and material inputs to the farmers and fishermen for starting fresh water aquaculture and mariculture and for innovations in fields of fishing, gear and processing technology. The Integrated Fisheries Project, and the Central Institute of Fisheries, Nautical and Engineering Training offered short-term courses for those employed in the fishing and fish processing industry. In spite of all these efforts, fresh water aquaculture and mariculture on scientific lines have not been widely adopted by the farmers/fishermen of Kerala. On the marine side, the majority of the fishermen still use only country crafts and gears and produce nearly 80% of the marine catches. In spite of the several developmental programmes and fishermen welfare schemes implemented under the previous Five Year Plans the fishermen remain largely backward socially and economically.

CONSTRAINTS TO THE DEVELOPMENT OF FISHERIES EXTENSION IN KERALA

It would be interesting to examine why the fisheries extension works did not achieve the results in the past. The following constraints are apparent.

1 There is no organised set-up for Fisheries Extension in the Department of Fisheries as well as in the other fisheries research and developmental institutes. Lack of qualified hands in extension, and lack of equipments and facilities are evident.

2 Establishing a well-organised extension set-up on the marine fisheries side is rather prohibitively capital-intensive and demand highly qualified personnel. For example, in order to demonstrate the techniques of fishing or navigation, costly fishing vessels, fishing nets like purseseines, echo sounders, fish finders, electronic navigational aids etc. have to be commissioned, and highly skilled personnel have to be employed for demonstration.

3 The modern techniques of navigation and fishing are rather very much capital-intensive that even if a well-organised extension wing is set up for transfer of the technology, there will be only very few fishermen coming up to be benefitted by this transfer of the technology. Only a few rich entrepreneurs are likely to be benefitted by setting up a high-cost extension unit. The need for the development of an intermediate technology harmonising the good aspects of both the traditional as well as modern techniques is suggested here.

4 On the culture fisheries side, by analogy with agriculture, a strong extension wing can do a great deal of useful work for the transfer of the latest technology to the farmers. But here again, extension work was not quite fruitful owing to a variety of reasons like lack of organisational set-up, qualified personnel, physical facilities, facilities for multi-locational adaptive trials etc.

5 Lack of professionally educated and qualified staff for extension work has been a major drawback. Professional education in fisheries has been started only quite recently. Apart from the few courses offered at undergraduate level in fisheries extension, there is no opportunity to acquire professional competency in extension methodology at present. The only All-India institute imparting training in in-land fisheries extension is the Central Fisheries Extension Training Centre, Hyderabad offering a 10 months' Certificate course in inland fisheries extension. Extension is too important to be tagged on to either the research personnel or the development officers. It appears that specially trained extension workers, proficient in the art of extension and properly trained in the subject matter capable of developing good support with Research and Development personnel should be produced.

6 Research results having direct practical utility and definite economic advantage are likely to be accepted and adopted by the fisher-folk without much extension work. A typical example is the synthetic yarns replacing the vegetable fibres used in net-making. More and more of such research results having direct application in the field have to be produced, so that extension becomes an easy process.

7 In a few cases atleast, extension work has not succeeded because multilocational adaptive trials were not conducted in advance to verify whether a new technology will suit a particular agro-climatic or ecological condition. A typical example is the consideration for implementation of a massive project for carp culture in the Kari lands of Kuttanad, before ascertaining whether the carps will survive in the acid waters of the Kari lands and whether corrective steps will be economically viable. Here, carp culture is a proven technology, but its adaptability in a particular ecological situation is to be tested before advocating its adoption.

8 Transfer of half-baked technology often places the extension workers in a ridiculous situation. In order to claim credit, research institutes often publicise their research results before a technology is perfected under field conditions. Field experiments are to be necessarily conducted and the technological and economic viability of the new technology has to be tested. A typical example of such a case is the proposition of commercial farming of frogs.

9 Often, the desired developmental progress and production are not achieved when there are gaps in the package of practices recommended to the farmers. That means, technological developments should be balanced and should cover all aspects of a project plan. A typical example is the culture of *Macrobrachium rosenbergii* in paddy fields of Kuttanad. The culture trials have yielded extremely good results. But when more and more farmers have come forward for taking up *Macrobrachium* farming, the lack of supply of the required seed material has become a limiting factor. The technology of hatchery production of *Macrobrachium* seed has not been perfected to the extent of supply in commercial quantities.

10 There is lack of a Fisheries Information and Forecasting Service with a Public Relations Officer and Subject Matter Specialists in the Department of Fisheries who could have utilised the mass media for communication of vital information to the fishing community.

FISHERIES EXTENSION PROGRAMMES FOR THE FUTURE

1 Establishment of Fishery Information & Forecasting Bureau

The vast amount of money and effort expended on studies on marine fisheries would be useful to the fishermen and their industry at large only if information on current pattern and trend of the fisheries and fairly reliable prediction of the fishery in the coming days are made available to those concerned. The current information to be useful should be passed on before the distribution pattern changes. By a system of collection and collation of fishery information from exploratory and experimental fishing vessels, supplemented by data from commercial fishing vessels, it should be possible to indicate to the industry the areas of abundance of fish, qualitatively and quantitatively, on a day-to-day basis. A forecast of the likely movement of the fish sheals could also be indicated based on present trend, past information, and planktonological and oceanographic data. The establishment of Fishery Information and Forecasting Bureau will be a major step towards revamping the extension wing of the Department.

2 Establishment of a Research & Extension Advisory Cell

The major functions of such a cell under the Department of Fisheries will be:

a) to indentify priority areas for research with respect to the problems of fisheries of Kerala so that the institute responsible for research could be approached for research on such problems on a priority basis. Nominal financial support could be offered by the Department in order to draw concerted research efforts on high priority research problems relevant to Kerala.

b) to identify technologies that could be given adaptive trials under different ecological conditions and suitably modified, if required before being released to the farmers/fishermen. The technological innovation will be tested and certified by this cell, before being recommended for wider adoption or financial support.

3 Establishment of a Communication Cell under the Department of Fisheries

A series of package of practices and recommendations for fish culture, prawn culture, fish seed production, prawn seed production, fish handling, fish processing, quality control etc. and technical pamphlets in Malayalam meant for the farmers and fishermen are to be produced regularly and up-dated from time to time in collaboration with the Kerala Agricultural University. A Public Relations Officer with the assistance of Subject Matter Specialists and Para-technical staff can run this cell.

4 Fisheries Extension Organisational set up for the Fisheries Department

Realising the importance of extension, it is suggested that all the extension activities could be reorganised under the control of an Additional Director of Fisheries, with a Joint Director in charge of the Fishery information and Forecasting Bureau and the Marine Fisheries Extension works and a Joint Director in charge of the Inland Fisheries Extension works. There could be Asst. Directors (Extension) in charge of each of the districts. Personnel with minimum qualification of B.F.Sc. Degree could be posted as Extension Officer (Fisheries) in each of the Fishing village with the formation of the Fishermen Welfare Societies. In addition, special development projects like 'Fish culture in the Kuttanad' should have subject matter specialists in the cadre of Deputy Directors and Assistant Directors. There should be a Public Relations Officer assisted by staff qualified in communication, editorial works and in the operation of audio-visual aids.

5 Fish Farmers Development Agencies

It has been realised that extension work devoid of administrative and financial support may not succeed beyond a point. The Fish Farmers Development Agencies seek to provide a package of assistance under the direct control of the District Collector, providing long lease of water areas, training, extension services, credit and incentives by way of subsidy. All the districts of Kerala are to be brought under FFDA.

6 Krishi Vignan Kendra for Inland Fisheries

In view of the vast potential for development of culture fisheries especially in the Kuttanad and Kole Lands, there is scope for the establishment of a Krishi Vignan Kendra for Inland Fisheries, for educating the farmers in the scientific methods of fish and prawn farming, especially the mixed farming of paddy and fish.

7 Extension works on fish handling and processing

Quality control is a must for continued export and marketing of our marine products. Often, criticisms are heard about the low quality of our marine products. Through extension work a good deal of quality control measures could be introduced at every stage of handling and processing of fish. Since fish handling is mostly done by the illiterate fisherfolk, it makes it all the more necessary that suitable extension techniques are evolved to convey the message. While inplant inspection and pre-shipment inspection are regulatory measures, the educational approach through the medium of extension is supposed to be more effective.

8 Paddy-cum-fish and Prawn culture in the Kuttanad and Kole Lands

Kuttanad the 'rice bowl' of Kerala could as well serve as the 'fish basket' of Kerala, as this region, about 1.16 lakh ha. in extent is endowed with plenty of water resources and it was demonstrated by the Agricultural University that it is not difficult to raise a crop of fish or prawn after harvesting a crop of paddy annually. Similar is the case with the Kole lands of Trichur. The technology of carp culture is a well-established one and one of the major constraints in adopting the same on a wider scale in the Kuttanad, is the lack of knowledge of production of carp seed locally. Other minor constraints are initial capital investment required, non-availability of mahua oil cake, anticipated marketing difficulty when large scale farming is attempted, etc. which could be solved in due course. So, here is an instance where large-scale carp farming has not taken roots only because of lack of a strong extension service, backed by financial support.

In order to introduce and extend paddy-cum-fish culture in the Kuttanad, a three-tier approach is recommended. The affluent and educated farmers should be trained in the setting up and operation of low-cost carp hatcheries, so that the required carp seed could be produced locally by them. These affluent farmers would be able to mobilise the initial capital investment required for this purpose.. The ordinary farmers forming the second tier should be trained in the operational details of paddy-cum-fish culture so that they might engage themselves in farming operations. The third tier is constituted by the landless labourers of the Kuttanad who could be trained in marketing of the produce, in fish seed trade or in cage or pen culture of fish in public waters. A similar approach could be made in the case of the Kole Land also. Through an integrated approach, made possible through a strong Extension wing of the Department of Fisheries of Kerala and with research and extension education support offered by the Kerala Agricultural University, it would be possible to bring atleast 20,000 hectares of paddy fields in the Kuttanad and 5,000 hectares in Kole lands under paddy-cum-fish culture before the turn of this century.

9 Macrobrachium culture and other promising fields

Macrobrachium rosenbergii is one of the most preferred species for aquaculture in view of its high demand in the export market. A reliable technology for the commercial production of its seed is being perfected at the Azhikode Centre of the Department of Fisheries. In S. E. Asian countries, expecially in Thailand, its seed is being produced and sold by the farmers. Before the turn of the century atleast it must be possible for us to perfect and transfer the technology to the local farmers.

Some of the other promising fields of research that might require strong extension work much before the turn of the century are hatchery production of tiger prawn *(Penaeus monodon)* seed, culture of air-breathing fishes, hatchery production of *Mugil cephalus* seed etc.

10 Organising aquarium fish export trade

Through an organised fisheries extension wing it must be possible for Kerala to emerge, before the turn of the century, as one of the leading states in India in the matter of production and export of tropical ornamental fishes and aquatic plants. Aquarium fish trade has to develop from the stage of amateur activity to the status of an industry. Steps have to be taken for an orderly, planned development of the trade through privately owned lead centres which should be technically and materially assisted by the Government. The production and export of aquarium fish would not only help earning foreign exchange, but would also create employment in the rural sector where even the women folk could find profitable vocations. According to a recent report of the International Trade Centre, the world trade in tropical aquarium fish is estimated at about 600 million US $ annually of which exports from Asia, particularly from a few southeast Asian suppliers account for over 60% of the total export trade. Although our neighbouring countries like Sri Lanka, Phillippines and Singapore are doing well in this business, India has not made so far any significant progress in this trade. Through planned extension work aquarium fish breeding could be organised as a cottage industry and export could be arranged through a marketing society formed for this purpose. The required research and extension support could be provided by the Kerala Agricultural University and Marine Products Export Development Authority.

11 Research on Extension

With the development of fisheries extension on a firm footing, there would be scope for conducting research on assessing the effectiveness of the different media and extension methodology used in fisheries extension for transfer of the technology to the needy farmers or fishermen. The KAU might take up such studies after the formation of a separate Department of Extension under the Faculty of Fisheries.

12 Establishment of Extension units under the different fisheries Institutes

There is scope for the establishment of an Extension Unit with each of the institute concerned with Fisheries Research or Development in the State. These units could arrange for the preliminary screening of the research results and recommend for adoption of those results which are found to be useful under field conditions. In the Development Department, these units could arrange for the multilocational adaptive trials before the new technology is adopted for wider use, involving large financial outlay. Before the turn of the century it must be possible for us to achieve progress in all the aspects discussed here.

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Restoration of dignity to the vocation of farming. An essential pre-requisite to accelerate development of Agriculture

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The late Poet laureate of Kerala, Vallathol Narayana Menon wrote as early as 1926 in one of his renouned pieces entitled 'FARMERS LIFE'.

"FARMER, MY FRIEND, THOU ART A CONDEMNED LOT
TO MANY A VEIN GLORIOUS STYLIST
BUT IT IS OUT OF YOUR SILENT TOIL
ALL THE REVERBERATIONS OF MACHINES HAIL"

The poet goes at length to drive home the message that but for the farmer and farming the whole Universe would have been a monotonous scene of disfunction, inertia and chaos. He recalls the references made about agrarian endeavours in Vedas and confirms that these are not platitudinous, but identification of farming as an unavoidable, inevitable economic activity of great piety and sanctity that sustains the material and spiritual needs of the society. Vallathol eulogises the farmer as a brave hero, who made the world worth living through his untiring efforts. He attributes nobility and greatness to the job of farming. He concludes the poem with an emphatic exhortation.

"If you want prosperity, happiness
And freedom to prevail,
Redeem the life of the farmer
in tune with the changing times".

The Farmer

Those of us who go about aggressively promoting agricultural development, seems to be overlooking the most vital component of Agri-business—the farmer. He is the one who consistently and persistently fights against heavy odds like agro-climatic disfavours, difficult terrains, natural hazards, crop enemies and paucity of resources. He used to have more failures than chances of success. Success do not excite him nor failures deter. He does not revolt even when subjected to severe exploitation and humiliation. Recognition is something which he has never clamoured nor aspired for. He hears about new materials and methods of farming. Acceptance of these innovations is optional to him. He tries some of them, adopts those which appeal to him. He has only limited access to new technology. He dare not seek them, as he feels it is all inaccessible to him.

He prays to the 'Goddess of Farming' and seeks her blessings for the well being of his agricultural enterprise. He behaves a contented man, cut away from all sophisticated systems and comforts – the social animal often quoted unawares as the back bone of the nation's economy.

80% of our population is like him, living in far flung villages and earning the livelihood through farming and allied occupations. Our economy is thus predominantly agro-based.

Drawbacks

It has all the built-in draw backs of an under-developed economy such as

(1) Low rate of literacy
(2) Low productivity in agriculture
(3) Low per capita income
(4) Adherence to tradition bound practices
(5) High density of population
(6) Poor sanitation
(7) Lack of adequate communication facilities
(8) Inadequacy of food, clothing and shelter for the people etc.

Since Independence there has been remarkable improvement in these conditions, yet much remains to be done.

In view of the predominance of agriculture and related occupations, modernisation of farming and increasing agricultural productivity should have been accorded the top most priority in all our development plans.

Results of research have to move faster to the field and diffusion of innovation has to be accelerated. It is commendable that within less than four decades, output of food grains has touched an all time high of 150 million tonnes, registering a three-fold increase.

Could we attribute this solely to the modern technology ? It is indeed a triumph of the farmer. The gains could have been still higher, had we motivated the farmer better. Farming largely remains an undignified job even now, failing to attract enterprising entrepreneurs in our country, with the sole exception of Punjab.

'Job' — misinterpreted

Everybody, particularly the educated and unemployed manpower in the rural setting refuses to choose farming as a remunerative vocation. To them vocation, job or employment means a white collar or arm chair engagement.

Their definition of a job, is an employment in a Government office, Industrial establishment or Bank, which will fetch them a three digit or four digit salary on the 1st of every month, after an eight hour duty on working days. Even those who have sizable arable land, prefer to work in an office, because of the status and recognition that go with such 'jobs' in the society. Farming is thus left largely as a traditional vocation to the elders at home who have been in this business for long.

History

History reveals that agricultulture in the form of settled cultivation was started in our country around 7000 years ago in the Indo-Gangetic plains. Due to agro-climatic diversities the country is endowed with rich flora and fauna. This is precisely the reason that India became one of the early centres of domestication of several important crops including rice.

The ancients were, however, afraid of the loss of soil fertility and the devastation of crops by pests and diseases. They, in their wisdom, restored soil fertility through practices such as shifting cultivation, conservation and use of animal refuse and waste and the introduction of legumes in crop rotation. They insulated themslves from crop failures caused due to vicissitudes in weather or incidence of pests by growing a mixture of crops in the fields.

Many an effort like this, which would throw light on the originality and ingenuity of the ancient farmer, could be traced. This farmer has undergone evolutionary changes in behaviour and attitude. But his commitment to land and the arable culture stayed in tact.

Treatment to the farmer

Improvement in agricultural production and productivity attained successively could be attributed largely to the meticulous hard work put in by the farmer. The 'farmer' who is the king pin around whom the whole gamut of prosperity and abundance revolve, has never been accorded the pride of place he deserves in the society.

Planners, administrators and decision makers all alike 'look down' on him. The treatment meted out to him by the Mass Media like newspapers and electronic channels also are none different. Not even 2% of the space in newspapers care to carry some items on farming and related vocations. Out of the 12 hours devoted for broadcast over the national radio, not even 10% of the air time is set apart for agri-business. So also Door Darshan.

In a predominantly agro-based economy like ours, should not the farmer and his craft get a better deal? The success story of an innovative farmer is not considered news worthy. Phoolan Devi, the notorious dacoit, is better known in our country than many Krishi Pandits, who have literally achieved 'vertical expansion' in farm productivity.

Farming and farmer are thus pushed down. How come such a vocation, though the most noble and laudable among economic activities, be meted out a step-motherly treatment? New talents hesitate to tread into the field of agriculture because of its inferior status.

If our agricultural system is to attain the due degree of modernisation, it should be able to win the acceptance of enterprising entrepreneurs. This is possible, only if farming is projected as a 'decent job'.

Farming, which had enjoyed a pride of place even in vedic times, should be restored its lost glory. This could be achieved only through an on-going and intensive drive under the auspices of Institutions of the standing of the Agricultural University.

Though it is hard to suggest a rigid course of action to achieve the objective, I may dwell on certain long-term strategies that could be discussed.

Begin with Students

Special lessons in the curriculum in schools and colleges projecting agriculture as an economic activity of rich legacy and tradition should be included. The lessons chosen should carry sufficient persuasive influence to accord respectability to the farming community.

Similarly, organising 'Young Farmers' Forum' in educational institutions should be made compulsory. The members of such Forums should be imparted training to acquire improved techniques. Those students who opt for joining such a fraternity could be encouraged by granting special credits. This would create a congenial climate in academic institutions to promote a sense of respect for agriculture and allied vocations.

Exercises of these nature are likely to yield promising results, as we are contemplating to "catch them young"

State level Farm Fair

As of now there is no systematic efforts to convene 'Farm Fairs' at state level for providing a common forum for farmers from different regions to interact and share their experiences. This should be done on a regular basis in different venues from year to year. Such occasions could also be employed gainfully to project agriculturists of outstanding brilliance by instituting attractive awards either in cash or kind.

Separate awards could be presented to individual farmers with significant achievements in their respective field of specialisation like Rice, Coconut, Rubber, Tapioca, Poultry, Dairy, Fish farming, Piggery, Kitchen Garden, Ornamental gardening etc. The success stories of these award winners could be projected through the mass media as an effort at motivating the latent talents of others.

Recognition of the performance of innovative farmers and the projection accorded to them will certainly bring in a lot of respect to the agrarian community.

Cost-benefit aspects

Cost benefit aspects of the vocation of farming and allied activities are not that well known to attract new and young talents. Though we produce a lot of literature on improved methods of crop husbandry, seldom do the cost of cultivation and per hectare net return from different crops find an authentic mention in them. An idea about the profit realisation is, perhaps, the largest single factor that could motivate and attract entrepreneurs. Unfortunately ready reckoners in this regard are grossly lacking. This is an area which should engage the immediate attention of the propagators of innovative ideas.

Incentives

Incentives offered for generating self employment among educated and jobless rural youth have to be made more attractive and liberal, particularly agro-based vocations, so as to attract new talents to take up agro-economic ventures. Once the youngsters are given to believe that farming and allied vocations are equally dignified and paying, the rush for white collar jobs would certainly come down resulting in a large section prefering to choose farm-based activities.

Communication support

Rural Development enterprises including agriculture, do not enjoy the communication support and motivational persuasion legitimately deserved by them.

Mass media like Newspaper, Radio and TV do not accord adequate coverage for news-worthy items of relevance to rural development. Nor they cater in a need based fashion.

Publication of a specialised daily news paper exclusively for Rural Development and related aspects would be worthwhile in a state like Kerala where the literacy is as high as 70%. There is a lot of technology that is still in the shelf, awaiting release, for want of appropriate channels and self contained media. The information seeking behaviour of the farming community in this state is immensely favourable and receptive to imbibe anything new. The farm feature pages, carried weekly once by leading newspapers in Kerala, bear ample testimony to the response from farmers. This aspect could be taken advantage of better, if a specialised news paper is started for carrying innovative items for promoting agriculture and rural development. Only then can we project the farmer and farming and accord a dignified place to both.

Past experiences show that continuous and ongoing campaigns are effective in driving home the intended message. A shining example is 'Family Planning and and the concept of small family'. The educational propaganda on planned parenthood has helped in instilling sufficient awareness in the minds of couples. They have become adopters of one method or the other for arresting unwanted pregnancy.

The "we two-we have two" pattern of family size has come to stay, irrespective of caste or creed, rich or poor, literate or illiterate, employed or unemployed.

So also, the lost glory and dignity of the vocation of farming could be restored if an intensive educational campaign employing all the channels of communication is launched on a continuous basis. Besides some of the steps suggested earlier, the University could take this up also as a Public Relations exercise.

Our late Prime Minister Lal Bahadur Sasthri had coined the slogan "Jai Jawan Jai Kisan". Jawans are held in high esteem throughout the country, but Kisans are not. Dignity of Kisans has eroded over the years. It needs immediate restoration, if farming and allied activities are to flourish and prosper.

I wish the Kerala Agricultural University initiate the process of redemption and bring back the nobility, greatness and sanctity enjoyed by farming. Unless this is done accelerated devlopment of agriculture would remain an unfulfilled dream.

The farmer has to be tamed, his dignity has to be upheld, he has to be inspired, informed and entertained. So that his toils and moils become meaningful.

The rural farmer as a poet remembered—
is rough, coarse and dry in exterior
but soft, delicious and nourishing in interior
thus most of the native farmers are just like
a coconut fruit.
He is lovable, affectionate and good at heart.
Let us restore his lost glory.

Problems and Prospects of Adult Education

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Problem

India is an agricultural country. Most of the learners in Adult Education Centres are either farmers or daily wage labourers. Despite phenomenal expansion of formal education in India, the absolute number of illiterates has continued to swell. It has increased from 246.4 million in 1951 to 445.8 million in 1981 accounting for two thirds (63.8 per cent) of the total population. A bird's eye view of its statistics is given below.

Literacy level

Year	*India* %	*Kerala* %
1951	16.6	46
1961	23.2	56
1971	29.3	64
1981	36.2	70

Looking to the trend, both the country and the state as well will face a problem of educating the masses by 2000 A. D. According to UNESCO, India will be the only country with illiteracy as statistics show that even today for example India and Kerala are having 11.5 crores (1/7 of the population) and 11.5 lakhs (1/20 of the population) of illiterates respectively.

In Kerala the massive programme undertaken by different agencies is as follows:

1. Kerala University	—	700 Adult Education Centres
2 Development Department	—	300 Rural Functional Literacy Programme Centres
3 State Adult Education Department	—	552 Adult Education Centres
4 Voluntary Agencies:		
a. KANFED	—	500 centres
b. Quilon Service Society	—	60 ,,
c. Trichur Welfare Association	—	30 ,,

Even with their trend of development in the field of adult education the experts are of the opinion that we need 98 years to acquire cent per cent literacy level in this State.

Prospects and perspectives

According to Dr. (Mrs). Welthy Fisher, a recipient of several honorary degress and awards like Ramon Magsaysay Award, the Nehru Literary Award and the Humanitarian Award, the four F's which are relevant to rural India are Functional literacy, Family life planning, Food production and Freedom to choose one's own Government. The functional literacy programmes relating to agriculture and allied sciences aim at not only imparting litetacy skills but also provide basic knowledge of the improved methods of agriculture relating to high yielding varieties of crops and the likewise. The UNESCO sponsored functional literacy world experimental programme, particularly the project in India linked with Farmers' Training for increased crop production. Functional approach is linked with production targets as well as with employment scheme. Literacy cum training activity and literacy cum social awareness helps to raise agricultural production. Skill building could be achieved by the illiterates and the neoliterates through simultaneous skills acquiring of the 3 R's and of the ideas and techniques related to the work situation involved. "Work skills" shall relate to different management practices in agriculture and allied sciences. "Work themes" could be worked out and grouped under varied fields of agricultural sciences. Modern production in agriculture is becoming more and more technical for which enormous inputs of knowledge and sophisticated crop planning are necessary apart from credit, storage and marketing arrangements. These essential requirements necessitate adult education for the farmers so that the schemes of agricultural production such as soil conservation, water use, dairying and animal husbandry, etc. may be implemented successfully.

Adult Education Programme amongst women is important today either as potential mothers or workers. As Mahatma Gandhi said "Education should be so revolutionalised as to answer to the wants of the poorest villager". According to a report of the National Adult Education Council the literacy rate of the women in India is as follows.

Female Population

Year	*Population (in millions)*	*Literacy rate (%)*
1971	264.05	18.70
1981	330.46	34.58

Phased development and adoption of science and technology in agriculture have given rise to the need for greater information and knowledge of scientific skills and services. While men farmers, being on the field, have a greater access to such information the females have lagged behind. Educational programmes for rural women can help in bridging such gaps.

In general, Adult Education programmes have three components—literacy, social awareness and functionability. The 37th All India Adult Education Conference held recently at Banaras Hindu University recommended that the Agricultural Universities should also take up adult education activities for their target group for which the UGC should come forward to fully support these programmes of education and extension services of the Agricultural Universities. The conference also recommended that in order to create awareness, to impart skills and to bring about attitudinal changes among women of the rural and the tribal areas, adult education functionaries have to be identified and trained.

With the above perspective in view, the Kerala Agricultural University could take up the following approaches, projects and programmes with the assistance of national funding agencies like UGC, ICAR, IABA as well as international agencies like the UNESCO, UNDP, CIDA, UNICEF, and the DANIDA.

Projects and Programmes

I Continuing Education Section

The KAU like the other Universities could take up correspondence courses and skill-oriented diploma courses for the neoliterates amongst the farming community. The section could also offer such courses for the instructors and supervisors who are adult educators under the Adult Education and functional literacy programmes in the State.

II Agricultural Polytechnic

The institutions could take up farm-oriented vocational education programmes. The non formal education programmes of adults could generate opportunities for employment in rural areas.

III Media Centres for Adult Education

Use of media is the latest concept of the day under Development Communication. The Centre could be a resource centre for audiovisual communication producing visual and teaching aids for the neo-literates and the nonformal education community involved in farming.

IV Instructional Material Centre

The KAU could produce trainiters' name ,master princes, an advanced material of the present primers used in the Adult Education Programmes for the farming community in Kerala. The University could also produce bulletins to suit the readability and understandability of the neoliterates and the farmers in the functional literary programme in the State. Such post-literacy material will be of much importance to the adult educators in Kerala.

V Library services

Books, bulletins and such other materials produced by KAU could be distributed, circulated and revolved with neo-literate agricultural courses now functioning under the adult education programmes of the State. Both institutional and peripatetic training programmes with consultancy services built in, could be taken up. Trainings for the instructors and the supervisory community of both Government and private agency will boost up their technical calibre in agricultural and allied services.

VI Experimentation Research and Evaluative Programmes

Possibilities of research as operational research and action research programmes could be anticipated to be taken up by the KAU. Such researches could be linked up with rural development studies in adult education.

As an effort to consolidate all the projects and programmes mentioned, a Regional Adult Education Institute in Agriculture may be established in 2000 A. D.

Veterinary Extension in KAU 2000 A. D.

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By 2000 A. D. the challenges before Veterinary extension will be enormous. To meet these growing challenges, a beginning has already been made by the Extension Department of the College of Veterinary and Animal Sciences, Mannuthy.

The broad objectives of the University's Veterinary Extension programmes are as follows:

1 To provide back-stopping to development departments relating to Veterinary and Animal Sciences.

2 To set up suitable models in Veterinary Extension for homestead development.

We are in fact influencing farmers' decisions with reference to latest technology in Veterinary and Animal Husbandry, through the medium of professional Veterinary Extension personnel of the development departments of Animal Husbandry, Dairy Development, MILMA, etc.

The extension role of KAU should not stop with mere supply of information to development departments but should be supported convincingly by novel extension approaches. What is meant by this novel extension approach is that it should stand out in quality so as to serve as best model for the development departments to duplicate them on a large scale.

The extension approaches already adopted by the University eg. Village Adoption Programme, Krishi Darshan, Lab-to-Land Pragramme, various information support programmes, training, etc. stand out as models for the development personnel not only in our State but in other States also.

The fund of knowledge of veterinarians should be enhanced by consistent and adequate need-based training programmes. The University also has the massive responsibility of evaluating the *modus operandi* and the impact of these programmes on its intended beneficiaries. In short, we should be serving as a resource centre not only on veterinary extension technology but also its methodology.

The T & V System, followed in agricultural extension world wide, may not be practicable in Veterinary extension because of the reason that a technical intermediary is required for implementation. Moreover, Livestock innovations are complex, the unit of production is small and scattered over a larger area. In 1979, the Kerala Agricultural University on an experimental basis started a Farm Advisory Counter in one of the adopted villages at Vilangannur. It has been found that this centre has been serving as the feed back nucleus for the scientists of the University. The specialists are attending to the problems of the farmers at this centre at a fixed time and date every week and discussing problems and suggesting solutions. This facilitates the scientists to get to know the problems of the community in depth enabling effective feed back of different problems. This Centre also catalyses the student-farmer contact which provides the best forum for the students of the Veterinary College to mingle with the farmers at the farmers premises, helping them develop the 'farmer-scientist' relationships even at the onset of their professional career. This Centre is acting as a training centre as well for the transfer of no-cost and low-cost technologies and developing skills among the farmers and making them as 'practicing scientists' and to develop leadership among them.

As stated earlier, to provide the State Department of Animal Husbandry, Dairy Development, MILMA, etc. with 'working models' of extension, few hospitals of the Animal Husbandry Department can be taken up in a phased manner to serve as pilot Veterinary Advisory Centres guided by the staff of the Veterinary extension department of the College of Veterinary and Animal Sciences, Mannnuthy. To meet this challenge, adequate facilities, men and materials, have to be provided. These Centres will be in direct contact with the College of Veterinary and Animal Sciences, as per a fixed schedule and the experts from the extension department of the College of Veterinary and Animal Sciences will be visiting these centres on a fixed day and time to help the veterinary surgeons in charge of the centre for the implementation of the different extension programmes in the area concerned. The Veterinary Surgeons in charge of the centres will visit the University periodically for training and updating their knowledge. By 2000 A.D., it is envisaged to operate 100 such centres and experts from the extension department of the College of Veterinary and Animal Sciences will be visiting each centre once in a fortnight as per a pre-determined schedule.

A phased programme for the establishment of Veterinary Advisory Centres is furnished below:

Seventh Plan	25	Veterinary hospitals
Eighth Plan	50	do
Nineth Plan	100	do

Another model to be tried through this Extension Advisory Centres is establishing 'Minikit' farms in the selected farmers' premises which will serve as demonstration units and as a model for other farmers and the results of such units would be the success stories for the proposed Video and T. V. programmes of the University. This will also explore the scope of new system of co-operative cattle, goat and poultry farming and no doubt this will be a success story for tribal families.

By 2000 A. D., a radical change is expected in the outlook of people on A. H. practices with increased utilization on INSAT System and Television, besides other sophisticated communication media like Video. This communication channels may be utilised to the maximum for easy transfer of technologies to the farming community. Organisation of Television and Video clubs along with Radio Rural Forums, with priority assigned to the backward areas, will go a long way in contacting the low-income farmers, agricultural labourers, Harijans and Girijans. Establishment of Video libraries in the district headquarters or zones will help in channelising the cassettes to the Video clubs in rural areas. Comprehensive ideas like "cause and cure" will thus permeate to the farming community through the cassettes thus supplemented after the T. V. programmes.

To match the growing responsibilities, adequate facilities in the Department of Extension, College of Veterinary and Animal Sciences would have to be provided. The dream of developing 'ideal scientists' instead of 'idle scientists' could come true only if the scientists have commitment for extension work.

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Media of Tomorrow and its Relevance to KAU.

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The two great events the world had witnessed in the 19th century were the Industrial and Agricultural revolutions. Now we are on the threshold of another revolution, viz. the Information Revolution. This is centered round electronics comprising computers and satellites.

As an information gathering and retrieving system, a computer is in existence for well over two *million years.* That is the 'wet computer' of the human brain. Human brain discovered language and several other means by which information could be conveyed from person to person and from one place to another transcending physical and cultural barriers. In the olden days messengers ran several miles, they rode horses and used boats to cross islands and even continents. Roman emperors whose domain extended from Britain to Egypt could rule the land because they could build up a good communication system.

In 1860, the American Government introduced the 'Pony Express'. The end of the last century marked the new era of communication—the era of electronics. Telegraph took over from ponies and horses. The news of the assassination of Abraham Lincoln reached 3,000 miles away in California within seconds after it happened but London came to know about it only after eight days because the cable under the Atlantic was yet to be laid.

Telephone came to the scene by the turn of the century. Although Marconi had taken the patent for radio in 1896, regular broadcasting started only from 1920. Mean while cinema, first, the silent movies and then as talkies became a great entertainment and educational medium. Today it has reached great technical excellence.

It was in 1927, television appeared as an experimental medium. However it had to wait till the end of the Second World War to become popular in the West. T. V., sometimes called the 'idiot's box' the 'one-eyed monster' and the 'electronic nipple' has become so ubiquitous that its influence both positive and negative is evident in Western countries.

When radio and television became powerful as means of communication, scientists focussed attention on developing computers and satellites. Today, a great revolution has come in the field of communication through these two newcomers on the scene.

In the Western countries, newspapers are said to be a dying phenomenon. Many big newspapers either have faded or finding it very difficult to keep up with the race of the electronic medium. Cable TV, which has come of age in the West, is bringing in a flood of new programmes which is said to transform the entire life style of the Western nations. Through cable TV., you can get at home, twenty four hour programme through different channels such as news, sports, entertainment and informative programmes. In the West today there is even a talk that the day will not be far off when there will be paperless newspapers. You press a button on your cable TV you have the headline news upto the minute. Choose the item you want to read and there are details on the screen.

Fantastic as this may sound, the possibilities of electronic medium are yet to be explored in full. Computers and satellites have ushered in an information explosion. They cannot only feed us with information, but also spy on individuals, communities as well as nations. We will be soon living in houses without walls. The 'Big Brother' will always be watching us.

It is in this context we should take a look at the communication scenerio of a developing country like India and what it holds for us by the turn of the century. Television is going to be the medium of the next century. It will reach the nook end crannies of the country. Even the remote areas will be attracted towards this medium in not a distant future.

Illiteracy is no bar to see and absorb TV programmes but what type of programmes will we be able to give to the villagers? Currently this question is agitating the minds of all right thinking people. Due to the high cost of producing TV programmes, our country now is in the horns of a dilemma of how to fill in the available time. Sponsored programmes which are entertaining in nature are the order of the day. Dated programmes produced in Western countries are telecast on Doordarshan because they are easy and cheap to procure. Although our planners, time and again, have reminded us that all our media should give due importance for development items, very little headway has been made in this direction.

The blame for this should be borne squarely by all the development departments, the input and financial agencies as well as the agricultural universities. Here is a medium ready to offer any amount of time for programmes on development but none of these institutions has any definite programmes to utilise these facilities. This started with the SITE and is continuing with INSAT-1B. Delhi Krishi Darshan Programme which runs for half an hour in the evenings is so stereotyped and unimaginative that even farmers for whom they are intended would perfer to turn off their sets or doze off during the programme.

As far as Kerala is concerned, KAU has a golden opportunity to use the television facility which will be available in the near future. The immediate task should be to set up a studio for production of programmes, but in the long run, the University should develop a department for programme producers on development items. Currently a leading Agricultural University in the north has acquired under foreign aid all the equipment for TV programme production, but there are no trained persons to make use of the facility. We should not face such a situation. Within the next ten or fifteen years KAU should not only be able to produce excellent programmes for the TV, but provide young bright boys and girls trained in the art and techniques of producing programmes for other agencies within and outside the State.

Another area we should immediately concentrate is on the development of our printing programme. The Oxford University Press has brought name, fame and fortune for the University through their publication programme. It is said that the two books that are sold in millions without any advertisement every year the English Bible and the Oxford Dictionary.

Due to high literacy, we are definitely better placed than all other States in the country in building up a good publication programme on sound commercial lines. Gone are the days of letterpress and expensive hot metal process. Instead, there is offset printing and photo composing. We must introduce these modern techniques and also organise a good system for advertising and sales promotion of the publications ranging from text-books to pamphlets. Unlike literacy books, we won't need to depend on conventional book sellers for the distribution of our publications. Dealers of input agencies, co-operatives and other financial agencies who are in constant touch with the farmers in the rural areas, will be too willing to act as commission agents for our publications provided they are properly planned and brought out.

But the real profit and reputation for the University will come through the monographs, text books and similar items which will have an All-India appeal. Here we can encourage not only our scientists, but outstanding scientists from other parts of the country to write for us so that these works will have a ready market all over the country.

Another area the KAU should look into is to have undergraduate and graduate programmes in development journalism comprising all faces of rural and urban development and not confined to agriculture and animal production. This may be under the agricultural faculty and the syllabus should be drawn up in such a way that the students get practical training in editing, reporting, camera and studio work, art and layout and allied fields so that they can find immediate employment in newspaper offices, book publishing firms, public relation and advertising organizations and TV stations after graduation.

These are some of the tasks which we should take up today so as to meet the challenges of the 21st century. As the Americans say, "We won't be able to do tomorrow's jobs with yesterday's tools'. Let us change the tools.

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K. A. U. Farm Advisory Service in 2000 A. D.

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The ownership pattern of agricultural land in Kerala has been undergoing rapid changes in the latter half of this century. During this period we have witnessed a drastic reduction in the size of farm holding with the result that the number of farmers is on the increase year after year. This change was probably due to the peculiar sociopolitical and demographic characteristics of the State. One can normally expect only an acceleration in the speed of this change. Consequently the University may have to cater to the needs of a very large number of farmers especially marginal and submarginal farmers in the next century.

While this change in the ownership pattern is drastic, the rate of changes in the technology has been gradual and is almost static at present. There has been increased awareness of the immediate need for the changes in technologies. The scientists may take a long leap and bridge this gap in the years to come. Due to the ecological and technological changes, new problems are likely to come up.

Thus, by 2000 A. D. we may have to face a new set of farmers with a new set of technologies. The farmers and the extension personnel will approach the University with new ploblems and the Farm Advisory Service will have to meet this challenge. During 1950's our approach was cropwise, which was later replaced by mixed cropping and finally mixed farming. In other words, at present we are laying more emphasis on homestead development. In the past, farming was a traditional occuputlon and the same trend continues even now, except in the case of a few plantation crops. By the twentyfirst century, our farmers can be expected to be much more critical in their approach based on economic analysis.

To face these changed situations the scientists will have to work out and develop appropriate technologies for the different farming situations. There should be major changes in our package of practices recommendations for different crops. Firstly, we should have tract-wise recommendations for different agroclimatic zones. Secondly, there should be different recommendations for different levels of management, say high level, middle level and low level management conditions as the farming community will be highly heterogenous not only in their socio-economic status but also in the proportion of the time spent in farming. There may not be any appreciable level of adoption for our general recommendations as most of them are valid only under ideal management situations. For annual crops the recommendations should be tractwise and seasonwise.

The twentyfirst century farmer can be expected to be nontraditional (or modern) when compared to his counterpart in this century. Naturally, a major criterion for the adoption of the new technologies in the next century will be their benefit: cost ratio. In other words, the new farmer will adopt the practices strictly on the merits of economic advantage only. In this process he will exercise his freedom and discretion in selecting the most suitable combination of technologies for his situations.

At present we are not advising the farmers on the nutrition aspects of food and farm produce. The next century farmers will be more conscious of these aspects as people can be expected to be much more health conscious.

Utilisation of agricultural byproducts and processing technology are new fields in which the University has to start extension education programmes. These may help the farmer to generate additional income to his family.

To cater to the needs of the future farmer the Farm Advisory Service should be restructured incorporating specialists from different fields like Agriculture, Animal Sciences, Farm Economics, Nutrition, Rural Engineering, etc. There should be a separate cell for farm visit which should be equipped to suggest on the spot solutions for the farmer's problems. Such a unit should ultimately work as a consultancy service and levy fees for the advices rendered.

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KAU and the Public

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Any organisation, which has a social role to play, necessarily needs a closely connected network with its various publics, to perform the best of its duties. The organisation like ours, with its three dimensional functions of teaching, research and extension in the different aspects of rural life, certainly warrants such a closely knit efficient system of public relations. It is not only for image building of the University, but it can also help to create the realistic perception and credibility about the organisation in the minds of its internal as well as external publics. Good public relations will help to have a sense of belongingness among the internal public comprising the members of governing bodies, officers of the University, scientists, administrative staff, students and labourers. On the otherside, it will create an impression that the University is a vital organisation in the society, among the external public including the Government, sister organisations, farmers and the general public.

In this paper, an attempt is made to identify some areas which can be effectively used by the University for its public relations. The programmes without much financial commitments, but with greater impact may be taken up and implemented as phased action.

1 The public forums in rural areas like the festivals, markets, etc. can be utilised for opening sales counters and information counters.

2 All mass media including the Press, Radio and Television may be made use of for serialising features and success stories touching the University activities.

3 Opinion leaders among the farming community can also play a vital role in image building of the University. Some progressive farmers, who will act as opinion leaders, may be selected throughout the State and close liaison be established with them by involving them in all possible programmes of the University. They must be made well aware of the research efforts and achievements.

4 The social elite class forums like Lions Club, Rotary Club etc. are implementing a number of Welfare programmes especially in the fields of education and health. The University can co-operate with them to chalkout and implement some action plans in agriculture and allied aspects.

5 The social organisations like NSS, SNDP etc. organise several functions and establish institutions, in which a good number of people are associated. The University can establish linkages with such organisations to help them to have programmes for agriculture and allied aspects.

6 The annual meetings of students organisations like KSU, SFI etc., usually have a number of sessions and seminars. The University can enter the student community with some action programmes utilising such occasions.

7 No social institution such as co-operative societies, panchayats, schools religious institutions should be left out. The University can co-operate with them helping to develop and implement some programmes for agriculture and allied fields of development.

8 The public relations wing can have an organised traditional media troop involving the students, staff and labourers for presenting programmes in all available platforms, charging only the actual expenses.

9 This wing may prepare sound and video cassettes, slide stories and documentary films on different facets of the University programmes and use them.

10 National programmes in Television and Radio may be arranged. Regular programmes and serialised features in regional Television and Radio may be planned or reorganised.

11 The public relations wing can play a role in the social celebrations like boat race, flower shows, processions etc. with its own floats or counters high-lighting the presence of the University.

12 In a state like Kerala, where the literacy level is very high when compared to other states, the reading habit of the general public may also be exploited by our public relations. We can try to get columns in all the periodicals and children's magazines to narrate our messages in suitable formats. The University may think of publishing a series of picture stories in the pattern of 'Amar Chithra Katha' which will catch up a wider readership.

13 A good reception counter and a visitors' room may be planned attached to the public relations wing in the headquarters. The visitors' room may be provided with display boards having charts and information details on the programmes of the University.

14 The housewives, who play an important role in decision making process' may be reached with suitable programmes. The Women's Clubs in rural and urban areas may also be collaborated for this.

15 Close liaison be established with the agriculture wing of all political parties and help them to prepare action plans for increasing productivity. The University may participate in the functions organised by these organisations. Since they get active participation and social approval from a good number of people, their orient-ation can be channelised in positive lines through these efforts.

16 We should also reach the younger generation in high schools and colleges, since a positive attitude towards the farming profession should be developed in such early stages to make them like it and enter it after studies either as a self-employment project or side-affair. Conduct of quiz programmes and essay competitions on

agricultural sciences will ensure more participation of the school and college students and motivate them to gather information on this subject. The University can involve in the programmes of young farmer's clubs or biological science clubs in schools and colleges.

17 A house magazine may be started,which covers all campus events pertaining to the students, staff and labourers in the constituent colleges/research stations. Such a publication will help in developing mutual understanding and a sense of belongingness among the concerned.

18 Contact programmes for the labourers working in the colleges/research stations may be arranged. They should feel a sort of high status among the labour class in becoming a worker in the University and be motivated to develop as model homestead formers in their piece of land, accepting the technologies from the University. In all field days organised, separate sessions for the agricultural labourers may be arranged to fulfil this purpose. It will help to improve their work efficiency also.

19 Cultural programmes and competitions may be organised for the internal public occasionally. Such programmes and campus days will help in their integrity.

20 Public relations is not merely image building and it can not be a substitute for deeds. The duty-bound performance from top to bottom as well as their response to the external public will definitely have an impact on the image building process. If there is no prompt and fair dealing from our side to the external public, however efficiently we are working, it is no use in the eyes of the tax payers. For example, if a farmer experiences much difficulty in getting a clear information or some seeds or planting materials from one research station, what will be its impact in his mind?

21 Orientation training in public relations and development communication may be given to all staff of the University.

22 A full-fledged public relations wing may be set up in the University. Since the organisation is mostly concerned with the applied subjects like agriculture, animal husbandry, fisheries, home science, etc. and the major clients are the farmers, technical hands should be entrusted with the task of public relations. The public relations men of the University should be good communicators in the related fields. A good network of public relations operating from the headquarters and extended to the tertiary institutions may be developed. The five regional research stations can be the coordinating centres in different zones of the State. The proposed organisational set up is as follows.

PUBLIC RELATIONS OFFICER
(Headquarters)

5 Asst. PROs. in Regl. Res. Stations	Media cell	Reception	Sales & information counter	Circulation & advertisement

Kerala Agricultural University and Public Relations

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"Public sentiment is everything. With public sentiments behind you nothing can fail, without it nothing can succeed. Those who mould public opinion have more impact on people than those who enact laws."

—Abraham Lincoln.

The Kerala Agricultural University is engaged in the triple tasks of Education, Research and Extension. The research and extension policies enunciated by the University emphasise the need for solving the problems of farmers and increasing agricultural production in the state as well as increasing net income of farmers through the dissemination of scientific know-how.

Increased crop production is a function of matching several inputs like seeds, fertilizers, irrigation, plant protection, availability of credits and above all, transfer of technology. The main concern of Kerala Agricultural University is the transfer of need-based technology to the farming community and this calls for a well built extension system with good public relations.

Technology is fast developing and farming is no more a way of life. Even the small farmer is conscious of the cost-benefit ratio of the recommended technology. Hence, the formidable task ahead of Kerala Agricultural University will be transfer of appropriate technology and keep the clientele informed of the programmes of the University for increasing agricultural production. We should have a profound faith in the capacity of the people to solve their own problems and involve them in the needs identification, programme development, implementation and evaluation. This could be achieved only through good public relations.

Public relations is the art and science of winning public acceptance and support for the programmes and personnel of any organisation.

Winning public acceptance and support depends upon the amount of rapport built between the scientists and their clientele. This could be better accomplished through the extension machinery of the organisation. Hence, public relations should be taken as a challenging task of the Extension Education in the years ahead. This system should establish a two-way communication flow that will keep people informed of our programmes and feed back the changing needs, concerns and problems of people. This is essential to create an environment of understanding, co-operation and interaction that are indispensable for the growth and development of people-centred organisations like Agricultural University.

Staffing: Taking public relations as a function of the Extension Directorate calls for strengthening the machinery through a net work of personnel stationed at the headquarters of the various campuses and major research stations of the University. The responsibility of co-ordinating the work of these network of staff shall be entrusted with an Associate Director (Communications/Public relations) stationed at the Directorate of Extension.

Media use

It is a fact that Kerala Agrl. University has built a good extension organisation during a short period of last one decade. Now the responsibility of projecting the activities of the University to the public is vested with the communication Centre, at the Directorate of Extension. The media used for the purpose include News paper columns, farm school on AIR, correspondence courses, Farm Advisory Services, Exhibitions, Krishi Vigyan Kendras and the publications. But the coverage of some of these media especially the Farm School on AIR, Farm Advisory Service and KVKs are limited to certain areas. So also the mechanics for feeding back the information from the field to the Communication Centre are also far below satisfaction. Hence the methods for public relations should be by widening the scope and coverage of the devices and communication media that are already available alteast by regionalising their area of jurisdiction. It is also important that these are tailored to the needs of a variety of groups and individuals that make up our clientele and the general public. Regionalising the activities of these media is the best solution for catering to the varying needs of the people. Care should also be taken to see that the messages communicated through the media are shaped to accomplish the primary objective of public relations.

Training needs of both farmers and officials of various development departments, voluntary organisations etc. could be entrusted with the regional KVKs and FAS for the respective area.

Television which is going to be a potential mass medium in Kerala by 2000 AD could be effectively utilised communicating scientific information and establishing good public relations. Closed Circuit Television system at regional level will help cater to the local needs.

Yet another method for establishing effective public relations is to open information-cum-sales counter at the head quarters of different campuses and major research stations of the University. These counters will act as easily accessible centres for technical information and guidance for people of the area. Sales of quality planting materials, animal products and publications of the University could also be undertaken by the information-cum-sales counter.

Village adoption programme

Village adoption programme of the University which was expected to create a good impact on the public has not succeeded to the expectation. One of the reasons for this unsatisfactory state of affair is the lack of adequate and constant supervision of the programme. A better method of implementation of this programme seems to be adoption of villages around different campuses and major research stations only. This will help concentration of efforts rather than dilution. The network of personnel responsible for public relations stationed at these places will implement the village adoption programme with a time-bound extension programme involving all the scientists and/or students of the respective stations.

Exhibitions

Exhibitions have the dual value of education and entertainment· Many a times, exhibitions motivate the viewers to put into practice those techniques which are technically sound and ecnomically feasible. Starting mobile exhibition units at regional level will not only help to cater to the regional needs but also will establish public relations. The recurring costs of organising the exhibitions also could be reduced considerably.

Publications

High literacy percentage of Kerala farmers give greater scope for popular publications. The Newsletter now published in English could also be published in regional language so that the image of the organisation can be spread to rural folk also. Similarly more publications which are of interest to farmers could be published in Malayalam and see that they reach the intended readers.

Thus streamlining and co-ordinating the various communications devices and media will go a long way in establishing good public relations.

Public relations should be a continuous process and needs to be a continuing goal for institutions engaged in solving farmers' problems. Arm chair extension is a negation of good extension work. All those who are engaged in education, research and extension should also establish relationship with farmers and their problems. And for the extension personnel it is a professional obligation too.

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Administration

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Wise Administration is crucial to the success of any organised agricultural development. An abundance of plans, funds and technical expertise will be of little use unless they are effectively mobilised and translated into localised actions that fit in with the needs of farmers.

An Administrator or Manager is one who gets results primarily through the action of other people. There are two ways to accomplish a task. One is a single person to do it himself, the other is through an organisation with the co-operation of many people, each of whom is responsible for a particular part of the task. In the latter case the work must be planned, organised, coordinated and directed by someone and that person is the administrator. In an organisation dealing with agricultural development, the administrator should have technical training in the particular field of activity as well as training as an administrator. If he has had technical training he must take steps to learn as much as he can learn administration. If he has been trained in administration, he must learn as much as he can about the technical subject matter dealt by the organisation.

Understanding an organisation

Once a person is appointed as an administrator his first task is to understand the organisation. The 1st step in this direction is to know clearly the objectives of organisation or in other words,

1) What the task of the organisation is supposed to be
2) What the task actually been in the recent past

The next step is to understand the routine procedures in the administration. It is preferable to meet the subordinates as a group and ask each to explain what his responsibilities are, how he carried them out, how often and in what manner he reported to the previous administrator. Discussion should be encouraged among them, but it would be premature to express judgements or try to reconcile differences. The immediate purpose is to learn how the organisation operates at present. A logical next step is to study the budget of the organisation and inspect its physical facilities. It would be a mistake to blame people for what is really due to poor facilities or due to a shortage of funds.

A deeper analysis

Upto this point the attempt has been to learn what the existing task is and how the organisation operates. Unfortunately many administrators stop at this point and try to keep it running as it has in the past and no more. However, a good administrator does more. He tries to equip himself, improve his organisation and performance. The following tips can be considered for this.

1. An understanding of agriculture as a system

The administrator should try to understand agriculture as a total system. He should have a firm grasp of the way in which farms, farmers, a wide variety agri-support services, transportation and industries that manufacture farm inputs or that process farm products fit together in a modern agriculture.

2. An understanding of agricultural development

In addition to a broad understanding of agriculture, an administrator needs an equally broad understanding of agricultural development. This is necessary—

1. To help get more *Production* out of existing agricultural capacity.
2. To help to increase the *capacity* of the country for agricultural production.
3. To contribute to *adjustments* within agriculture and between agriculture and the wider national economy.

3 Organisations in relation to each other

As one deepens his understanding of agricultural development he can see more clearly where and how his organisation does or ought to fit in. At this point it is important to get acquainted with the administrators of other agencies. One can then begin to consider what modifications in the task or programme of his own agency might be desirable.

4 How well does the organisation serve its clients?

An organisation can be well organised, to function smoothly and get reports in time and still not meet the real needs of its clients. The college courses may be on topics of little use to students. Research can be conducted on frivolous topics. Irrigation systems can be well managed out to the main canals but water distribution schedules not meet the needs of the farmers. Therefore an administrator should know his clients, their requirements, their problems and what they think of his organisation in order to provide maximum benefit to his clients.

All the above factors under the heading " a deeper analysis" have to do with what public administration specialists call the "task environment". The result of the above analysis is two-fold. First, it gives the administrator an overall view of the resources of his organisation to work with resources of (1)personnel (2) funds (3) physical facilities, (4) established procedures and (5) programmes of other organisations. Second, it lays the basis for beginning to think about modifications that would make his own agency more effective.

5 Proposals for change

The administrator should start early to make a wider analysis of both the tasks and the task environment of his organisation. He should start early to involve other members of his staff in the analysis and in discussing tentative proposals for change. The above analysis will mark the administrator as (1) who is *thinking* about the task of organisation, (2) who wants to see it be as effective as possible, and (3) who is not afraid of change but will not propose changes without good reasons.

Essential tasks of administration

Administration is more an art than a science. A good administrator should recognise the various component tasks that together add upto good administration. There are two sets of these tasks. They are the ones that must be performed just to keep the organisation and its programmes running, we may call them *"essential tasks"*. The other sets we may call *"strategic tasks"*. These can help to improve the quality of the programmes and to develop a productive interaction with other agencies.

Essential tasks

A Prior planning

1 Setting performance objectives for the next fiscal period
2 Budgeting
3 Determining a work schedule
4 Planning information flows

B Execution

5 Assigning tasks
6 Supervising personnel
7 Authorising expenditure
8 Maintaining physical facilities
9 Resolving conflicts
10 Revising programmes to fit emerging situations
11 Reporting and assessing progress
12 Selecting and promoting employees

The objective should be selected in terms of (a) Activity to be undertaken (b) what is hoped to accomplish by means of each activity and (c) how much of each activity could be successfully executed within the next fiscal year. In an Agricultural University a "programme budget" will be an ideal one which has the advantage of connecting expenditure with specific programme objectives. The administrator should see that the increased enthusiasm of one section of the organisation does not throw the total programme of the organisation out of balance.

Once the budget is approved it is time to prepare the work schedule of what is to be done month by month, or sometimes week by week. The work of the Agricultural University must be closely co-ordinated with the growing seasons of different crops. Certain types of agricultural research must also confirm to the agricultural year. The teaching of some of the subjects also needs to be related to agricultural seasons. PERT (Programme Evaluation and Review Technique) is a useful management tool in Agricultural Universities where lack of realistic work schedule leads to great inefficiency.

In general, an administrator needs to be upto date on what is going on in his organisation. For this purpose we should collect information either through written reports, staff conferences, field visits or through correspondence.

To place each person in a job for which he is well qualified is a first step in successful administrations. Aptitude, enthusiasm, honesty, ability to keep accurate financial accounts etc. are to be considered in assigning tasks to individuals and groups.

Supervision of personnel is the primary and important task of an administrator. A discussion of "horizontal organisation chart" is appropriate in this respect. Against "Vertical organization" charts with Chief Administrator at the top, the subordinates on the next lower lines and other administrators and unit arranged on successive lines, the "Circular or horizontal organization "chart" Fig. 1 recognises that:

(1) it is the technicians in the most specialized units that actually accomplish that work of organization. They are the cutting edges of the organization.

(2) the task of administration is primarily to organize, co-ordinate and facilitate the work of technicians

(3) the task of technicians is to advice the administrator to whom each is responsible.

(4) the direct connection of each technician is only to the administrator of his unit.

The budget is only the starting point in good financial management It is better for the administrator to keep a running record of expenditure, because it will improve the quality of his administration. The administration is also responsible to build up all the required physical facilities for all the units of organization. Repairs of equipments need to be handled promptly.

Resolving conflicts is another major task of administrator. It is far better for a dispute between staff members to be settled between them so that those involved can continue to work together effectively. The administrator should stand ready to revise the programmes of his organization whenever desirable to meet emerging situations.

Reporting and assessing progress are theo ther important tasks of an administrator. However, reports should be no more numerous or lengthier than really necessary. Due consideration may be given to employees already in the organization at the time of new selections and promotions. A carefully written job descriptions together with relevant suggestions about the personality qualities is an important first step.

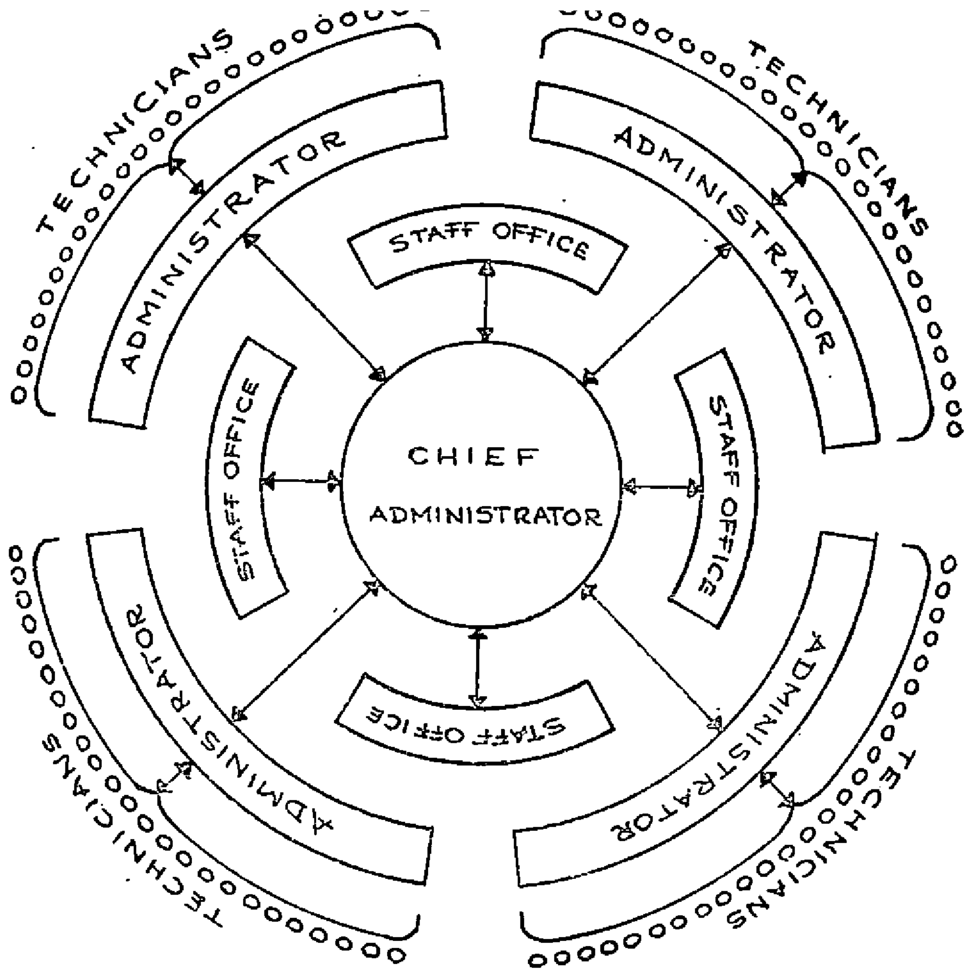

Fig. 1 Circular organisational chart

Under "strategic tasks of administration" the following tasks are considered.

(1) Maintaining staff morale

(2) Staff development

(3) Thinking ahead

(4) Fostering linkages with complementary organization

(5) Expanding the organizations' resources

Morale has to do with the commitment that employees have to their unit and its task. All possible steps should be taken to boost up the morale of the employees in an organization. Morale can be enhanced by providing jobs according to taste, raising the level of salary, promoting to higher cadres etc. In the case of promotions let us remember "Peter's Principle" which holds that each employee tends to rise to the level of his "incompetence" in an organisation. Morale is also enhanced when responsibilities of each employee are clearly spelt out in writing. Seeking counsel from subordinates is also an approved step in enhancing morale of staff. Due credit and praise may also be given to the subordinates for ideas as well as for the performance of routine tasks. Also avoid the following practices which have negative impact on staff morale.

(1) Personal favouritism (2) Nepotism (3) Pretending that one knows more than he does (4) delays in making decisions.

Staff development is another strategic task to be considered. This is closely linked and overlaps with maintaining staff morale. Every one "learns by doing". Staff seminars, inservice training outside the organisation are some steps in this direction. Increasing the responsibility of promising subordinates, exchanging jobs between two promising subordinates are other techniques for staff development.

Thinking ahead is a must for good administrator. A good administrator keeps growing faster than his present job. He"keeps ahead of it". He keeps thinking ahead, considering how the work of his organization might be improved next year. He is responsible for his own inservice training.

Almost every agri-support organization is complementary with many others. In can be done by taking a genuine interest in the work of other organizations, acknowledging the mutual dependence that exists and getting personally acquainted with the administrators of other programmes.

The resources of the organization can be expanded by the careful planning of a wise administrator. He can give good publicity for his organization by writing news stories and feature articles or by inviting newspaper reporters to visit the organization. The administrator can identify who the key people are in determining budgets. It is a good practice to make their acquaintance informally whenever that can be arranged. The reception that requests for a larger budget receive depends to considerable degree on how much the budget decision makers know about the organization ahead of time and how favourably or infavourably they feel towards it.

Finally the administrator will have to carefully utilize his time most effectively. There are usually some limitations on what he can do that are beyond his control. Part of the solution is in how he organizes the total task of his organization. Part of it lies in delegating authority and presiding over an administrative process. Part consists of carefully analysing the essential and strategic tasks of his agency and deciding how much of his personal attention he should give to each. Part depends on how effectively he disciplines himself to follow a planned programme for allocating his time.

The administrator is also a human being. He is as subject to pride, self-justification and habit as anyone else. These human characteristics and others can lead him into serious mistakes that are specific to the administrative process. Call these temptations, traps, pit–falls-they can cripple him as an administrator. At the same time being an administrator gives one great opportunities that can make all of the problems and frustrations well worth while.

Promoting agricultural development

The effective functioning of research, teaching and extension organizations is required for meaningful agricultural development. The development of improved technology is of little use unless these technologies are translated to the real farmer's situations. For this, trained agricultural technicians are required in large numbers and this is one of the major tasks of agricultural universities.

Administrators are essential to all these activities. But not just mediocre, traditional, time serving administrators. The task requires good administrators, to try continuously to improve the efficiency of their organizations.

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Human resource Development—The challenges before Kerala Agricultural University

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'Give me any man/woman, I will make him/her work'. Administrators with the above view try to use 'force' to make people work. But experiences have shown that even works which are mechanical in nature cannot be efficiently got done by this approach.

Administration in India today is mostly participative in nature, giving emphasis to freedom and initiative of employees. In 2000 A. D. initiative of the employees will have more emphasis in performing the research, teaching and extension functions of the Kerala Agricultural University. Hence the Kerala Agricultural University should start action now for making its employees more competent to perform the activities required for the attainment of the goal of 2000 A. D.

The very title of this paper highlights three important points. They are:

1) Human beings in an organisation are important 'resources',

2) they are to be 'developed' to make the organisation more effective and productive, and

3) the development of human resource is a 'challenge'.

'Development' means making 'desirable changes' and hence 'human resource development' means making desirable changes in the human beings to make them more productive 'resources'. The two important points are (1) what are the aspects of human beings that are to be developed, and (2) what are the desired changes required in these aspects. Every individual has a body and mind. For a sound mind a healthy body is essential. Hence human development should cover the development of body and mind, the Physiological and Psychological aspects. However in this paper emphasis is given to 'mind' and hence human resource development is defind as 'making desirable changes in the behavioural components of the employees of the organisation to make them more productive 'resources'.

What an individual does and how he does it are decided by many internal and external determinants. The internal determinants cover the psychological aspects which make up the personality of the individual and the 'external' aspects relate to the 'environment'.

The important internal psychological aspects that are found to have influence on productivity which are to be created in individuals are listed in Figure-1.

An individual will be productive in an organisation when he/she:

1) accepts the organisation goal,

2) has the aptitude to undertake the required activities,

3) has a clear understanding of his role and the job activities,

4) has the motivation to undertake the activities, and

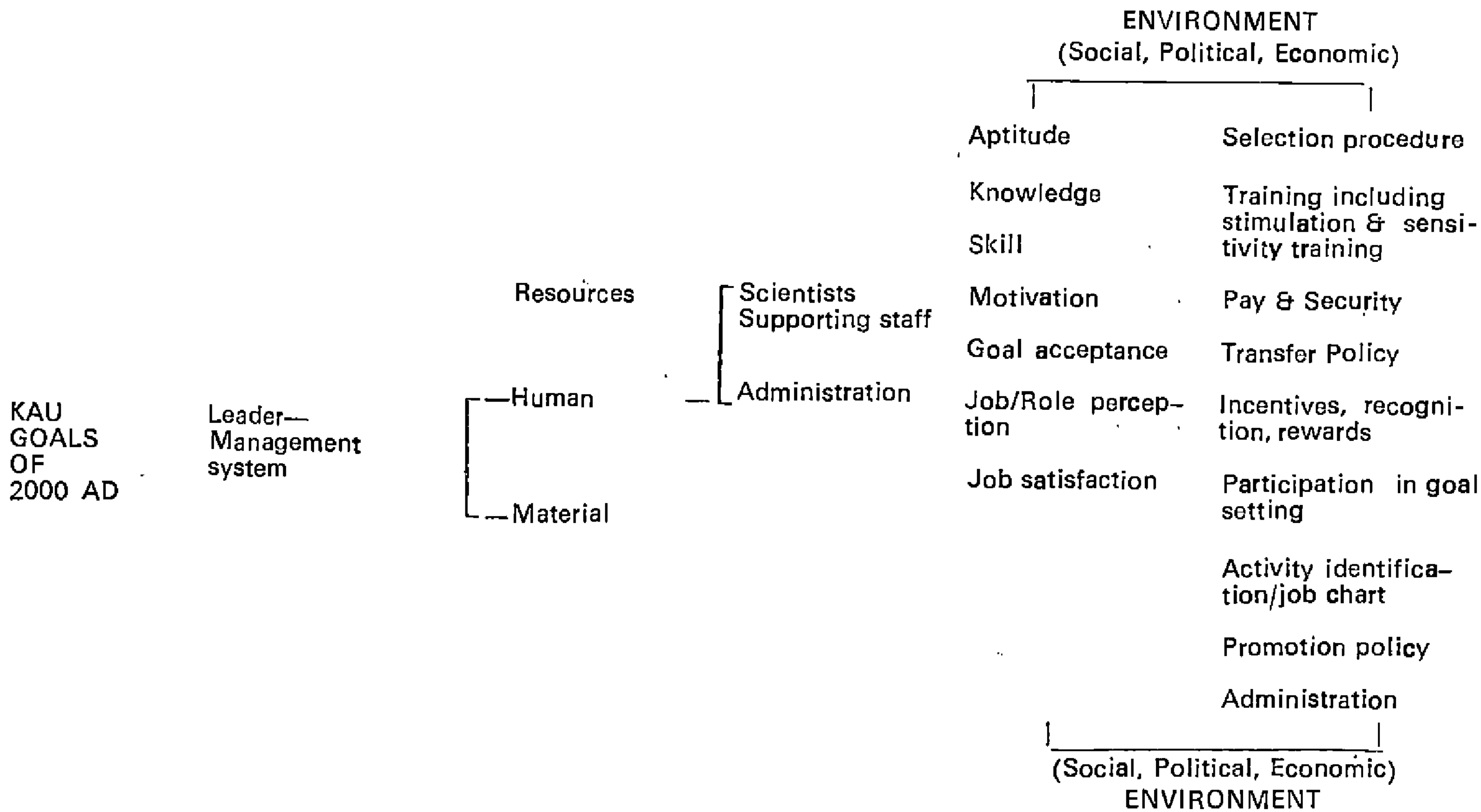
5) obtains job satisfaction.

Kerala Agricultural University should develop the above qualities in its employees who can perform the different functions in 2000 A. D. more efficiently.

The important activities that are to be undertaken for human resource development are listed in Figure-1.

Figure–1

HUMAN RESOURCE DEVELOPMENT STRATEGY



d. Social Organisations and the uplift of the Underprivileged Section

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PROBLEMS OF TRIBAL DEVELOPMENT IN KERALA AND PERSPECTIVES FOR THE FUTURE

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ABSTRACT

The former masters of the world, the tribal people, are today under relentless pursuit from more civilised communities. Forced assimilation into the modern society leading to cultural extinction has been the situation alround the globe. In India, however, progressive development without sacrificing their cultural distinctiveness is being attempted. The ethnic diversity of Kerala's tribal people, and the vast differences of the habitats in which they are placed magnifies the types of problems faced by them, though numerically they constitute only 1.03 per cent of the total population of the State. The onslaught from the plains people by way of exploitation of their meagre resources and dispossession of their lands, lack of technological skills and managerial abilities, social and physical distances from the mainstream of population, impoverished lands and subsistence agriculture are some of the major problems faced by them.

It has been suggested that the development strategies of the future should adopt the extension approach instead of the present welfare approach. Detailed planning of micro-development projects with multi objective and integrated approach and their implementation with continuous transfer of technology from Institutions such as the KAU will enable to join them in the mainstream without sacrificing their cultural and ethnic identity.

1.0. Once the tribal people were the masters of the world. But today they are under relentless assault. Faced with the onslaught of civilization, they have nowhere to hide or retreat. They have only two alternatives viz.,

1.1. A forced assimilation into the modern world which carries a threat of cultural extinction. Alternatively, under democratic governments with a benevolent concern for the economic emancipation of the tribal people progressive development without sacrificing their cultural distinctiveness and ethnic identity.

1.2. In India the Father of the Nation Mahatma Gandhi called them "Adivasis' or the "Original inhabitants". They have also been described as "Girijans" alluding to their habitats along the foot hills of major mountain systems. The Government for bureaucratic purposes calls them the "Scheduled tribes". There are more than 40 million aboriginals in this country which are grouped as 427distinct tribes concentrated in the Central, Eastern, North Eastern India which can be considered to be the major tribal belt of the country. It does not mean that they are not dispersed in other regions. However, the only thing in common is that they like tribal people everywhere in the world have long been the poorest and the most exploited in the country. They are also the ones that have benefitted the least from attempts at modernisation since the fruits of development are more often than not intercepted and usurped by their exploiters.

1.3. The two prominent components in the national effort for the development of scheduled tribes and tribal areas are protection and development. This two-pronged approach was realised by the founding fathers of our constitution who made the basic constitutional provisions to ensure the building up of the required strength in them to meet competitive situations from the mainstream of the population. These special constitutional provisions to promote and safeguard the legitimate interest of these weaker sections have helped them to face unequal situations and join the mainstream of life. These constitutional provisions and other protective legislations stemming from them in the last 37 years have helped in developing an elitist group from among them.

1.4. Since independence Fifth Five Year Plan,at the national level several efforts have been made to enable the tribal people to make giant strides in socio-economic development. Till the programmes were formulated in an *adhoc* manner without much perspective and they were mostly welfare schemes. The tribal sub plan strategy adopted in the Fifth Five Year Plan and subsequently made it obligatory for each concerned sector of development in a State Plan to make due contribution to the effort on behalf of the scheduled tribe population. The heightening tempo of the effort can be gauged from the rising financial investment for tribal development from the Fifth Plan. Thus the investment which was of the order of 75 crores in the 4th Plan (0.5% of the total) increased to 1182 crores (3.01%) in the Fifth Plan. Based on trend analysis for the Fifth Plan it is expected to increase over 4000 crores (5%).

1.5. The tribal communities in India largely occupy forested regions for long periods in their history. They have lived in isolation but in harmony with nature. They draw their sustenance largely from the forest. They have had a symbiotic relationship with the forest which continues undisturbed in interior areas even now.

1.6. Members of the scheduled tribes in Kerala number about 2.61 lakhs (1.03% of the total population) and belong to as many as 35 distinct communities (Census of India, 1981). They are found in all but Alleppey distinct along the foothills of the Western ghats and in the Idukki and Wynad districts and Attappady valley of Palghat district, their concentration being most in the three last named areas. They can be broadly divided into those who mainly reside in the forest areas and those who live on the fringes of the concentrations of the general population in other areas.

2.0 Perspectives

The progress of the tribal people in Kerala has to proceed on the basis of where they stand now, what they want and where and how to go from the present position.

2.1 Where they stand now?

2.1.1. Land holding status

Most of the tribal families have some areas of forest land on which even though they may have non-lienable right, cultivation can be undertaken. Many of them have practiced shifting cultivation till recently and are in a process of dispossession by settlers from the plains. This usually takes the form of a mortgage with possession but without any registration, often with the tacit understanding if not approval of the local forest officials. Even without mortgages for an initial loan leases are effected which a tribal family considers as a boon little realising that it heralds the permanent alienation of that plot of land. Gradually the tribal family is a labourer in their own homestead. From an intensive survey the Bureau of Economics and Statistics has shown than 70.4% of tribal families possess land, the remaining 29.6% being handless. The landless which constitute 52% in Cannanore district have problems which are entirely different.

2.1.2 Social and Physical distances

They are subjected to problems of isolation of their habitats from the main population centres and are only moderately served with infrastructural facilities. Communities such as the Muthuvans (Idukki district) and the Kurumbas (Palghat district) are typical examples.

2.1.3. Vulnerability to victimisation

This isolation in the context of the intensification of forest management makes them subject to victimisation from various vested interests including the officers of the Department itself. Further they are the first to be sacrificed if any major irrigation, road, building or other projects are implemented in any forest area.

2.1.4. Catspaw to forest offences

These circumstances have resulted in increasing alienation of these people from the personnel and policies of the Forest Department which erstwhile, they had looked upon as the guardian of their interests. Together with the poverty they have now become the catspaw in the hands of the encroachers, the depradators and poachers in the forest. As the most exposed, they become punished when enforcement catches them. Thus working in collusion with upper caste persons and encroachers, poachers, depradators and forest contractors or in opposition to them always puts them at the disadvantageous end.

2.1.5. Inadequacy of legal systems

Kerala has given protection to the scheduled tribal (Restriction of transfer of lands and restoration of alienated land) Land Act 1975. However, this Act has not yet been enforced. The decision to be taken will be on the cut off date for the restoration of alienated land. As enacted, it may not be practicable to enforce the restoration of alienated land due to the power of the entrenched interests.

Though this picture is gloomy on the other side, as per Kerala Land Assignment Act, 1964, upto 29,000 persons belonging to scheduled tribes have been assigned with 43.75% of surplus land. The poromboke lands available in the forest have also been assigned to 78760 beneficiaries belonging to SC & ST families upto 1978. As per the provisions of the Kerala Private Forests (Vesting and Assignments) Rules 10,000 ha of land has been vested with government as on 1–8–1978. Fifty percent of this land is to be assigned to scheduled castes and 20% of the remainder to scheduled tribes. As per Kerala Arable Forest Land Assignment Rules one third of such assignments should be to beneficiaries of scheduled castes and scheduled tribes. By 1978 about 4500 ha had been assigned to about 3700 persons. Thus Kerala Land Reforms Act and various Land Assignment Rules have helped a large number of scheduled tribes families to become owners of land.

But these enactments have not served as a deterrent on the land hungry plains people. Alienation of tribal land continues apace and impoverishments with new forms of exploitation continue to be their fate.

2.1.6. *Impoverished lands and subsistence agriculture*

Various reasons have led to uneconomic productive relation between the lands and the cultural practices adopted by the tribal people. The gradual reduction in the range of their migrating and shifting cultivation circuit has resulted in the loss of fertility and high erodibility of lands in their possession. The hillmen settlements established by the Forest Department as compensation for their giving up shifting cultivation are mostly in poor forest land–not an adequate compensation for abandoning shifting cultivation. Inadequate application of inputs in season, indifferent quality of planting material, and indifferent crop protection measures have reduced the viability of agriculture as an occupation. Lack of skills, both technical and managerial, have compounded the effects leading to further impoverishment to a level of subistence farming.

2.1.7. *Collection of minor forest produce*

Tribal people continue to adopt collection of minor forest produce (MFP) as a means of livelihood. This is one occupation in regard to which the tribal people can claim a monopoly of expertise. Around 1979, the Government reserved the right of collection of these items to the Girijan Co-operative Societies working in different forest ranges in the place of the older system of contracting to private contractors. The societies were allowed monopoly collection since private contractors often employed non tribal labour for collection and used to adulterate the produce. The present system of collection through Girijan Co-operatives worked well until Government issued orders directing that all items collected should be sold to a Government company for manufacture of Ayurvedic preparations at negotiated prices. The result was that the Societies were put at the mercy of the minions of this company resulting in an economic exploitation far more disastrous than the older subjection to contractors. Most of the societies which got impoverised have now started reviving consequent to the correction of the mistaken approach to monopoly procurement.

2.2. What they want?

2.2.1. Titles on lands

The issues of nonalienable but inheritable pattas which will not allow the tribal people to sell lands assigned to them but at the same time enable them to take agricultural loans and other loans for permanent improvement, planting of economically viable tree crops etc. is one of the major requirements for development with the active participation of the tribal people. This will enable them to feel more responsible for the improvements of their tribal lands.

2.2.2. Infrastructure and transport

To get over the constraints of physical and distances at which the tribal people are placed in relation to the main population centres, transport facilities have necessarily to be improved. This will also help to get over the social distances between tribal and non tribal communities. Various development programmes for the tribal communities with their and neighbouring communities participation allow social distances to be narrowed down.

2.2.3 Organisational requirements

Government have been well aware of the needs of the tribal people and sought to solve them by organisational means. A separate Department of Tribal Welfare was formed around 1975 and tribal sub-plans formulated for specific tribal areas.

1. From nonspecific general plans, it is more and more realised that multi-objective micro development plans should be formulated for tribal areas and families at the District Planning level.

2. Such plans should take into consideration the highly location-specific nature of the habitat for development as well as the differences in resource endowments of the location and the people. The level of skill and managerial attainments have to be taken into consideration, for the human resource development programmes.

3. Training has to be given a high place in the programmes of development.

4. Eco restoration and eco development programmes with economic returns have to be linked with family development and other economic programmes.

5. Several such micro development programmes have to be planned and implemented for the various habitats of the 35 different tribal communities.

6. As far as possible the development projects have to be integrated projects. The current philosophy of "welfarism" has to be changed to one of "extension" in the development approaches.

2.2.4 *Minor forest produce*

As has already been made out, this is one occupation in which the tribal people can claim a monopoly of expertise in the collection. They require that a scientific orientation is given to minor forest produce collection. Sustained yield studies have to be conducted and nondestructive methods of collection of economic produce devised. Minor forest produce collection and related studies being inter-disciplinary to both Agriculture and Forestry is an area of neglect. This needs strengthening in future years. What is most relevant is that such newly evolved technology is immediately transferred to the tribal people. Rather, it is better to evolve better technology with their full participation even at the research stage.

2.2.5. *Establishments of herbal gardens*

The tribal people have their own system of ethnomedicine in addition to their greater faith in the Ayurvedic system. Their habitats are rich in the germplasm of many Ayurvedic herbs. These have to be catalogued and established in herbal gardens in location nearby to their settlemants to enable their collection and sale through their own cooperatives.

2.2.6. *High technology alternatives*

We have in Kerala two case studies of high technology plantation settlements for tribal people. The Sugandhagiri at Wynad and the Attappady Colonisation Society at Attappady. In both these cases sophisticated and large scale cardamom estates have been established and tribal families who have been earlier dispossessed of their lands were settled. The initial period of readjustment was full of troubles. But conditions can now be described as revealing the basic soundness of the approach. This approach appears to be feasible for the settlement of the landless tribal people.

2.3. Where and how to go from the present position?

2.3.1. It has been made out that there should be development of the tribal people without destroying their ethnic identify, cultural heritage and other values. This means that the development strategies should be ecobased, centering on eco-restoration and development but ensuring economic returns to the tribal people.

2.3.2. The nonpolitical nature of the development of tribal communities compared to the greater politicalisation of the development process of the marginally less unfortunate brethren, the scheduled caste people, because of their larger numbers, points to the need of identifying a leadership structure for the tribal people based on the needs for development. That a development oriented training for identified leadership of tribal communities is more relevant in Kerala in view of their anthropological diversity.

2.3.3. It is necessary for us to identify the technologies appropriate to solve the problems and suitable to the habitats of the tribal people in Kerala. It has to be consistent with their present socio-economic status, level of skill attainments and managerial capabilities. Modules of viable technologies have to be assembled together and applied to the requirements of the members of each family. Such assemblage of technologies will give several viable alternate models. These models when tried out in different socio-economic contexts of the tribal communities of Kerala will enable the execution of several microdevelopment projects.

2.3.4. It is in such a context that institutions like the Kerala Agricultural University have a vital role to play in the coming years. The Kerala Agricultural University is evolving several technologies in Agriculture and related fields. They can be suitably tailored to the immediate needs of development of tribal people. Further by interacting with tribal lore and wisdom with the scientific manpower of diverse disciplines highly relevant to development, institutions like KAU will be able to establish models of development for tribal communities.

2.3.5. The vast problems of development of about 35 different tribal communities cannot be completely sorted by an institution like KAU. But the University can certainly build such models.

Its attempts at building models of development were successful when it functioned as a model agency in the implementation of development programmes to a small tribal community at Pottomavu in the Kulathupuzha range in the period 1976-1979. In this model the KAU had evolved a system of continuous training for the trrbals and they had internalised may of the technologies.

From this experience the KAU has two major research programmes currently on going at Champakkad and in the Amboori area. The former is an eco-restoration project with tribal participation and the latter is an integrated programme of both research and development involving scientists of different disciplines.

2.3.6. Based on these experiences KAU has submitted seven action research programmes for nearly Rs. 1.07 crores to several funding agencies as part of its efforts for the VII Plan. The approaches made in these programmes are on the lines discussed earlier. The implementation of such projects will enable our capabilities to be developed to help the tribal people of Kerala to cross the poverty line and to join the mainstream of society but maintaining their cultural identity.

Management of peoples organisations—A functional approach

P. Indira

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College of Co-operation & Banking, Mannuthy

India, a country with about 4/5th of it as rural population, has recognised the need for rural development programmes. At present, we find that there is no dearth of such programmes, but they fail to attain the effect they are to have on the rural population. Various development programmes have been tried through various developmental agencies like SFDA, MFAL etc. But most of these have failed in their task of making an impact on the rural masses. Peoples organisations were then said to be the best for carrying out these development programmes. This was due to various reasons, the most important of which is that they often work with the active participation and involvement of the people. Peoples organisations include Co-operative societies, Youth clubs, and statutory bodies like Panchayats. The involvement of the people themselves, whose increase in standard of living is the main aim of Rural Development Programmes, makes it the most effective agency in implementing such programmes.

But often we find that even these organisations fail to achieve the target of uplifting the rural poor. This is in spite of the fact that they have been adjudged the most befitting organisation to carry out these programmes. An analysis of the causes show that it is mainly due to the lack of proper infrastructural facilities which are to accompany the various programmes and lack of easily accessible financial facilities. Yet another important contributor towards this picture of dismal failure of these organisations is the lack of personnel with proper aptitude for undertaking these programmes.

A peculiarity of the voluntary organisations is that they are suited to the requirements of the society (taking into account the features of the locality). Manning such an organisation is no easy task since it necessitates people with rural commitment. But most of the existing organisational structures for rural development have developed bureaucratically. Instead of taking into account the farmers' consideration and responding to their needs, they often carry out the programme in a rigid form irrespective of the preferences, priorities and peculiarities of different localities. This emphasises the need for rural commitment on the part of the personnel of the organisation selected for the implementation of the Rural Development Programmes. The absence of this impairs the programme right from the planning stage upto the execution of it. Local initiative may provide the incentive, but carrying it out in a professionalised manner calls for divergence from the so far followed method of merely depending on local leadership for the success of the voluntary organisations. The leadership has to be professionalised.

Here, one may think that the democratic principles are being violated when scientific management is applied to any voluntary organisation. But experience shows that these two go hand in hand as is proved by the very famous Anand pattern of societies.

The rural commitment—as has been identified necessary for the success of the peoples' organisation—involves full understanding of the rural sociology, having a good idea of the rural requirements, potentials, aspirations and motivations. Professional managerial expertise coupled with rural commitment is what is necessary for these types of organisations. For this they should be given training in rural culture.

KAU's role

Professionalisation of the above said leadership is a suitable task that the KAU can take up, since it deals with developing professionals in other areas. It can take up various courses like other bachelor degrees in the University which aim at bringing out personnal necessary in various fields. Such a course shall include rural economics, agricultural sciences, rural sociology, accounting techniques, planning techniques etc. It should be admitted that such a professionalisation requires higher levels of education. Provision of such a well-educated professional group to spearlead the voluntary organisations to success shall be taken up earnestly by the KAU.

Another aspect in which KAU can actively engage is the provision of training facilities to the personnel of voluntary organisations especially that of co-operatives. So far KAU has not undertaken any such programme effectively. These training facilities shall include reorienting their approach and helping them to have a fresh look at the existing state of affairs of the co-operatives. Such a review will help them to indentify the causes for the failure of various rural development programmes executed through them as well as be aware of the weakness of their organisations.

Along with the various training programmes, executive development programmes suited to different levels of executives should be developed. Recognising the fact that primary level institutions are the most vital of the link, maximum thrust should be given to this level of the structure. The secretaries and non-officials of the primary societies should be given training in various areas like communication, delegation of powers, dealing with non-officials etc.

The functional aspect of management of the co-operatives and other organisations shall be emphasised here. The tendency of these organisations has been to enlarge their area of operation thus expanding the organisation itself. This emphasises the functional management. The specific activities of these organisations like marketing, processing, financing etc. give rise to specific managerial problems. For example plant maintenance is essential for manufacturing of processing unit, maintenance of quality of product is essential for taking into account the social obligation.

For marketing co-operatives, they need proper marketing planning, a good knowledge of demand forecasting techniques, marketing mix decisions etc.

A marketing organisation has to take into account the satisfaction of its target consumers and a profitable marketing mix. But these voluntary organisations often fail to evolve good marketing strategy. Further, a systematic marketing audit focussing on objectives, policies, methods, organisation, processing the personnel, should also be popularised among these organisation. Similarly, financial management in these type of organisations should also be given importance. When we take up the financial management in the agricultural field, it should be noted that so far no accounting system suited to the agricultural operations has been formulated. Recently, the Institute of Chartered Accountants of India has formulated an accounting system for the agricultural and livestock operations. KAU can take up the task of popularising this accounting system, taking into account the special circumstances of Kerala. On the background of this, it can encourage the financial management function in the voluntary organisations.

The various training programmes shall take into account these functional aspects while being implemented. All fields of activities undertaken by the peoples organisations should be covered in the training programme.

The KAU being an institution working for the development of farmers, can restructure its extension work to include co-operative and other voluntary organisational personnel in its fold in the coming years. While the other graduates in the University like Agricultural, Fisheries and Veterinary graduates help the transfer of technology, the graduates of B. Sc. (C & B) will provide the necessary managerial personnel to these organisations.

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Role of Peoples Organisations in Rural Development

Jean Joseph

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The importance of rural development in any economy cannot be over emphasised—more so in the case of underdeveloped and developing countries like India. The development of rural areas is very essential for the development of the economy as a whole. A country cannot be considered as a developed one unless its rural areas are as developed as its urban areas. The progress of a country, in short, is determined by the prosperity and development of its villages. More than 80% of the population of India, which is a country mostly characterised by villages, still live in her 6 lakh villages. Thus the Indian economy can develop only if these villages are developed. It is in this context that the problem of rural development comes to the forefront.

Though several development programmes were adopted in our country since its independence, they did not serve to improve the conditions of our villages. This was due to the fact that our development programmes were more concerned with further development of the urban areas rather than striving to channel the activities and funds of the programmes to the villages. This in turn resulted in what Gunnar Myrdal termed as "back-wash effect". Not only did the villages lose their self-sufficiency, there was also a continuous drain of resources from the rural to the urban areas.

However, with the advancing of years, there has been an improvement in the outlook, attitude and policies of the authorities regarding rural development; They have started giving more stress to a more extensive coverage of population, elimination of rural unemployment and poverty; reduction of rural-urban disparities in economic development; and providing the poor with some income earning activity. Though many crash experimental programmes were introduced, they failed to make any repercussion in the rural front. This called for the introduction of new development agencies.

The development agencies like SFDA, MFAL etc. were introduced with the objective of providing special assistance to the identified new target groups of rural masses. But as these projects were introduced without proper co-ordination and linkages, they had to face a large number of problems. Thus IRDP was the result of the search for further improving the rural development programmes (RDPs), by providing assistance to different groups of the rural population. In spite of its very commendable objectives, the programme's performance was not encouraging in the Sixth Plan because of the inefficient style of functioning. Another reason was the lack of qualified personnel to guide the programme.

The benefits of the programme were enjoyed by ineligible persons through fraudulent practices. Mounting overdues, resultant lowering of the credibility of the programme, wilful defaulters etc. were the other problems faced by these development agencies and programmes.

It is at this juncture that the relevance and necessity of peoples organisations for rural development comes into the picture. The failure of the so-called development agencies and programmes have increased the relevance of such organisations.

The term "peoples organisation" will include all those organisations which are functioning with the active participation and co-operation of the masses. For eg., co-operative societies, youth clubs, Mahila Samajams, voluntary organisations like Mitraniketan, catholic church, PDDP, statutory bodies like panchayats etc. The peoples organisations existing at all levels, especially the ones existing at the grass-root level including the panchayats, co-operative societies and other voluntary organisations contribute towards the promotion of rural development.

The peoples organisations are characterised by personal commitment on the part of the people who actively participate in it. This is true atleast in the case of voluntary organisations. For them it is not just a matter of an impersonal organisation but something more than that. All these peoples organisations have basically one objective-that of bettering the social and economic conditions of the masses and to bringing about economic democracy, ie., even if these organisations are not able to eliminate the gaping inequality that is existing between the rich and the poor, they should be able to reduce it to a certain extent atleast. Thus, the attaining of the economic democracy which is much more important than political democracy—is the basic objective of all the peoples, organisations, voluntary or not. But in spite of all this, it can be seen that these organisations generally operate in isolation in the sense that each caters to the needs of a particular community or a section of it only. This has resulted in the existence of a number of peoples organisations in various parts of the State working parellely on the basis of certain fixed objectives, but with no agency or institution or department to co-ordinate or establish a link between the activities of these organisations. If these organisations are to accomplish their goal of fulfilling the task of rural development, it is inevitable and imperative that these organisations should be linked together. And this, in turn, can be achieved only by an agency or institution statutorily recognised.

Peoples organisations aim at the betterment of the rural masses. But this can be made possible only with the co-operation and active participation of the public. No voluntary or formal organisation can undertake a development programme without the co-operation and good-will of the public. This in turn can be ensured only by making them aware, by convincing them and by creating a "felt" need among them of the necessity of such an organisation for their economic and social bettement. The lack of such an attitude from the masses is one of the problems faced by the voluntary organisations existing today. Other difficulties faced by them are the lack of proper leadership and efficient and well-trained personnel to manage the affairs of the organisation. There are different official, non-official and peoples organisations catering to rural development. If the impact of their efforts are to be felt in the rural sector, their activities should be co-ordinated.

A great many of the problems faced by these peoples organisations can be alleviated to a certain extent atleast, by the creation of an authority for inter-agency, inter-departmental and inter-programme co-ordination. This will also help to avoid overlapping of programmes, duplication of work and the resultant waste of scarce resources. The agency so created can, by pooling and co-ordinating all rural development projects of all participating agencies—voluntary and statutory,—ensure the financial availability and enlargement of programme coverage to a very large extent. Moreover, this agency should be able to change the organisational structure for agricultural development, which is so necessary for rural development. As we all know, the majority of our people are rural people who suffer as a result of the city's domination and trade exploitation. In the face of this, the rural people are increasingly looking for an organisational structure which will release them from the middleman's claws and give them their fair share of the consumer's Rupee. This in turn will restore the balance of our society. If the aforesaid agency is armed with the requisite statutory power, well-trained and efficient personnel, and other facilities, a better organisational structure can be evolved which might be congenial for the effective implementation of the RDPs of the peoples organisation.

Though the creation of such an agency is a good idea, it should be noted that this agency should have no power to interfere in the actual working of the peoples organisations. The statutory power of the agency should be limited to such an extent that it does not in any way encroach upon the objectives and free working of the peoples organisations. The agency should act only as a guide for channelising the programme in the right direction and also providing sufficient extension servicess so necessary for their success. Once this agency interferes with the working of the organisation or restrict their freedom in any manner using statutory measures, the orientive of the peoples organisations to achieve their objectives would be lost. Thus, if the RDPs are to deliver the goods and to benefit the rural poor, conceptual, institutional and organisational changes to suit this purpose should be made.

As the afforesaid agency would require a long time to take shape, it is imperative that an alternative agency be selected from amongst the already existing institutions for aiding the successful implementation of RDPs at present. If this is left for a later period, it would help only to worsen the living conditions of the rural poor. It is in this context that the role of KAU becomes significant.

No other existing institution is so close to the rural masses as KAU is. That in itself makes it a pliable tool in aiding the implementation of the RDPs atleast until a new agency specifically for the purpose is created. The KAU can undertake research activities, surveys etc. in addition to the carrying out of extension activities through its Extension Wing. The KAU can also help integrate agricultural and veterinary programmes and such other community services with the RDPs.

But the most important contribution that KAU can make towards the effective implementation of RDPs is by building up a rural development services cadre aimed at selecting and training persons who would be willing to work in rural areas. A raw graduate or a post-graduate from a traditional university will not be very much appropriate for their purpose. This can be done by the KAU through its newly commenced course viz., B. Sc. (Co-operation and Banking). It should prescribe B. Sc. (Co-operation and Banking) as the minimum qualification for first entry into this cadre because this course gives a good background in the economics of resource allocation, project planning, rural sociology, marketing management, agricultural sciences, co-operation etc. which are the essential qualifications that a person should have if he/she is to work in the implementation of RDPs. But if this is to be made possible, the KAU should first of all equip the proposed Faculty of Co-operation with the required personnel and infrastructure so that it may churn out the necessary personnel for the successful implementation of the RDPs.

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PROGRAMME

22nd NOVEMBER 1984

2.00—3.00 PM		Registration of Delegates
3.30—5.30 PM		INAUGURAL SESSION
Prayer	:	
Welcome	:	Shri. T. Madhava Menon, IAS, Vice-Chancellor, KAU
Inaugural Address & Keynote Address	:	His Grace Benedict Mar Gregorios, Arch Bishop of Trivandrum
Vote of Thanks	:	Dr. N. Sadanandan, Dean (Agriculture), KAU.
5.30—6.00 PM		Tea Break
6.00—7.30 PM		LEAD PAPERS
Chairman	:	Dr. S. Vasudev, Chairman, State Committee on Science, Technology & Environment, Kerala
Rapporteurs	:	Dr. A. M. Chandrasekharan, Asst. Professor, KAU Shri. J. Arthur Jacob, Asst. Professor, KAU

1 New Horizons of Agricultural Education

Prof. A. Abraham,
Chairman, Tropical Botanic Garden & Research Institute, Trivandrum

2 Extension Challenges—2000 A.D.

Dr. C. Prasad,
Deputy Director-General (Extension), ICAR, New Delhi

3 Problems and Perspectives of Agricultural research

Dr. K. V. Ahmed Bavappa,
Director, CPCRI, Kasaragod

23rd NOVEMBER 1984

9.00—11.00 AM		LEAD PAPERS (contd.)
Chairman	:	Dr. M. N. Menon, Retd. Commissioner of Animal Husbandry, Govt. of India
Rapporteurs	:	1 Dr. T. Sreekumaran, Associate Professor, KAU. 2 Dr. M. A. Azeez, Jr. Asst. Professor, KAU

4 Administration & Finance

Shri. P. S. Habeeb Mohammed, IAS,
Vice-Chancellor, Kerala University

5 Problems of Organisation and Management

Dr. P. K. Gopalakrishnan,
Member, State Planning Board, Trivandrum

6 The Role of the University in the Welfare of the Underprivileged sections of the People

Shri. T. Madhava Menon, IAS,
Vice-Chancellor, KAU

7 Animal Husbandry, Veterinary and Fisheries Education

Dr. M. N. Menon,
Retd. commissioner of Animal Husbandry,
Government of India.

11.00—11.15 AM : Tea Break

11.15 AM—1.15 PM SESSION ON RESEARCH

Chairman : Dr. S. Kedharnath,
Director, KFRI, Peechi

Convener : Dr. C. C. Abraham,
Assoc. Director of Research, KAU

Rapporteurs : 1 Dr. K. Narayanankutty,
Asst. Professor, KAU
2 Dr. N. Divakaran Nair,
Jr. Asst. Professor, KAU

(*a*) *Theme Paper on Research*

Dr. P. C. Sivaraman Nair,
Director of Research, KAU

(*b*) *Satellite papers on Research* :

1 Shri. K. Raghavan Nambiar,
Professor, College of Engineering, Trichur
2 Dr. M. Aravindakshan,
Director, Centre for Advanced Studies in Humid Tree Crops and Environmental Horticulture, KAU
3 Dr. C. Sreedharan,
Professor, KAU
4 Dr. C. C. Abraham,
Assoc. Director of Research, KAU
5 Dr. N. Mohandas,
Professor, KAU
6 Dr. M. C. Nair and Dr. S. Balakrishnan
Professor & Assoc. Professor, respectively, KAU
7 Dr. K. I. Wilson,
Professor, KAU
8 Dr. T. S. Venkitesan,
Professor, KAU
9 Dr. P. Balakrishna Pillai,
Professor, KAU
10 Dr. Abi Cheeran, Shri. Sajan Kurien and Shri. N. Mohan Babu
Professor and Jr. Asst. Professors, respectively, KAU
11 Dr. N. Mohanakumaran,
Assoc. Director of Research, KAU
12 Dr. K. V. Peter,
Professor, KAU

13 Dr. (Mrs.) P. Padmaja,
Professor, KAU

14 Shri. K. K. Narayanan,
Student, KAU

15 Dr. (Mrs.) A. N. Remadevi,
Professor, KAU

16 Shri. P. V. Prabhakaran,
Professor, KAU

17 Dr. Sasikumar Nair,
Associate Professor, KAU

18 Dr. N. K. Nayar,
Professor, KAU

19 Shri. S. S. Nair and Dr. N. N. Potti,
Associate Professors, KAU

20 Dr. G. Mukundan and Dr. (Mrs.) Sosamma Iype,
Professor and Associate Professor,
respectively, KAU

21 Dr. A. Ramakrishnan,
Professor, KAU

22 Dr. T. G. Rajagopalan,
Professor, KAU

23 Dr. C. R. Ananthasubramaniam and
Dr. T. Prabhakaran,
Professors, KAU

24 Dr. A. Rajan,
Professor, KAU

25 Dr. V. S. Balakrishnan,
Asst. Professor, KAU

26 Dr. P. M. Mathew,
Professor, KAU

27 Dr. D. M. Thampy,
Professor, KAU

28 Dr. (Mrs.) L. Prema,
Associate Professor, KAU

(c) Discussion

1.15—2.00 P M : Lunch Break

2.00—3.15 P M : SESSION ON EDUCATION

Chairman : Dr. M. R. G. K. Nair,
Retd. Professor, KAU.

Convener : Dr. R. Kalyanasundaram,
Director, Centre of Excellence for Research in Animal Diseases, KAU

Rapporteurs : 1 Dr. K. G. Padmakumar,
Asst. Professor, KAU
2 Dr. (Miss.) D. Sudharma,
Jr. Asst. Professor, KAU

(a) Theme Papers on Education:

Agricultural Education : 1 Dr. N. Sadanandan,
Dean (Agri.), KAU

Veterinary Education	:	2 Dr. M. Krishnan Nair, Dean (Vety.), KAU
Fisheries Education	:	3 Dr. M. J. Sebastian, Dean (Fish.), KAU

(b) Satellite Papers on Education :

1 Dr. A. I. Jose,
Professor, KAU

2 Dr. V. Gopinathan Nair,
Professor, KAU

3 Dr. K. Rajamohan,
Professor, KAU

4 Shri. Jippu Jacob,
Asst. Professor, KAU

(c) Discussion

3.15—3.30 P M	:	Tea Break
3.30—5.00 P M	:	SESSION ON EXTENSION, ADMINISTRATION AND FINANCE
Chairman	:	Shri. H. L. Rose, Joint Director of Agriculture, Kerala
Convener	:	Dr. G. T. Nair, Professor, KAU
Rapporteurs	:	1 Dr. A. M. Chandrasekharan, Asst. Professor, KAU 2 Shri. G. Surendran, Jr. Asst. Proressor, KAU
(a) Theme Papers	:	
Extension	:	1 Dr. A. G. G. Menon, Director of Extension, KAU
Administration and Finance	:	2 Shri. Thomas C. George, IAS. Registrar, KAU
Campus Planning	:	3 Shri. K. R. Krishna Pillai, Directcr of Physical Plant, KAU
(b) Satellite Papers	:	1 Dr. M. J. Sebastian, Dean (Fisheries), KAU 2 Shri. P. K. Narayanan, Public Relations Officer, Rubber Board 3 Dr. A. M. Thampi, Professor, KAU 4 Dr. P. S. Pushkaran, Professor, KAU 5 Shri. R. T. Ravi Varma, Editor (Publications), KAU 6 Dr. M. J. Thomas, Professor, KAU

7 Shri. Ranjan S. Karippai,
Asst. Professor, KAU

8 Shri. O. Abdul Rahiman,
Associate Professor KAU

9 Dr. V. K. Sasidhar,
Professor, KAU

10 Dr. G. T. Nair,
Professor, KAU

(c) Discussion

5.00—5.30 PM SESSION ON SOCIAL ORGANISATIONS AND UPLIFT OF THE UNDERPRIVILEGED SECTIONS

Chairman : Shri. K. Viswanathan,
Director, Mitraniketan, Vellanad

Convener : Dr. C. A. Jos,
Professor, KAU

Rapporteurs : 1 Dr. T. Sreekumaran,
Assoc. Professor, KAU
2 Dr. M. A. Azeez,
Jr. Asst. Professor, KAU

(a) Satellite papers :

1 Dr. R. S. Aiyer,
Professor KAU

2 Miss. P. Indira,
Student, KAU

3 Miss. Jean Joseph,
Student, KAU

6—8 PM : SPECIAL ADDRESS

Prayer :

Welcome : Dr. M. J. Sebastian.
Dean (Fisheries), KAU

Special Address and Release of ‘പുരസ്തകപ്പത്രം’ : Shri. Raghavan Pozhakkadavil, MLA,
Member, Executive Committee, KAU.

Presidential Address : Shri. T. Madhava Menon, IAS,
Vice-Chancellor, KAU

Felicitation Speech : Shri. K. Sivasankara Pillai,
Member, Executive Committee, KAU

Vote of Thanks : Dr. M. Krishnan Nair,
Dean (Vety.), KAU

24th NOVEMBER 1984

9.00 AM—1.30 PM PLENARY SESSION
(Presentation of the summary of deliberations by Chairma.. followed by session—wise discussion)

9—10 AM	RESEARCH
Chairman	Dr. S. Kedharnath
10—11 AM	EDUCATION
Chairman	Dr. M. R. G. K. Nair
11—11.30 AM	Presentatian of Thought Papers on Proposed Faculties etc.
1 Horticulture	Dr. P. K. Gopalakrishnan, Associate Dean, KAU
2 Forestry	Shri. S. M. A. Aslam, Special Officer (Forestry), KAU
3 Agrl. Economics	Dr. M. V. George, Advisor (Agrl. Economics), KAU
4 Cooperation	Dr. C. A. Jos, Professor, KAU
5 Agrl. Statistics	Dr. K. C. George, Professor, KAU
6 Rural Home Science	Dr. (Mrs.) L. Prema, Associate Professor, KAU
7 Agrl. Engineering	Dr. P. Basak, Honorary Visiting Professor, KAU
11.30—11.45 AM	Tea Break
11.45 AM—12.45 PM	EXTENSION, ADMINISTRATION & FINANCE
Chairman	Shri. H. L. Rose
12.45—1.30 PM	SOCIAL ORGANISATIONS AND UPLIFT OF THE UNDERPRIVILEGED SECTIONS
Chairman	Shri. K. Viswanathan
1.30—3.30 PM	Lunch Break
3.30—5 PM	VALEDICTORY SESSION
Prayer	
Welcome	Dr. A. G. G. MENON Director of Extension, KAU
Presentation of Resolution	Dr. P. C. Sivaraman Nair, Director of Research, KAU
Valedictory Address	Shri. Raghavan Pozhakkadavil, MLA Member, Executive Committee, KAU
Presidential Address	Shri. T. Madhava Menon, IAS, Vice-Chancellor, KAU
Felication Speeches	1 Prof. Alexander Zacharias, Member, Executive Committee, KAU 2 Shri. K. Sivasankara Pillai, Member, Executive Committee, KAU
Vote of Thanks	Dr. G. R. Nair, Associate Director of Extension, KAU

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