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**REPORT ON
AGRICULTURAL
AND
HORTICULTURAL
DEVELOPMENT
OF
MANIPUR**



**KERALA
AGRICULTURAL
UNIVERSITY**

**VELLANIKKARA, TRICHUR - 680 654
KERALA STATE**

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The Chief Minister, Shri Rishang Keishang, found time in spite of his busy schedule, to give us the opportunity of discussing the various nuances of the developmental processes in the State. To him also, we are deeply grateful.

The Deputy Chief Minister, Shri Tompok Singh and the Minister for Development were also kind enough to give us the benefit of their views on the development strategies appropriate to the State. We record our thanks to them.

Dr. K. J. Mahale, Vice-Chancellor of the Manipur University and Dr. P. C. Bora, Vice-Chancellor of the Assam Agricultural University associated with the work of the Team and were most helpful. To them also we are deeply grateful.

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Above all, we owe a deep debt of gratitude to Shri K. D. Menon who master-minded the entire programme. There was no detail which he left unattended. To his courtesy and unfailing assistance, we owe whatever is of value in our effort. Words fail to express our appreciation of all the kindness and courtesy which we received from him.

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Summary of the Report

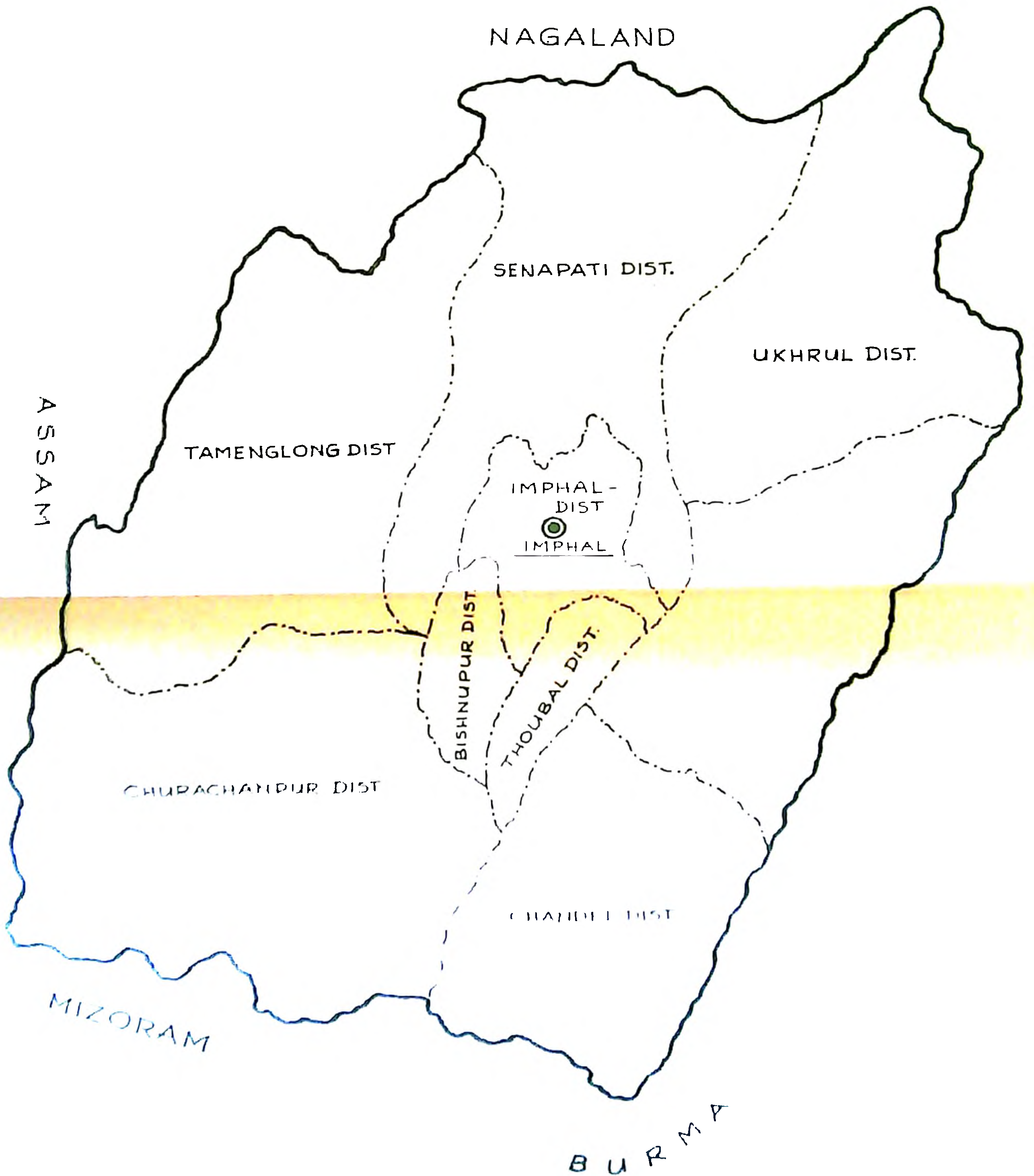
- 1 A Study Team of Experts from Kerala Agricultural University visited Manipur State from 14th to 25th September 1984.
- 2 A wrap up meeting was convened on 24-9-84 under the presidency of the Minister for Development, Manipur, at which the Vice-Chancellors of the Kerala Agricultural University, the Assam Agricultural University and the Manipur University and the Principal Secretary to the Government of Manipur participated.
- 3 The Vice-Chancellors and the Experts had discussions with His Excellency the Governor of Manipur, the Chief Minister and the Deputy Chief Minister, on 25-9-84.
- 4 The Physical features, soil and climate, facilities of transport and power, irrigation and water management are narrated in paras 2.1 to 2.5.
- 5 The status of cultivation in the valleys has been distinguished from that in the hill areas in paras 3.1 & 3.2.
- 6 18 institutions of the Departments of Agriculture, Horticulture and Forests, the Plantation Development Corporation and the ICAR were visited and are described in Appendix I
- 7 A critical review of the present agricultural practices and an analysis of potential in respect of fruit crops, vegetables, tapioca, non-traditional plantation crops, spice crops, aromatic and medicinal plants, has been presented in Chapter 4.
- 8 The strategy to be followed in respect of agricultural production and specific recommendations for adoption are in chapter 5. In a nutshell:—
 - i) Delineate the State into different Agro-climatic Zones (5.2);
 - ii) Accord priority to the Development of hill areas, specifically:
 - a) Increase productivity in contexts of shifting cultivation (5.3.1);
 - b) Adopt a "Single Window" approach to Agricultural extension in tribal areas (5.3.2.2).
 - c) Introduce farming and homestead farming systems (5.3.2.3);

- d) Encourage afforestation and social forestry by giving partnership and profit sharing arrangements between Government and the tribal people in order to ensure the latter's involvement (5.3.2.4);
 - e) Commence at once operational Research and introduction of scientific *taungya* systems to achieve combined and multiple use of forest land (5.3.2.4);
 - f) Start agro-based industries (5.3.2.6);
 - g) Adopt the Jiribam Tea Estate pattern for employing and profit sharing in large scale capital intensive plantation development in *jhummed* areas as a measure for settling nomadic populations (5.3.2.8);
 - h) Establish Krishi Vijnan Kendras specifically oriented towards tribal cultures and located in tribal area (5.3.2.9);
- iii) In the plains concentrate on water management and drainage and broaden the agricultural base by incorporating multiple cropping systems with high value crops (5.4);
 - iv) Identify growth centres to be connected with road network and supplemented with bridle tracks and footpaths from production centres together with ware-housing and cold storage facilities (5.5.1);
 - v) Accord Price support and buffer stocking operations for agriculture produces (5.5.1);
 - vi) Provide cold storage facilities (5.5.2);
 - vii) Start Animal husbandry for production of milk products and beef in hill areas together with processing and preservation facilities for ultimate sale in metropolitan markets. In the plains, poultry both for egg and broiler production with the same objective (5.6 & 5.7);
 - viii) Develop fisheries where feasible (5.8);
 - ix) Take special care in preserving eco-balances and endangered plant and animal species especially in and around the Loktak lake. Indegenous species to be preserved both *in situ* and in botanical and zoological gardens (5.9 & 5.10);
 - x) Re-orient departmental research efforts (5.11 and Appendix II);
 - xi) Establish AGRICULTURAL DEVELOPMENT BOARD at the highest level to direct and co-ordinate policy and various departmental activities (5.12).

- 9 For improving the standards of Agricultural Education, the need for selecting a more suitable site for the College of Agriculture with a full fledged Instructional Farm is stressed. The departments of the College have of course to be strengthened (Chapter 6).
- 10 The need for collaboration with other institutions, like, the Assam and Kerala Agricultural Universities, Manipur University, I.C.A.R. Research Complex and the Assam Regional Station of Medicinal Plants has been indicated (Chapter 7).
- 11 Details of some of the important non-traditional groups of crops such as plantation, spices, aromatic and medicinal, have been referred to in Appendix III.
- 12 A few projects indicative of what may be proposed for development of agriculture and horticulture in the State have been listed (Chapter 8).
- 13 Specimen form for preparation of project proposals is given in Appendix VI.
- 14 Three Projects prepared *pro forma* are in Appendix VII (a), (b) and (c) as examples.

MAP OF MANIPUR

SCALE: 1 cm = 10.08 km.



CHAPTER I

Introduction

Shri K. D. Menon, IAS, Principal Secretary (Development), Government of Manipur, visited Kerala Agricultural University (KAU), Vellanikkara, on 25 June 84. A meeting was held on that date in the College of Horticulture. Shri Menon also had discussions with the Vice-Chancellor. Based on these discussions, the KAU agreed to send a team of experts to study the problems and make recommendations for the horticultural development of the Manipur State and to advise on the introduction of new techniques and crops suitable to the agro-climatic and soil conditions of the State. The terms of reference to the study team were stipulated as "to study and advise the Manipur Government on horticulture research and development including the functions of the Agricultural College, Manipur". The following scientists of KAU were members of the team:-

1. Dr. P. K. Gopalakrishnan, Associate Dean, College of Horticulture, KAU.
2. Dr. M. Aravindakshan, Director, Centre of Advanced Studies for Tree Crops, KAU.
3. Shri S. Balakrishnan, Professor of Horticulture, KAU.
4. Dr. C. Shreedharan, Prof. & Head, Department of Agronomy, College of Horticulture, KAU.

The team visited Manipur State from 14 Sept to 25 Sept 84. Besides visiting various agricultural and horticultural farms, College of Agriculture and organisations of different Corporations, the team had detailed discussions with the officials of different departments and institutions.

On 24 Sept 84, a wrap-up meeting was held in the Government Secretariat, Imphal in which the Vice-Chancellors of KAU, Manipur University and the Assam Agricultural University and the Principal Secretary (Development), Government of Manipur participated, besides the members of the visiting team. The Minister for State (Development) presided over the meeting. The meeting was also attended by all the concerned officers of Manipur State departments.

On 25 Sept 84, the team called upon His Excellency the Governor of Manipur, the Chief Minister and the Deputy Chief Minister and had the benefit of their advice on possible agricultural developments in the State.

The Vice-Chancellor and the members of the team are happy to record their gratitude for the kindness and courtesy with which they were treated during their visit and the facilities made available to them by the Principal Secretary and all his colleagues. Special thanks are also due to the Ministers, the Dy. Chief Minister and the Govt. of Manipur. The team is especially grateful to His Excellency the Governor for the encouragement he gave to it.

CHAPTER 2

Background Information

The State of Manipur lies in the North Eastern extremity of India. It is a distinct region encircled by hills with a fertile, oval shaped valley in the middle. Manipur State is often described as the 'Jewel of India' or the 'Switzerland of India' because of its pleasant and salubrious climate.

2.1 Physical features

The State of Manipur is bound on the North by Nagaland, East by Upper Burma, South by Burma and Mizoram, and West by Assam. It is situated between 23.80° to 26.08°N and 93.03° to 94.78°E.

The area of the State is 22,356 sq. kms. Out of the total boundary line of 854 kms, a distance of 532 kms is international boundary line with Burma. The hills cover nine tenths of the total area of the State. Manipur is comprised of six districts, viz., Manipur Central (Hq. Imphal), Manipur East (Hq. Ukhrul), Manipur North (Hq. Senapat), Manipur South (Hq. Churachandpur), Manipur West (Hq. Tamanglong), and Thoubai (Hq. Chandel). The density of population is 64 per sq. km., and the percentage of literacy is 41.99. The State is endowed with six major rivers and four major lakes. The capital of the State is Imphal.

2.2 Soil and climate

The valley of Manipur is situated at an altitude of about 792 metre above MSL. The valley is known as 'Imphal Valley' and its alluvial soil is highly fertile. The soils of the valley are deep and fairly rich in N with an organic content of one to six percent. It is fairly rich in K but with low available P (8 ppm). The pH of the soil ranges from 5 to 6.5. It is reported that there is very good response for P. The soil contains about 50% clay and the drainage is very poor.

The soil of Manipur are derived mainly from tertiary rocks and are mostly clay to clayey loam. In Manipur East, igneous rocks are found which contain quartz, limestone and black clay. Brine wells occur at Ukhrul. Near the Burma border, the soil is generally sandy loam with occasional patches of laterite.

The climate of Manipur is pleasant and healthy though it varies according to elevation. The Imphal valley has a salubrious climate. But places like Jiribam adjoining the Cachar District of Assam and Moreh on the Indo-Burma border have hot summer and these places are comparati-



Manipur—The land of hills and valleys

vely less cold in winter. At the same time, Ukhrul, Mao, Tamenglong and other places on the hills experience moderate to severe cold during winter and remain cooler than the rest of the State. Manipur experiences high rainfall and its distribution is fairly satisfactory. The rainfall and temperature pattern in different locations are appended at IV and V respectively.

The variations in climate within a span of 22,000 sq. kms. is something wonderful. This speaks of the great potential for growing a wide variety of crops ranging from tropical to temperate. Manipur has vast potential for development, not merely of a particular crop but a variety of them which will be of tremendous value.

2.3 Transport

The primary factor inhibiting development is the difficulty of transport and communication. Railway link is only through Assam. Road facilities are not satisfactory, and are much lower than the all India average.

2.4 Power

Power shortage is another major obstacle. Manipur meets its power demand mainly from its own generating system. The per capita availability and consumption of power is much below the national average.

2.5 Irrigation and Water management

With the commissioning of the multi purpose Loktak Project, an area of 20,000 ha can be irrigated in the valley. But the hill areas which constitute 90% of the State is the source of the rivers of Manipur which run North to South. At present, the terraced rice cultivation in the hills draws irrigation from these streams and rivers. Proper water harvesting techniques can be devised for making this source more efficient and productive. The southern part of the State is studied with lake but the problem of drainage is serious because the soil is clayey. Construction of canals and water ways to serve a multiplicity of uses including fisheries but with the main purpose of drainage into the lakes can be attempted.

CHAPTER 3

Present Agricultural Practices

3.1. Cultivation in the Valley

The present practice is to grow rice only during one season. During the second season no crop is taken. However there are possibilities for raising two crops of rice during early Kharif and the late Kharif. The exact time of sowing as well as the varieties should be identified. A cropping system with two crops of rice and mustard/ pea/potato/lentil during the rabi season may be popularised after sufficient trials.

Sugarcane is being grown in a small area in the valley. The variety is Ponda (red) which yields only 20 to 25 T/ha. Possibilities of introducing high yielding varieties should be explored.

Cattle development is in an infant stage. It seems that fodder shortage is the main problem even though a lot of green fodder is available in the hills. Introduction of better type of milch cattle along with good quality fodder will solve the milk problem of the valley, particularly if supplemented by sugarcane tops as fodder.

3.2. Cultivation on the Hills

The hills of Manipur have congenial soil and climate suitable for tropical, sub-tropical and temperate crops. Already pineapple and oranges are grown in abundance. Pine apple is produced in the hills of Imphal East, Thoubal and Tengnopal Subdivisions. It is grown in other hilly areas also up to an elevation of 1220 m above MSL. The Ukhrul subdivision at an altitude of 1500 m above MSL grows walnut, chestnut, apple and plums. Approximately an area of 1000 Sq. kms., in Manipur East district grow temperate crops. The oranges of Churachandpur, Tamenglong, Kungchup and Mao areas are said to be of high quality. The State is specially suited for citrus fruits which grow well at altitudes up to 900 m above MSL.

In the hills and valleys, apples, apricots, raspberries, strawberries, peaches, plums, pears, limes, olives, pomegranate, guavas, mangoes, jackfruit, chestnuts, walnuts and bananas are grown. But none has attained much flavour and economic production as much care and attention have not been bestowed for their scientific and economic cultivation.

Agriculture is the main source of livelihood. The agricultural production except in the valley remains sluggish and stagnant. The State depends on other States and the Central Government for agricultural produce.

About 68% of the area was occupied by forests previously. Due to intensive and continuous shifting cultivation (*jhumming*), this forest wealth is declining very fast. There are *jhummiyas* who are permanently settled in one particular hillock and change the site of cultivation in the neighbouring hills. There is a nomadic tribe who shift their residence as well as area of cultivation. Since the soil is a continuous deep column without the presence of any appreciable rocks, it is subjected to severe loss, often leading to land slides, flooding of rivers, lakes, etc. At present, the *jhumming* cycle has been reduced from ten years to four years, which does not permit the land to recover its lost fertility and accelerates erosion. There is urgent need to improve the practices under *jhumming* so that productivity is improved and soil is saved. The team sees this as the major challenge because nine tenths of the area of Manipur are comprised in hilly districts.

Agricultural and Horticultural Potential

4.1 Present Agricultural Practices –A critical Review

The existing agricultural practices mainly centre round rice production. The horticultural activity is confined to growing a few fruit crops and vegetables. The present development efforts in agriculture have been mostly centred in the Imphal valley.

4.2 , Horticultural Crops

4.2.1 Fruits

Soil and climatic conditions are conducive for the cultivation of a variety of tropical, sub-tropical and temperate fruits and vegetables. The rainfall in most of the places is well spread throughout the year which make it possible to grow rainfed crops. Though regular monsoon begins in June and ends in October, there are assured pre-monsoon showers during March to May. Even the comparatively dry period from November to February also receives rain sporadically. The temperature conditions by and large vary according to topography. But generally, summer does not tend to become hot. Such favourable conditions have enabled growing of pineapple, oranges, etc., almost wild.

The hill areas in general are not suited for growing food crops as in plains (valleys) even if they are terraced. The proper land use, therefore, consist of making hill areas economic for tree crops. The hills are covered at present by wild vegetation which has been cleared substantially by practicing *jhumming* which has led to heavy soil erosion. In some such areas, fruit plants, important among them being pineapple, banana, orange, lemon, lime, apple, plum, etc., are seen grown. In addition, wild varieties of walnut and cinnamon are seen to be growing well, but large areas are still available for exploitation.

The three main fruits which are common in all the tracts of of Manipur are pineapple, citrus and banana.

4.2.1.1 Pineapple (*Ananas comosus*)

Manipur contributes to the production of pineapples by cultivation in low hills and around the central valley. Due to lack of proper cultivation practices, yields are low compared to Kerala and Karnataka. The growing areas are also widely scattered causing serious problems in collection and marketing and in providing agricultural extension services. By adoption of scientific cultivation practices with the aid of efficient extension machinery it will be possible to atleast double the productivity. Further increase in area may be a problem as a reasonable

outlet for fruits and fair price for them are difficult to find. The position is aggravated because of lack of transport and processing facilities. Only after the development of market for fresh fruits and processed products of pineapple further increase in area may be thought of.

Although there are many varieties of pineapple, smooth cayenne (Kew or Giant Kew is a mutant of smooth cayenne) is the most favoured variety for canning purpose. This variety is preferred for its fruit size, cylindrical shape of fruit, smooth and thick skin and high fibre content to get firm slices. Pineapple juice export is important. Queen variety may be useful for this. As Manipur has succeeded in getting business with USSR for pineapple slices and tit-bits, it can take a special advantage of this situation by reorienting the cultivation of pineapple to fit processing need. The yield and other attributes of Kew variety can be improved through adoption of appropriate package of practices. Standardisation of agro-techniques, extension of harvesting period, etc. are necessary and call for continuous research. Development of internal demand through publicity for ready to drink pineapple beverage may be thought of. The policy adopted by the Himachal Pradesh Government for popularisation of apple juice in various locations of India is an eye opener in this regard.

4.2.1.2. Orange and other Citrus Fruits. (*Citrus spp.*)

Unlike pineapple, orange and other citrus growing areas are almost compact at present. North eastern India is considered as the home of cultivated oranges. The decline malady in orange is prevalent in Manipur also. The research findings indicate that insect and fungal attack, malnutrition and virus diseases are the main causes for the decline diseases. The disease can be arrested by using proper root stocks, planting material, plant protection measures and adequate nutrition. If assured marketing is possible, orange industry can be revitalised thereby achieving more productivity and expansion of area. As the world demand is mainly in the form of juices, concentrates, jellies and segments, Manipur can specialise on juice concentrates. This product has the advantage that they can be reconstituted at the consuming countries under different brand names. West and Middle East countries may be the markets for the product.

Lemons thrive well in the State. European and American industry depends on lemon varieties, *Lisbon*, *Eureka*, *Villa franca*, *Italian*, etc. The production should also be orientated towards internal consumption. Scope exists for the production of essential oils by distillation of the peels (peel oil) for export.

4.2.1.3. Apple and Guava (*Malus Sylvestrius & Psidium guajava*)

By introducing improved varieties and using disease free root stocks, apple cultivation can be standardised. In guava also introduction of varieties to assist the processing industry may be necessary. The production will however have to be oriented towards internal demand including the Calcutta market.

4.2.1.4. Banana (*Musa cvs.*)

Though banana grows in the wild state, the cultivation is not organised. Mainly culinary and champa varieties intended for internal consumption are grown. Cavendish variety is seen introduced by the Department of Horticulture in Jiribam. Considering the wide adaptability of banana, introduction of other important varieties such as Monsmari (Monsmari has special advantage over Robusta that it does not choke in winter) and Nendran (the commercial variety of Kerala) is necessary. There is also need to grow banana varieties in different altitude to test their adaptability.

4.2.1.5. Non traditional Fruit Crops

Manipur offers good scope for growing many other non traditional fruit crops. Walnut (*Juglans regia*) has potential as a commercial crop



Banana Var Monsmari
Mutant of Robusta. Highly suited for cooler regions. (Kerala)



*Nendran banana—Var. Zansibar
Commercial variety of Kerala*

because of its advantage of being non perishable. As a dry fruit its bulk is reduced and the transportation cost is less. Exploration of market for walnut in and out of India appears necessary.

The market prospects for perishable fruits may not be bright. However internal demand is sure to rise in due course. Calcutta is the nearest metropolitan market for fresh fruits from Imphal. So further development of fruit industry will depend more on internal demand.

4.2.2. Vegetables

Efforts should be taken to build up internal demand. Tomato can be produced as a supplementary item in order to run the fruit processing industry during off-season. Varieties oriented towards processing are to be introduced and cultivation restricted to the vicinity of the processing unit for commercial cultivation.

The tomato and brinjal varieties now being grown in the State are seen affected by wilt disease. Wilt resistant varieties available in KAU may be tried.

In respect of potato, the minimum seed requirement of the State is about 1000 Tonnes at present, of which only 300 Tonnes are now made available. With cold storage facilities, it should be possible to bridge the gap besides augmenting demand for the seeds.

Cole crops are being grown in Manipur but not in an organised way, although potentialities are immense, the achievement in this line calls for continued research on vegetable crops.

One handicap in the expansion of vegetable crop production is non-availability of elite seeds. Hence it is advisable to establish seed production farms in different regions.

Tapioca may be tried as a homestead crop along with yams, colocasia, banana, ginger and turmeric. Post harvest technology of these crops has to be popularised. The present practice of harvesting the entire crop of tapioca in one stretch has to be discouraged. Only one or two culms according to the necessity of the family have to be plucked every day. Staggered planting should also be adopted. Tapioca can be grown in Manipur wherever there is no frost.

The technique of cooking tapioca particularly decanting the water after boiling should be popularised. The excess tapioca available after harvest can be preserved as chips for which artificial drying may be required. Possibilities of making starch from the surplus tapioca have to be explored. This type of homestead farming with tapioca can be practiced both in the valleys and hills.

4.2.3. *Plantation and Spice crops*

Plantation and spice crops are foreign exchange earners and there is growing internal demand. They are labour intensive and provide stable employment. Development of these crops is possible without detrimental effect on food production through adoption of farming systems. Among the plantation crops, tea, rubber and coffee are important. In respect of spice crops, there are both perennial and annual types. Cardamom, pepper, clove and nutmeg among the perennials and ginger and turmeric among the annuals are important.

4.2.3.1. *Plantation Crops*

4.2.3.1.1. *Tea (Camellia sinensis)*. Even though export prospects and internal demand are good for tea, growing of tea by individual cultivators may not be possible at present. A start has been made by the Manipur Plantation Crop Development Corporation to cultivate tea at Jiribam which enjoys a tropical climate. This has figured probably due to the experience gained in the adjacent areas of Assam district in tea cultivation. Even though, the venture is started late, there is necessity to speed up planting keeping the time schedule.

If the ecology of tea is taken into consideration, it can be stated that many locations apart from Jiribam may offer scope for cultivating tea. Considering the prevailing rainfall and temperature in various locations, it might be possible to grow tea in many locations of all the

districts of Manipur. Therefore efforts to introduce tea cultivation on trial basis in all locations possessing ecological conditions suitable for tea cultivation appears necessary and this venture would be rewarding both from point of view of productivity and quality of produce

4.2.3.1.2. Rubber (*Hevea brasiliensis*) India is the fifth largest producer of natural rubber. Due to growing demand for natural rubber good scope exists for its further development. There is not much scope for expansion of rubber cultivation in the traditional southern states. Rubber cultivation is almost new to Manipur and only a start has been made in Jiribam. Unfortunately, most of the hills of Manipur are highly elevated and not easily accessible. Because of the high elevation and terrain, most of the forest areas located along the hills may not be conducive for rubber cultivation. However, certain locations possessing lesser elevations and hills (Eg. Western district of Manipur) are available for exploitation. Thus, commercial cultivation of rubber can be thought of in foot hills and valleys in and around Jiribam and Noney along the Jiribam road. Growing of rubber by individual cultivators may be possible and should be encouraged. If suitable technical and financial assistance are given, many may come forward. Strategy in cultivation of food crops in interspaces of rubber during the pre-bearing period of rubber to tide over the difficulties in gestation period is to be worked out based on the taste and tradition of the people of each tract.

4.2.3.1.3 Coffee (*Coffea spp.*) is concentrated now in the southern state of Kerala, Tamilnadu and Karnataka occupying about 99 percent area wise in India. There is good scope for developing new export markets and expanding internal trade. On account of scarcity of land, there is limited scope in extending the area under coffee in southern states. The North eastern region offers good scope for coffee cultivation in the hilly areas which are under jhummia cultivation

In Manipur State, the climatic and ecological conditions for growing different varieties of coffee may exist in selected areas. A good start has already been made by establishing coffee demonstration farms in Pansang and Nonch. The Coffee Board is also establishing a Coffee Demonstration Farm at Nonch. If the lacunae such as inadequacy of trained personnel, untrained labourers and improper cultivation practices are tided over, there is good scope for commercial cultivation of coffee. Instead of exploiting land for monocropping of coffee, it would be desirable to adopt coffee based cropping system comprising proven intercrops. Orange and black pepper will prove as efficient intercrops and the venture will be more attractive to the cultivators. In new plantations, if banana and dioscorea cultivation is done, primarily as temporary shade they will provide food also to tide over gestation period. Based on the performance of coffee, the following recommendation may hold good.

For elevations upto 671 metres, provided rainfall is optimum, Dwarf Arabica (Sl. 7.2 and 7.3) and Robusta (S.274) may be cultivated. Locations having elevations from 671-1067 metres, Dwarf Arabica and Arabica selections (Sl. 195 and 1934) may be cultivated. Beyond elevations of 1067 metres, coffee cultivation has to be discouraged under Manipur conditions. However, it might be possible to locate certain frost free ideal locations above elevation of 1067 metres for Arabica coffee cultivation which can be ascertained only through exploratory trials. Retention of natural forest canopy by proper thinning has to be aimed at to avoid loss of valuable trees. In case shade is to be provided, shade trees of Albizia Species, Silk cotton, Dadap (*Erithrina lithosperma*), Jack, Tree bean and Silver oak may be established as permanent shade. They may serve as standards for pepper in a coffee based cropping system.

4.2.3.1.4 Cashew (*Anacardium occidentale*) is an important plantation crop from the point of view of national economy. It is an



Cashew—Var BLA 139-1 (Kerala)

export oriented crop and is industry based. India's production is awfully short to meet the demand of the factories. Till recently, India was importing raw nuts from African countries, but the same is not possible now as processing has been started in those countries. Therefore, there is every necessity to increase production of cashew by extending its cultivation. Unfortunately, due to pressure on land in Kerala, the scope for expanding area under cashew is limited. Under the circumstances, it is desirable to exploit the non traditional area for its cultivation.

In Manipur, in Jiribam, a plantation of cashew in an area of 28.3 ha has been established. It is said that some trees in the plantation yields about 8-10 Kg. of nuts per tree. The problems noticed are that the varieties (obtained from Ullal and Kerala) planted are late season ones which come to bearing during peak rainy months. It was informed that the nuts germinate in situ. Considering these conditions, commercial cultivation of the already available varieties cannot be advocated. It should be possible to identify varieties of cashew which would flower and produce nuts much before the monsoon period. This would involve detailed study of all the available varieties for their behaviour under Jiribam and Moreh conditions before commercial cultivation is started. So, it would be worth while to build up a germplasm of all types and selections of cashew from Kerala, Karnataka, Andhra, Orissa and West Bengal and conduct detailed studies.

4.2.3.1.5 Coconut (*Cocos nucifera*) is almost a new crop to Manipur. 135 plants of different varieties of coconut obtained from



Hybrid coconut—T x D (Kerala)

Ernakulam of Kerala are seen planted in Progeny orchard Jiribam. The details of varieties are not known. They are generally called as Ernakulam dwarfs and Green dwarfs. Based on the colouration of petioles and growth habits, the naming of varieties does not seem to be correct. The cultivation practices followed are also not scientific, because of which plants have not borne any fruits. Coconut is an industry based crop and is a boon to homesteads and marginal farmers. So, any attempt to standardise the varieties and cultivation practices is worth while. It is hence, necessary to introduce all the available varieties in Jiribam and Moreh locations to take up detailed studies and evolve strategy on coconut based cropping system.

4.2.3.1.6 *Areca nut (Areca catechu)* The performance of areca-nut in Jiribam and adjacent localities has been found to be good. There is scope for popularising the cultivation of this crop. Varietal improvement programme by introducing all varieties including Assam, Mangla etc. and trials on evolution of package of practices especially on Areca-nut based cropping system are necessary.

4.2.3.1.7. *Cacao (Theobroma cacao)* is a tropical beverage crop which might be suitable in Jiribam and Moreh areas. Experimental cultivation of 'Forastero' variety in Government farm is suggested.

4.2.3.1.8 *Oil palm (Elaeis guineensis)*. The centre of origin of the oil palm is the tropical rain forest region of West Africa. Considering the ecology of the crop, trial cultivation of Dura and Tenera varieties of oil palm can be taken up in Chalpikrong and Jiribam regions of Manipur State.

4.2.3.2. Spice Crop

Among the perennial spice crops, cardamom, pepper, clove and nutmeg assume importance.

4.2.3.2.1. *Cardamom (Elettaria cardamomum)*. This is the cardamom of commerce and is a foreign exchange earner. There is every necessity to grow cardamom in far away places from Southern India due to disease incidence (Katte disease). Thus, the possibility of growing cardamom in Manipur is of significance. The true cardamom thrives at elevations ranging from 600 to 1500 metres with well distributed and fairly heavy rainfall and a cooler weather. Soil should contain organic matter. A dense tree cover is another requirement. A few places in Manipur may be suitable for this crop. Therefore, experimental plantations are to be established in all locations where conditions are favourable according to the requirements of the crop. Based on performance studies, the following cultivars are recommended for testing in different elevations:

Malabar	--	for areas from 600 to 1200 metres.
Mysore	--	900 to 1200 ..
Vazhuka	--	900 to 1200 ..

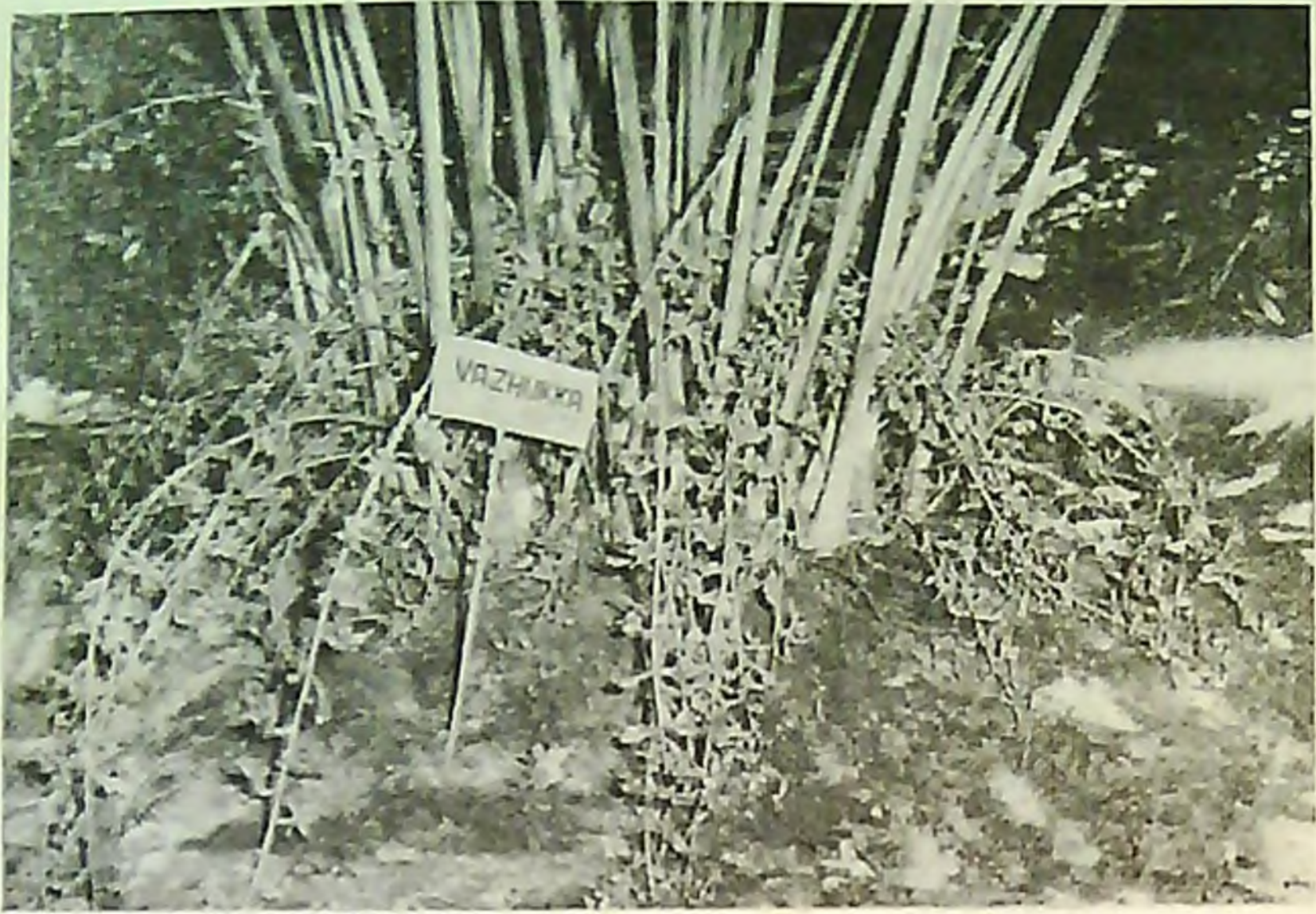
It is also worthwhile to introduce cardamom substitutes viz., *Aframomum* spp. from Africa, *Amomum aromaticum* (Bengal Cardamom) and *Amomum subulatum* (Greater Indian or Nepal Cardamom).

4.2.3.2. Pepper (*Piper nigrum*) is one of the oldest and most important of all spices. It is a native of western ghats of India and performs well in the hills of Assam and North Burma.

Eventhough, Manipur State has not started commercial cultivation of pepper, the scope appears immense when existing conditions are considered. The team could see only 2 plants of pepper (variety-Panniyur-1) in the Progeny orchard, Jiribam. The standard used is jack. Because of heavy shade and poor management, the production is poor. The variety Panniyur-1 is more suited to open areas. There is good scope for introducing other varieties such as Karimunda, Arikulam mundi, Kalluvally, Balancotta and Kottanadan from Kerala besides varieties from



Cocoa tree—Var. Forastero (Kerala)



Cardamom varieties (Kerala)

Assam and Karnataka. Till results of study on varieties are obtained, commercial cultivation of pepper can be done using proper standard in locations upto elevations of 900 metres where there is no fear of frost. Varieties Panniyur-1 (for open situations) and Karimunda (for shady situations) may be popularised. The crop can be grown both as a pure crop and as an inter crop in coffee and fruit plantations. A rapid multiplication plot on pepper adopting bamboo method will solve the problem of production of large quantity of planting material. Pepper may also be introduced in all the stations and progeny orchards located in elevations upto 1200 m to assess its adaptability.



Pepper—C. V. Panniyur—1 (Hybrid) (Kerala)

4.2.3.2.3. Clove & Nutmeg (*Eugenia caryophyllus* and *Myristica fragrans*). As no standing trees of clove and nutmeg could be found in Manipur State, experimental planting of these crops in different ideal locations is suggested.

4 2 3 2.4. Annual spices: Among annual spices, ginger (*Zingiber officinale*) and turmeric (*Curcuma domestica*) rank superior. Ginger is not a new crop to Manipur and its cultivation is in existence though not on organised scale. No known varieties suiting to the trade are cultivated. The variety/varieties cultivated are fibrous. The technique of production of dry ginger, in which form, Kerala exports ginger, is unknown. There is good scope in organising ginger cultivation both as a pure crop and as an inter crop. As dry ginger can be kept for long, there will be no difficulty in transporting the same for long distances. The following varieties are advocated for testing and large scale cultivation.

For dry ginger — Maran, Wynad Manantoddy and Valluvanad.
For vegetable ginger — Ernad, Kuruppampady and China.
For extraction of oleoresin — Rio-de-Jeneiro.
For fibre less ginger — Tatingua and Taiwan.

For enhancing productivity, package of practices are to be evolved for this crop. When the cultivation is stabilised and production becomes sizeable, a factory for extraction of oleoresin for export can be considered. Possibilities of artificial drying of ginger also are to be explored in places where the harvesting season is threatened by rains.

Turmeric has limited scope due to price fluctuations although it can be successfully grown under Manipur conditions. So, its cultivation has to be limited to internal consumption only. However, there is scope for testing the varieties-Duggirula, Tekurpetta, Sugantham, Kodur, Armour and Alleppey for their yield and Curcumin content. The processing of turmeric has also to be popularised.



Ginger cultivation in Manipur

Although both ginger and turmeric are tropical plants, they have adaptability to grow in regions of sub tropical climate. Rich soils with good drainage are to be preferred.

There is also scope for trial cultivation of minor spices such as coriander, fenugreek, fennel etc. which can be done in stations by introducing improved varieties.

4.2.4. (c) Essential oil and Aromatic plants.

Most of the lands in Manipur State have potentialities for the cultivation of fruits, plantation and spice crops provided proper regions based on agro-climatic conditions suitable to crops are identified. Unfortunately, the fruits, at present do not promise economic returns to cultivators on account of the absence of good marketing facilities.

Under this context, it would be appropriate to think of alternate crops in the interest of farmers and in the economy of the State as a whole. India is in short supply of many essential oils and bulk of such oils is imported. For the preparation of drugs, medicinal plants are required. Lands in hilly regions and more particularly, the lands available under jhummed cultivation offer good scope for this venture. India's production of essential and medicinal oils is not significant except in the case of sandal wood oil. No attempts have so far been made by the State Government to bring these crops under scientific cultivation. Very few have also knowledge about these crops except citronella. The Regional Research Centre, Jorhat has indicated the scope for development of essential oil and medicinal plants. Accordingly, the following crops offer scope for indepth study:

Java citronella (*Cymbopogon winterianus*)

Palmarosa (*Cymbopogon martini*)

Japanese mint (*Mentha arvensis*)

Black pepper mint (*Mentha piperata*)

Geranium (*Pelargonium graveolens*)

Cinnamom (*Cinnamomum spp.*)

Dioscorea (*Dioscorea spp*)

Pyrethrum (*Chrysanthemum cinerariaefolium*)

Belladonna (*Atropa belladonna*)

Chamomile (*Matricaria chamomilla*)

Patchouli (*Pogostenon patchouli*) and Vanilla (*Vanilla fragrans*)

The climate and soil variations of Manipur provide a congenial condition for growing a variety of medicinal and aromatic plants. The success of growing these crops, however, depends upon the absorption of the produce by the industries and pharmaceuticals. With the growing

demand for medicinal aromatic oils and herbal medicines within and outside the country, it might be possible to grow medicinal plants in the state. To begin with, it may be worthwhile to make a complete survey of the existing medicinal herbal wealth so that the rare species available could be protected and preserved. Measures to preserve these wealth also could be undertaken probably in research farms or under natural ecosystem. Domestication of the useful species by trial cultivation so as to make them amenable for future commercial cultivation, introduction of species from similar agroclimatic conditions etc., can also form aspects of future detailed studies.

The details of some of the important non-traditional crops may be seen in appendix II.

CHAPTER 5

Strategy for Development

5.1. The description in the previous chapter emphasises the strengths and weaknesses of the developmental efforts so far undertaken in the agricultural sector. Any strategy for the future should take the following unique features of Manipur into consideration:-

a) 90% of the land area of the State is comprised in the hilly regions, where only 33% of the population reside;

b) Wide variations of agro-climatic conditions characterise the State;

c) Soil climate and situation favour the intensive cultivation of low bulk/high value crops;

d) Distance and dependence on long and difficult transportation routes makes it imperative for the State to aim at some degree of self-reliance in the production of foodgrains, and other crops of importance for the daily needs of the people;

e) There is a large reservoir of professionally trained agricultural graduates seeking employment;

f) Basic data on many aspects of agricultural and horticultural potential are lacking.

In this Chapter, an attempt is made to suggest certain lines of strategy which will be feasible and necessary taking into consideration the above factors.

5.2 Delineation of Agro-climatic zones.

The range of variations in agro-climatic conditions necessitates the immediate effort to delineate the State into distinct agro-climatic zones. Along with that, detailed soil-capability studies should also be undertaken so that scientific land use planning can be attempted. The activity will provide useful and productive employment opportunities to some of the presently unemployed agricultural graduates.

5.3. Development of the hill areas

While this is the most obvious strategy, it is also complicated by various complex factors.

5.3.1. Firstly, these areas are the home of distinct ethnic groups each with its own cultural and traditional individuality. Development effort has to be devised taking into consideration these values. The active involvement of the Department of Anthropology of the University of Manipur as well as the North Eastern Hill University will be a pre-condition for appreciating these values and devising programmes which will be acceptable to the people concerned.



Tribal hamlet at Manipur—View of jhummed land

5.3.2. Secondly, it is obvious and widely recognised that the present practice of *jhumming* is wasteful of effort as well as a threat to the soil. A change from this system will not be successful if it is violent. Some possible directions in which this can be attempted would be:-

5.3.2.1. Increase the productivity.

It has been already pointed out that the period of the *jhumming* cycle has been reduced to such an extent that nature does not have time to restore the fertility of the land by the time the cultivator comes back to the starting point. This can be corrected by improvement in the tillage systems and reducing the intensity of tillage. Cropping systems involving a mixture of crops, contour planting tree-species, judicious use of weedicides and fertilisers, introduction of improved but proven planting material, plant protection and more efficient harvesting are some of the methods which can be adopted.

5.3.2.2. Single window approach to extension education in the Tribal areas.

We could find two types of shifting cultivation: Some communities stay in the same hamlets but shift the area they cultivate from year to year, where others are nomadic and shift both their residences and their cultivation. With regard to the first set, we propose that technical advice as well as the source of inputs and services should be available

from a single source located close to the hamlet or a set of them. This officer will have to stay at the community and be available to them night and day if he is to inspire confidence. Here again, the availability of a large number of unemployed agricultural graduates is a plus factor in the sense that it can be made a condition of their appointment that they should stay in the area of the posting for at least three years. This will also enable a meaningful assessment of each officer's work at the end of the period.

5.3.2.3. Introduction of farming systems

and development of a home-stead system of cultivation in the tribal areas will also help to prevent the tendency to shift from plot to plot. Such systems can be devised to suit the peculiarities of each location and the system made to accommodate various crops and animal husbandry/poultry keeping activities of immediate importance to families. Simultaneous as well as relay cropping systems can be introduced so that the same area will provide occupation and returns throughout the year. Location-specific operational research programmes have to be started for perfecting and standardisation of such systems.

5.3.2.4. Afforestation and Social Forestry.

It is estimated that the area under forests, which used to be 68% a few years back, has been considerably reduced by the shortening of the *jhumming* cycle and the consequent failure of natural regeneration. It was reported that the present efforts to encourage Farm and Social Forestry have not succeeded according to expectations because of non-adoption by several Tribal communities. This indicates that strategies have to be devised for involving them more intimately in the programme. It is suggested that such involvement could commence with consultation and association of the concerned tribal community through a process of direct continuous inter-action by the extension agent in the selection of the species to be planted. Instead of selecting species which the people consider have no relevance to their way of life, fruit and fuel species may be introduced. It should be clearly explained from the start that the final cut as well as the usufruct will be the property of the community so that they have a vested interest in raising and protecting the plants. In order to prove the good intentions of the Government, initially, a "subsidy" to compensate for the loss of area from the *jhumming* circuit so utilised for social forestry programmes may be also paid to the tribal community, but calculated on the basis of the proportion of trees planted which survive at the end of the year, thus re-inforcing the vested interest of the community in the protection of the planted material.

5.3.2.5. Introduction of Taungya systems

Taungya has been the time-tested system for the combined use of land for forestry and agricultural crops. Of course, if unwisely practiced,

both activities suffer, but the opposite is also true if sufficient care is taken in the choice of the agricultural crop and the tillage practices adopted. Research and demonstration of such systems can be undertaken in all the hill districts. The team feels that generally non-irrigated varieties of rice, tapioca, ginger and turmeric are feasible taungya crops the agronomy of which can be tailored so that the growth of tree crop is not hampered, but at the same time, food and cash crops preferred by the tribal communities are raised. Such a development may also provide a viable alternative to shifting cultivation.

5.3.2.6. Introduction of Agro-based Industry

Already tribal people are engaged in traditional industrial activity using agricultural produce. They could be strengthened and new ones suitable to the plant introductions now proposed could be started. For example, with the large scale introductions of tapioca, it would be possible to produce dried chips and encourage the setting up of a few small scale starch making units. Mustard, now produced in abundance, is being taken to West Bengal for extraction of the oil, which is brought back at considerable cost for resale in Manipur. With the assistance of the Khadi and Village Industries Commission, it should be possible to set up hamlet level ghanis so that the value is retained and additional employment created locally. Similarly, bamboo and cane can now sacrificed in the course of *jhumming* could be the base for several cottage industries.

5.3.2.7. Generally

thus, for *jhummiadars*, who reside permanently in a location but only shift their locale of cultivation, systems whereby value will be added by increased productivity, social forestry, improved tillage practices and year-round activity would be the approach to development. These efforts necessitate the continued presence and ready availability of the change-agent; in other words, agricultural extension officers should be resident in the areas concerned and sufficiently empowered to meet the needs and demands of the cultivators not merely for advice but also inputs.

5.3.2.8. Nomadic shifting cultivators

People can be weaned away from nomadism only by the demonstration of superior comforts of settled ways of life. They are likely to be ethnically sensitive to some value system and any effort which even seems to violate them is doomed to failure. The problem is complicated even further by traditions of ownership and rights to the land: we understood that in some communities, the entire title is vested in the headman, whereas in some others all the members of the community share the title equally. We also understood that the Government are

seriously considering legislation to divest headmen of exclusive ownership. In this context, we thought that the experiment successfully implemented at Jiribam for the voluntary surrender of land in return for the right of employment and a share in the ultimate profit is very significant. Though this experiment is specifically for raising Tea, it could be generalised for most commercial crops and even forestry. It is suggested that forests may be raised by re-forestation or afforestation in *jhummed* land by entering into such partnerships with the tribal communities so that employment opportunities are generated in the process of raising them, the proceeds of the terminal cut are shared equitably between the Govt. agencies concerned and the tribal people, usufructs are fully the people's and the availability of Minor Forest Produce will provide additional employment and income to them.

5.3.2.9. Krishi Vijnan Kendras

We were informed that many training programmes undertaken by the Tribal Development Corporation, for example, in mushroom cultivation, were taken advantage of by people from the plains rather than by tribal farmers from the hills. The probable reason was the distance of the training centres. Training of tribal farmers has to be near at hand, continuous and, to the extent possible, informal. To achieve these objectives, Krishi Vijnan Kendra may be started with the ICAR assistance in selected tribal concentrations. Schemes may also be proposed under the Tribal Area Research Programme of the ICAR for starting integrated research and extension activities among them.

In the location, staffing and programme development of such centres, the active and continued involvement of the Department of Anthropology of the Manipur University would be useful to ensure the greatest conformity with tribal values for acceptance by them; otherwise, if antagonism develops due to any awkwardness, then the activity will be doomed to fail. On the other hand, if it succeeds, then it will be possible to devise programmes in an unstructured manner so that the trainees recognise their training needs and demand the facilities. It will also be possible to progressively raise the level of training so that as each skill is mastered, new ones can be introduced.

5.4 Development strategy in the Plains

The plains of Manipur are blessed with fertile soils and ample moisture, productivity being already high mainly in the case of rice. We have made specific crop-wise recommendation elsewhere but would like to emphasise that as a matter of strategy, two aspects stand out:

Firstly, drainage and water management are the most pressing challenges that have to be tackled;

Secondly, there is need to introduce and rationalise systems of cropping in the place of the mono-crop strategies which are conventional. We could identify possibilities for rice-based and homestead cropping systems in the plains in addition to the introduction of new value added crops. Here again the emphasis specifically has to be on low bulk high value crops so that profit is maximised in a context where transportation cost to markets is significant.

5.5. Infrastructure

5.5.1. *Communications.*

A well designed system of communication has to be built up so that farmers, particularly in the remote hill locations, do not have to dispose of their produce at unremunerative prices during the harvest season. Growth centres may be identified for linking in road networks, and in turn connected with production locales through appropriate bridle tracks or foot-paths. The tribal Development Corporation could set up market centres with storage facilities so that surplus produce could be kept over for better prices when the season changes. The Corporation could also devise price support policies and buffer stocking in order to ensure stable price realisation for the tribal producer.

5.5.2. *Cold storage facilities for preservation of Plant Material*

In addition to the general ware-housing facilities suggested above, there is need for a few strategically located cold storages, particularly for



Loktak lake

seed potato and other perishable planting material. Either the Corporation or a Co-operative Federation may set up such ventures with substantial assistance from the Government. This will help to store high value produce like apple, plum, peaches, and various vegetable crops.

5.5.3. Residences and incentives for officers

We have recommended that officers should be posted for long and continuous tenures in the hilly areas. This implies that residences should be provided to them and incentives given to them thus ensuring that they will not be miserable.

5.6 Animal Husbandry

Even though we could not make a detailed survey of the present state of development in the Animal Husbandry sector, we were impressed by the vast potential for this activity in the State. In view of the limited market for liquid milk in the area, any further progress will have to be based on non-conventional value-added products which could stand long storage and transportation, mainly to the metropolitan market at Calcutta. The climate in many parts of Manipur is conducive to the manufacture of various cheeses and other milk products, including perhaps the ever popular *rasa golla*. We have elsewhere suggested increase of sugarcane which will provide more sugar and will make it feasible to manufacture milk sweets at competitive prices. In addition raising of cattle for beef would also be feasible because there is no taboo on cow slaughter in the hill areas. The beef could be processed and suitably packed for sale in Calcutta. It will be possible to undertake a vast programme of agrostology and pasture development in the areas denuded by *jhumming* in the past.

5.7 Poultry development

The homestead farming systems that we have advocated will elegantly accommodate improved methods of poultry farming as well. Here again, broiler production together with processing and preservation would be feasible for sale in the metropolitan markets.

5.8 Fishery development

Manipur is blessed with many streams and tanks. The people in the plains, even though generally vegetarian unlike those in the hill districts, do take fish as a necessary ingredient in their diet. Introduction of scientific fish farming techniques is therefore feasible. In the hill streams, trout can be introduced as a game fish against some time in the future when tourism may be encouraged.

5.9 The special Eco-system of the Loktak Lake

This lake is a fresh water system over an area of about 60 sq. km., with a surrounding area of another 30 sq. km., which gets flooded to

a depth of 1 to 2 metres. It is reported that many indigenous species of life are endangered or threatened by alterations in the eco-system due to the formation of the hydro-electric project as well as the increasing pressure of human settlement. A long term project to study all aspects of this habitat may be taken up by the Life Science Department of the Manipur University. If no harmful consequences are likely to follow, the introduction of deep-water paddy varieties and combined cultivation of such varieties with the culture of the fresh water prawns may be tried out in the peripheral area.

5.10 Ecological precautions

The north-eastern regions of India and the adjacent Burmese areas are the place of origination of many plant species which are now threatened. Preceding and along with any attempt at agricultural development a project for the collection and preservation, *in situ* as well as in properly developed botanical gardens elsewhere is imperative. The germ plasm so collected and preserved will prove to be invaluable in the generation of improved material through suitable breeding programmes.

5.11 Re-orientation of departmental research efforts

We have devoted a separate chapter for proposals on Agricultural education in Manipur, with the long term objective of bringing together education, research and extension under one umbrella. As this will necessarily take some considerable time, research efforts will have to continue to be a departmental responsibility and we make some recommendations accordingly.

5.11.1. *Research in rice*

At present there is only one Rice Research Station at Wangbal. This is in the valley and therefore not suitable for the development of cold-tolerant, rain-fed cultivars suitable for agro-forestry practices in the hill districts. We recommend the establishment of a station at Ukhrul or Mao-Maram for this purpose. Another station may be established at Jiribam for conditions where two crops per year can be raised. A smaller station in the Loktak Lake area for the special problems of rice under conditions of submergence would be desirable, as would be one for the foot hills area.

5.11.2. *Research in horticultural crops*

A scientifically distributed pattern of research stations and the problems to be handled at each of them requires a proper agro-climatic and soil-capability mapping of the State, which we have already suggested as of the highest priority. Pending such classification, we recommend

for stations in the 'tropical' region, viz., Spices Development Farm, Moreh, and Projeny Orchard cum Cashew Farm, Jiribam, work

on and the standardisation of package of practices on sapota, mango, banana, pineapple, lemon, papaya, dioscorea and tapioca, plantation crops like coconut, arecanut and cashew and spice crops like pepper and ginger.

for stations in the 'sub-tropical region', viz., Coffee Development Farm, Pangsang, Govt., Projeny Orchard, Churachandpur, Coffee Development & Nursery Farm, Noneh and Govt., Projeny Orchard, Mantripukri broadening the base and continuation of the work already being done;

for stations in the 'temperate' region, viz., Govt., Projeny Orchard, Tengnoupal and Govt., Orchard, Ukhrul, intensification of the work being done on the apple, enriching the germ plasm collections, and work on coffee, cardamom varieties, cinnamon, and medicinal crops and essential oil bearing crops.

Detailed recommendations may be seen in Appendix II

5.12 Constitution of an Agricultural Development Board

In view of the vast potential and national significance of agricultural development in this State, it is suggested that a very high power board may be constituted to co-ordinate policy and activity in this area. As already pointed out, a major determinant of success particularly in the hill areas is the involvement of tribal people and the harmonisation of governmental action with tribal value systems. Tribal tenure of land is complicated from area to area as well as tribe to tribe. Tensions are also possible between tribal and adjacent non-tribal communities which will negate all attempts at improvement. The development process itself is likely to sharpen such antagonisms unless it is wisely and sagaciously orchestrated at the highest level. The morale of various echelons of officers working the various programmes and in various locales can be maintained only if confidence at the highest level is generated in the earnestness of purpose with which the challenges are faced and the honesty and efficiency with which tasks are fulfilled and work despatched.

5.13 A Specimen Project

Incorporating some of the elements of the well known 'T & V' systems and NARP adopted in most other states in India and to be implemented by the Agricultural Development Board proposed in the previous para may be seen at Appendix VII (b).

Agricultural Education in Manipur State

Agricultural College, Manipur

The college was started in 1979. It is affiliated to Manipur University and its annual intake is 40 for undergraduate programme. Semester system of education is followed adopting the syllabus of Assam Agricultural University. The College is governed by a society whose chairman is the Chief Minister. The following dignitaries hold the various offices of the society.

Vice Chairman	—	Minister of Agriculture, Manipur State.
Members	—	Minister of Finance, Manipur State.
"	—	Director of Agriculture, Manipur State.
"	—	Director of Horticulture, Manipur State.
"	—	ICAR nominee.

Twelve Departments are functioning in the College with Principal as the head of College.

The various departments are:-

Agronomy,
 Horticulture,
 Botany & Plant Pathology,
 Plant breeding & Genetics,
 Entomology,
 Agricultural Economics & Farm Management,
 Agricultural Chemistry & Soil Science,
 Agricultural Statistics, Mathematics & Physics,
 Animal Husbandry,
 Languages,
 Extension Education, and
 Agricultural Engineering.

The College offers B. Sc. (Agriculture) degree and the duration of course is 4 years. The budget of college is Rs. 30-40 lakhs per year.

The Instructional farm comprises of 18.2ha where paddy is the main crop. No garden land or hill area has been allotted to the college so far to deal with horticultural crops. The present Agricultural College situated in the Imphal Valley does not give adequate opportunities for students and teachers to orient themselves for horticultural crop production. The ultimate economy of the state, to a great extent, depends on horticultural crop production. The students should necessarily learn techniques for the three crop production, if they are to be profitably utilised.

The study team of KAU visited the college on 19-9-84 and had discussion with the Principal and staff of the college. The observations and recommendations of the team are furnished below:-

6.1.1 Site of the Agricultural College

The College is located in a valley with no land for cultivation of horticultural crops. Even the valley area available is only 18.2 ha in extent occupied mainly by paddy crop, a small orchard and buildings. As the total strength of students in the college is 160 and the economy of the Manipur State ultimately rests on horticultural crop production, more thrust in education has to be given to Horticulture. As the teachers have the responsibilities for teaching, research and extension education, facilities by way of proper land for horticultural as well as agricultural crop production are to be provided. Besides research fields, a good orchard consisting of all crops is a must. Recreation facilities as play grounds, botanical garden etc. are also to be provided to the students and teachers. To make agricultural education comprehensive, units of dairy, poultry etc. should also to be established.

To accomplish all the objectives, it is necessary to house the College in a campus having an area of atleast 500 hectares, that too comprising of Valleys and hill slopes. The present site of the college does not satisfy all the conditions. If all these facilities cannot be provided in the present Campus, it is advisable to shift the college to a more convenient location where sufficient land is available. It was mentioned during discussion that sufficient lands of appropriate nature can be had in Mahadeva tilla. It is hence suggested that an expert committee may be constituted immediately to select an appropriate site for the college.

6.1.2 Instructional Farm

The instructional farm facilities in the College are not adequate. The Instructional farm should have both valley and hill areas to grow agricultural and horticultural crops, for undertaking research on all crops. So, it is necessary to establish a full fledged instructional farm atleast in an area of 200-250 hectares comprising mainly of hill type of lands.

6.1.3 Buildings

The buildings now available are inadequate. Laboratory buildings of Departments for engaging 50 students are too small. Besides providing additional class rooms and laboratory rooms, there is necessity to improve the condition of the existing ones also. It is estimated that atleast four more lecture rooms and five more laboratory rooms of sufficient plinth area would be additionally required. Construction of adequate number of quarters for the staff is also a necessity. Green houses, potting house etc. are also to be provided.

6.1.4 Equipments

Most of the laboratory rooms are not adequately equipped. A detailed scrutiny on the availability of equipments in different departments is necessary so as to strengthen the same with modern equipments.

6.1.5. Library

The study team noticed that the present library is insufficient to cater to the needs of even a Gramasevak Training Centre. It is needless to mention that the standard of education is related to the accessibility of the students and teachers to literature. The team noted that the number of standard books available on agricultural subjects is scanty. The college subscribes only for 10 Indian journals. The existing books are not seen arranged discipline wise. Therefore, it is absolutely essential to strengthen the library by way of additional books, journals and staff. Additional space will have to be provided when the library expands. It would be desirable to plan for a modest library building in advance.

6.1.6. Staff position

The work load of teachers and the teaching staff pattern now in existence when compared with the minimum staffing pattern suggested by the ICAR for Agricultural Colleges indicate that the staff presently available in various departments in the College are too low.

The staff pattern for a major department as per ICAR norms for undergraduate course in a professional college is as follows:-

Professor	—	One
Associate Professor	—	One
Assistant Professor	—	Two
Instructors	—	Two

Therefore, improving the staff position should be considered as a priority item in strengthening the college.

To attract the best talented and qualified hands to the college, incentive either by way of higher pay scales or by way of advance increments are to be given. Possibly, two advance increments for M.Sc. degree holders and three advance increments for doctorate degree holders will be reasonable incentives to start with.

6.1.7. Other suggestions

(i) Botany and Plant Pathology have been combined and kept as one Department. As the functions of these two disciplines are different and Plant Pathology is a major discipline, they may be separated and each may be given status of independent department.

(ii) Plant Breeding and Genetics may be clubbed with Agricultural Botany Department. Separating them as independent departments can be taken up when post-graduate courses are started.

(iii) Agricultural Statistics may be given independent status.

(iv) A basic Science department may be constituted and the disciplines of Mathematics and Physics be brought under it.

(v) Agricultural Engineering may be given the status of a department.

(vi) The Heads of Departments of the college should actively associate with the research functions of the Agricultural and Horticultural Departments. They should provide leadership in this regard.

(vii) The College of Agriculture should have proper liaison with Life Science Department of Manipur University and ICAR complex.

It was informed that the college proposes to start post graduate courses in the disciplines of horticulture, agronomy and plant pathology during the seventh plan period. Unless, the college is strengthened in all aspects, it will be too early to start PG courses. Hence, it is suggested that they may be started during the later half of the seventh plan period.

6.1.8. Fund of the college

It was informed that fund requirements of the college are provided through or with the approval of the Director of Agriculture. Such a system may not be helpful for the growth of the college. It will be necessary to modify the system. The Principal of the college should be an independent officer and funds should flow directly to him from government/society.

6.1.9. Resident Teaching.

It is necessary to insist on resident teaching in a professional college. This would necessitate construction of additional hostels.

6.1.10. Syllabus

The syllabus now followed is said to be that of AAU. The courses should give maximum weightage for horticultural subjects comprising pomology, plantation crops, olericulture and floriculture, spices and essential oils and processing technology. It is suggested that the syllabus may be reviewed and revised if necessary.

CHAPTER 7

Collaboration with other Institutions

For the overall development of Manipur state especially in agriculture, it will have to develop collaboration with other institutions dealing with various aspects. This is all the more important as the State is in its infant stage of development, despite its potentialities. The task before it is huge.

To achieve success to a desired level in respect of research, education and extension, it appears necessary that Manipur State may collaborate with the following institutions for various functions.

- 1 University of Manipur,
- 2 Assam Agricultural University (AAU),
- 3 KAU.
- 4 ICAR Research Complex, and
- 5 Regional Research Station on Medicinal Plants, Jorhat, Assam.

7.1. Collaboration with University of Manipur.

As the flora and fauna of Manipur state are fast disappearing, it will be highly necessary to preserve them. To start with, it will be desirable to conduct surveys of flora and fauna in various locations such as uphills, foothills, valleys and in and around Loktak lake. A germplasm of flora and fauna especially of endangered species may be established so that by genetic engineering, the characters can be transmitted to the new generations of the different species.

For improving agriculture in hilly areas, a series of agro-techniques are to be evolved. KAU and Kerala Forest Research Institute, Peechi are conducting experiments on Taungya system and some of the data may be applicable to Manipur. Manipur University may draw on the data and conduct experiments at various locations.

7.2. Collaboration with AAU.

Assam is one of the most developed States in the North Eastern region. The AAU is nearest to Manipur State, on which it can depend for developing the valleys and hills besides agricultural education, research, and extension education. Therefore, Manipur may collaborate with the AAU, for research and data support.

7.3. Collaboration with KAU.

Considering the development of cropping system prevalent in Kerala and the potentialities of adoption of the same in Manipur, it is felt that KAU will be able to assist Manipur in:—

- a. Training of students of Manipur at graduate and post-graduate levels;
- b. Inservice training of Officers;
- c. Providing experts in specialised fields on short-term basis;
- d. Supplying planting materials for research purposes;
- e. Exchange of teachers; and
- f. Development of fresh prawn culture in Loktak lake.

7.4 Collaboration with ICAR Research Complex.

It is necessary to identify the areas of research through a joint effort by the State Departments and ICAR Research Complex. Long term projects requiring considerable finance, sophisticated technology and expert personnel may be taken up by the ICAR. The short term projects for the immediate benefits of the cultivators may be taken up by the Departments of the State. The State Government will take a lead in testing the field adaptability of the proven technology of the ICAR Research Complex in different locations of the State. This can be accomplished on mutual collaboration preferably by setting up a Research Advisory Council having representations from various departments and ICAR.

7.5. Collaboration with Regional Research Station on Medicinal Plants.

To diversify crop production and introduce aromatic and medicinal plants, collaboration with the Research Station on Medicinal Plants, Jorhat is suggested.

CHAPTER 8

Projects identified for immediate implementation

Agricultural Research

1. Delineation of Manipur into distinct Agro-Climatic Zones.
2. Establishment of hill research station for rice.
3. Establishment of Rice Research Station in foot hill area.
4. Establishment of Rice Research Station in deep water area.
5. Establishment of Rice Research Station in tropical area (Korobam)
6. Introduction of suitable Taungya systems,
7. Cropping system research in valleys and hill slopes.
8. Improvement of productivity of *Jhummed* lands.
9. Increasing the productivity of rice in the valley.
10. Ecological system studies.
11. Fresh water prawn culture in Loktak lake.
12. Post harvest technology in rice and tapioca.
13. Improvement of brewing technique of rice liquor.

Agricultural Development

1. Involvement of Tribal committees.
2. Afforestation of hill areas.
3. Establishment of Krishi Vignana Kendra in hill areas.
4. Establishment of Agro based industries.
5. Research on improvement of Communication in hill areas.
6. Cattle and fodder development.

Horticultural Research

1. Establishment of Research Stations in tropical region—Development and intensification of activities of Moreh Farm and Jiribam Progeny Orchard cum Cashew Farm.
2. Establishment of Research stations in sub tropical region—Development and intensification of activities of Pansang Coffee Farm, Churachandpur Government Progeny Orchard, Noneh Coffee Farm and Mantripukri Government Progeny Orchard.
3. Establishment of Research Stations in temperate region—Development and intensification of activities of Tengnopal and Ukrul Progeny Orchards.
4. Establishment of Zonal Research cum Demonstration Farms in each Agro-climatic zone.
5. Acquisition of additional area, construction of buildings, fencing etc. for Research Stations and Instructional Farms of the Agricultural college.
6. Evolving plantation based cropping systems.

7. Strengthening of research on horticultural and plantation crops in the Agricultural College.
8. Establishment of Instructional Farm in the Agricultural College.
9. Research on propagation and management of orchids.
10. Research on plantation, spice, fruit and vegetable crops.
11. Post harvest technology on ginger, turmeric, pepper, cashew etc.

Horticultural Development

1. Expansion of rubber cultivation in cultivators' fields in Jiribam and adjacent areas.
2. Demonstration of Scientific cultivation and management of fruit crops (pineapple and orange) in cultivators' fields.
3. Vegetable Development Scheme.
4. Arecanut Development Scheme.
5. Pepper Development Scheme in Jiribam, Moreh and adjacent localities.
6. Ginger Development Scheme including training in processing of ginger.
7. Tapioca Development Development Scheme including training in utilisation.
8. Reorganisation of Department of Horticulture for rendering effective extension service in tribal hamlets.
9. Commercial production of seed material of mushroom in the Mushroom Development Unit of the Tribal Development Corporation.
10. Diversification of range of products manufactured in the Fruit Preservation Factory.
11. Providing intensive training to different categories of staff of the Department of Horticulture, Tribal Development Corporation and Plantation Corporation on all aspects of horticultural and plantation crops including their processing.
12. Provision of cold storage facilities for seed and produce.



Appendix I

VISITS MADE IN MANIPUR STATE BY THE STUDY TEAM

I.i. ICAR Research Complex, Imphal.

The ICAR Research Complex, Imphal is an important organisation in Manipur State intended to provide technological support for the development of agriculture including horticulture, fishery and Animal Husbandry in the State. The Complex at present confines its research activities only on cereals and few fruits. The research activities have not been extended to the hills which constitute 90% of the area. Practically no work is being carried out on spices, plantation crops or medicinal plants. The station has found that the paddy var. Prasad is performing very well under the valley conditions. However, the acceptability by the farmers has not yet been ascertained and before popularising the variety, large scale adaptive trials should be conducted under different situations of Manipur State. Although the complex can be proud of its achievements over the work done in rice, vegetables and mushroom cultivation, its activities on horticultural crops including plantation and spice crops, which may prove as backbone for the economy of the State, are very scanty.

Besides, being located in Imphal Valley, the results of research work emanating from the station may have only limited applicability for adoption in varied topography, agro-climatic and soil conditions existing in the state. The Manipuris have a habit of taking raw rice with high amylose (glutinous) content. Sundrying during harvest period is very difficult. Mechanical drying may be adopted. Detailed studies on post harvest-technology for rice should be taken up by the ICAR.

I.ii. Coffee Demonstration Farm, Pangsang

is run by the Manipur Plantation Crops Corporation and is in its formative stage. A nursery of 47,000 plants with Arabica, Dwarf Arabica and Robusta selections is maintained. Pits have been dug for planting coffee seedlings and the natural canopy of forest is maintained through thinning of shade trees.

I.iii. Government Progeny Orchard, Churchandpur

established in 1953, was taken over by the Department of Horticulture in 1960-61. Situated at an altitude of 853 meters, the station comprises an area of 9.31 ha. The average rainfall is 196 cm. and the maximum and minimum temperatures respectively are 31.5°C and 3.3°C. The climate is subtropical. The standing crops consist of different varieties of mango, guava, banana, peanut, amla, chestnut and pear. The farm does not contribute much by way of research or demonstration. The performance of mango is not satisfactory. The climate of the area

being subtropical, a reconsideration of the crop selection appears necessary. Fruit crops like mango, guava, amla, etc. being tropical, it would be worthwhile to maintain them in a more appropriate agro-climatic zone. The sub-tropical horticultural crops like mandarin oranges, limes, lemons, pomegranate etc could be maintained and experiments strengthened on these crops.

Expansion of this farm as a sub-tropical experimental Station by way of additional land and other infrastructural facilities will be beneficial.

I.iv. Rice Research Station, Wanghal

was established in 1961 and has an area of 19.63 ha. It is under the Department of Agriculture. The objectives of the Station are:

- (a) to study the suitability and adaptability of high yielding varieties
- (b) to evolve high yielding varieties through hybridization.
- (c) to multiply foundation seeds for distribution to progressive farmers and
- (d) to maintain Germ plasm of rice varieties.

The station has evolved a number of crosses and two or three lines are ready for release. It has also tested cold tolerant varieties from Philippines and Kashmir. Two varieties, *Punshi* and *Plouoivi*, released by it have been widely accepted. The agronomy investigations consist of studies on N and Zn requirement of different varieties. The station lacks facilities for conducting trials on deep water rice. Development of irrigation facilities is the urgent need of this station. It is also conducting trials on rice entomology and Pathology.

Besides experiments on rice, studies in bean, sunflower, mustard and sugarcane are also conducted.

I.v. Progeny Orchard cum Nursery, Tengnoupal.

This orchard was established in 1958 in an area of 18.6 ha and situated at an altitude of 1839.37 metres above MSL and enjoying sub-tropical to temperate climate with maximum and minimum temperatures of 37°C and 0°C. The average rainfall in the region is 223.90 cm and crops grown are Assam lemon, Plum, Peach, Cheshnut and Walnut. It is said that the yield of walnut is 9 kg/tree. The intensity of utilization of area and revenue accruing out of cultivation are not satisfactory. By taking over some more area, with irrigation facilities, there is scope to convert this institution as a Research Station on Temperate crops.

I.vi. Spices Development Farm, Moreh.

is located at an elevation of 152.4 metres above MSL. The place enjoys a tropical climate. The maximum temperature goes upto 41°C and minimum to 15°C. Government had allotted 50 ha of land for the establishment of the farm, but the Department of Horticulture has taken over

only 12 ha of land. The advantage of the farm is that it has irrigation facilities as a river flows along the boundry of the farm. The approach to the farm is difficult and may be improved by providing atleast a suspension bridge. Mainly pineapple is cultivated at present in the farm.

This is a farm with considerable potential for being developed as a Tropical Horticultural Research Station. The entire area of 50 ha allotted may be taken over and activities expanded spices like pepper, nutmeg, clove, ginger and tree crops like mango, coconut, arecanut, cocoa, oil palm etc. may be tried at this station.

I.vii. View Land Estate, Ukhrol,

is a private farm, owned by Shri. L. Ramkating, Retd. District Agricultural Officer. The total area of the farm is 14.17 ha of which an area of 6.07 ha has been planted to apple, pears and plum. Besides, an area of 0.40 ha is planted with large cardamom said to be obtained from Sikkim. The plants are about 4 years old. The yield obtained is 100-150 gm dry capsules per clump. The variety is not superior. The plants are healthy. The technology of growing cardamom and the processing of produce are not known to the cultivator as well as to the local Horticultural officers.

I.viii. Locations in Ukhrol.

The advantage of Ukhrol district is that it consists of hilly and mountainous terrain, the highest of which rises upto 2,743 metres above MSL. The climate varies from sub-tropical to semi temperate to temperate. The geographical area is 1,722 square kilometres. The average rainfall ranges from 200 to 305 cms with minimum of 147 cms. In respect of temperature, the maximum is 31°C and minimum 10°C. The relative humidity ranges from 50 to 90 per cent. There is scope for starting a Research Station on Temperate crops. Acquisition of 50 hectares of land is necessary for this purpose.

I. ix. Fruit Preservation Factory, Imphal.

was started in 1958 under the Department of Horticulture to serve the purpose of demonstration and training in fruit preservation. This factory was taken over by the Department of Horticulture in 1977. The capacity of the plant is 200 tonnes, but not fully utilised. From 1983-84, Pineapple products are exported to U. S. S. R. Besides Pineapple products, lemon and orange squashes are also produced. Further diversification in the range of products may be considered so as to work the factory for longer period in a year. Possibilities of reducing the waste of Pineapple in the present system of canning may be explored.

I. x. Progeny Orchard, Mantripukri, Imphal.

is located in the heart of Imphal town. The notable feature is that about 200 varieties of roses have been maintained and propagated.

Planting of mango varieties, limes and lemons, apples, plum etc., have been done. Performance of mango varieties is not satisfactory. This may be tried in areas which enjoy a tropical climate.

I. xi Orchid Preservation Centre, Khonghampal, Imphal.

This orchidarium developed under stimulated natural conditions contains a large number of species (about 300 types) of orchids. A sincere attempt has been made to collect and maintain the several orchid species which is commendable. Orchids in North Eastern region are endangered plant species and the need to preserve and protect them cannot be over emphasised. The orchid centre was established in 1976 in an area of 21.26 hectares.



Canning work in progress—Fruit preservation factory, Manipur

It would be desirable to initiate further research on aspects like propagation and management of the several orchids. Tissue culture technique widely adopted in orchids could be thought of. It will be worthwhile, if investment is made on orchid research. Description of the species collected and their classification could be made and published.

I.xii. The Mushroom Development Unit,

is maintained by the Tribal Development Corporation. Besides production of seed material, training on scientific cultivation of mushroom to tribals is imparted. More facilities for commercial production of spawn and proper follow up action after training to assess the impact of training among tribes appeared necessary. Accommodation to the

trainees is needed. The training has to be extended to the people of the hilly regions also by re-orienting the programme on the lines of Krishi Vignana Kendra. The functions of the ICAR complex and Corporation have to be co-ordinated efficiently.

I.xiii. Pineapple Cloth Manufacturing and Training Centre, Porampal, Imphal

Studied the methodology of yarn and cloth making with pineapple leaves. The venture affords employment opportunities to women, but scarcity of raw material (Pineapple leaves) and high cost of transport are some of the main draw-backs.

I.xiv. Coffee Development and Nursery Farm, Noney (Longmai),

was established in the year 1980-81 in an area of 18.2 ha. The Station is located at an elevation of 640 metres enjoying an average rainfall of 289.1 cm. A coffee nursery with about five lakh seedlings and large number of shade tree plants has been established. Great difficulty in disposing of nursery plants is felt. The Liaison Officer, Coffee Board having his head quarters at Noney has to help in this regard. Different varieties of coffee under different intensities of shade have been planted.

Details of Planting:-

Arabica coffee, S. 1934	— 3.235 ha.
Robusta coffee-variety not known	— 0.850 ..
Arabica coffee-S.795	— 1.700 ..
" " S. 7.2	— NA

There is a perennial stream at the lower side of the farm which can be exploited. This farm can be converted into a Research Station on sub tropical crops.

I. xv. Coffee Demonstration Farm, Coffee Board, Noney, Tamenglong District

A coffee Demonstration farm in an area of 40 ha. is being established at Noney by the Coffee Board. A Liaison Officer has been posted. So far, an area of 4.3 ha has been planted to different varieties of coffee viz., S. 795, S. 1934, S.7.3 and S. 7.2 (Arabica selections), Tall variety of S. 7.2 and S.274 (Robusta selections). A museum of all varieties of coffee including the crosses between Robusta and Connera is maintained. Many shade trees are seen in the plot, the important ones being *Albizia sumatrina*, Silk cotton, dadap (*Erythrina lithosperma*), Jack, Tree bean, silver oak (*Gravellia robusta*) etc. The working of the farm needs to be oriented to adopt coffee based cropping system.

It was noticed that the existing forest trees have been clear felled and shade trees like *Erythrina* have been planted. It would be desirable to retain some trees for shade instead of total removal of them. A system with little disturbance to the ecosystem will have to be developed.

I. xvi. Progeny Orchard and Cashew Farm, Jiribam

is situated at an elevation of 100 metres above MSL, enjoying tropical climate. The area of progeny orchard is 11.75 ha and that of cashew plantation is 28.34 ha (Total 40.09ha.). The Progeny orchard was started in 1962 where as the cashew farm was started in 1971-72. Many crops are seen planted here:

Litchi	—	0.40 ha
Sapota	—	0.80 ha
Banana (var. Cold pod and cavendish)	—	0.40 ha
Eureka lemon	—	0.40 ha
Assam lemon	—	0.60 ha
Coconut (Different varieties called as Ernakulam Dwarf and Green Dwarf)	—	0.80 ha (as roadside avenue 135 plants)
Arecanut	—	0.40 ha
Papaya (var. Honey Dew & Ranchi)	—	0.40 ha

Besides, a nursery of 210 plants of betal leaf, two grown up pepper vines (Panniyur-1) and 40 plants of Guava (Var. Allahabad) have also been established.

In the cashew plantation, 3000 seedlings have been planted in 1981-82. Varieties are not known although seeds have been brought from Cashew Research Station, Ullal and Directorate of Cashew Development, Ernakulam. The cashew plants are seen planted on tilla top and in such a location, wind damage is found severe. The yield obtained is said to be 8-10 kg/tree. The plants flower in the months of March-April and harvesting is done in the months of June-July (Rainy period). Due to heavy rains, the quality of apples and nuts is deteriorated. Premature sprouting of seeds while in tree and after falling on ground is another drawback noticed. Area is comparatively free from tea mosquito. The processing aspect of nuts is not known.

This farm offers good scope for starting a Research Station on Tropical crops. Acquisition of some more area and provision of additional infrastructure facilities would be required.

I. xvii. Rubber Plantation Centre, Aglapur, Jiribam

was established in 1978-79 in an area of 100 hectares. Budlings of the varieties RRIM-600, PNR and G 107 have been planted. It is said that RRIM-600 variety is highly susceptible to wind damage. About 30 per cent of the trees have attained the girth for tapping. Tapping is to be commenced immediately.

The performance of rubber is excellent which is indicative of the promising potential for large scale rubber production in Manipur. If properly planned, several suitable areas could be brought under rubber cultivation which will contribute greatly to the economy of the state.



Rubber plantation, Jiribam, Manipur

I. xviii. Manipur Tea Plantations, Jiribam

The Manipur Tea Plantations, Jiribam was registered on 19-3-81 and the clonal nursery on tea was started in 1981 in an area of 5 ha. A new venture through voluntary surrender of about 1100 ha of land from tribals is being tried. The tribals who had surrendered the land are employed there. An area of 25 ha has already been planted with the finance from Tea board under the scheme "New Tea financing project for non-traditional areas". In spite of the fact that large tea plantations of Assam are situated just across the river, tea plantations have not been established in Manipur. The peculiar land ownership system has been responsible for this plight. Parts of Manipur hold considerable potential for growing tea on plantation scale. The technology is easily available from the neighbouring Assam state. The present experiment utilizing the lands belonging to tribal people, if it succeeds, will hold out high promise for the welfare of the tribal people as well as for the state as a whole. It may also be a viable alternative to *jhumming*. The team feels that the tea plantations should be given adequate support by the Government and immediate action taken for developing the plantations.

Appendix II

REORGANISATION OF DEPARTMENTAL RESEARCH EFFORTS

II. i. Agriculture

At present, there is only one Rice Research Station at Wangbal. Since this station is situated in the valley, the development of varieties suitable for the hilly regions cannot be taken up there. Moreover, the need for the tribal population with respect to rice is cold tolerant varieties as well as cultivars which will come up better under *jhumming* system. There is also plenty of scope for popularisation of deep water paddy. About 10,000 ha is in the deep water conditions where rice can be grown successfully. To meet the above demands of the rice cultivators, several research stations have to be established in different areas.

II. i. i. Establishment of rice research station at high altitude areas preferably at Ukhrul or Mao-Maram areas for screening cold tolerant varieties of rice.

II. i. ii. Establishment of a sub station at Jiribam

The climate at this place is suitable for growing two crops of rice in a year. Evolving varieties by raising 6 or 7 generations will take only 3 years if the trials are conducted in such areas.

II. i. iii. Establishment of rice research stations in the upland/foot hill areas

Sizeable quantity of the rice is being produced by terrace cultivation in the foot hill areas. The varieties, the climate and the cultural practices are different for the upland rice as against the rice grown in the valley. Hence a separate research station to cater to the needs of this type of cultivation is to be established.

II. i. iv. Establishment of a station in deep water areas

Large chunk of areas in and around the periphery of Loktak lake is being water logged to a depth of 1—2 M. At present, there is no rice cultivation in this area mainly for want of technology and proper varieties. A research station may be set up somewhere in the periphery of the Loktak lake. Deep water paddy varieties should be introduced from elsewhere. Growing fresh water prawns in combination with deep water rice will be a profitable venture in this area.

II. ii. Horticulture

Research on Horticulture, is still in infant stage in Manipur. The state completely depends on the ICAR Research complex situated at Imphal for its research needs. Unfortunately, due to many limitations, the ICAR Research complex has also not developed so far to the desired

extent. The topography of the lands and agro-climatic variations in different locations necessitate establishment of zonal research stations to tackle location specific problems. This can be accomplished only by the Government departments or College of Agriculture. While it is the responsibility of the College of Agriculture to conduct research in its campus and out stations and create package of practices, the College of Agriculture, Manipur is still in its initial phase of development. The Departments of Horticulture is endowed with better facilities and hence, in the interest of state's immediate development and to avoid further loss of time, it would be appropriate to entrust now the research activities to the department. As and when the college assures strength, these research organisations can be handed over to it.

The first step to be taken while thinking of establishment of campus research stations is the classification of locations as zones according to variability. In Manipur State, this has not been done and this process will take some time. So the only means by which, any suggestion on development on a research organisation can be done is only on an arbitrary classification of the existing organisations (one dozen) visited by the study team. These organisations stand dispersed in different agro-climatic regions of the state. The immediate need is the evolution of suitable cropping system in horticultural crops possibly for the people living in plains, sub tropical and temperate regions. These classifications are very broad based and require to be modified when zonal classifications of areas is completed.

Thus an arbitrary classification of the existing horticultural stations/ orchards based on their locations would be as given hereunder.

II.ii.i. Stations located in Tropical Region

- (a) Spices Development Farm, Moreh;
- (b) Progeny Orchard cum Cashew Farm, Jiribam.

II.ii.ii. Stations located in sub-tropical region

- (a) Coffee Development Farm, Pangsang;
- (b) Government Progeny Orchard, Churachandpur;
- (c) Coffee Development and Nursery Farm, Noney and
- (d) Government Progeny Orchard, Mantripukri.

II.ii.iii. Stations located in Temperate region

- (a) Government Progeny Orchard, Tangnoupal;
- (b) Government Orchard, Ukhrul.

If the above classification of stations is accepted, their research functions and the crops to be dealt with can be identified and the technical programme drawn.

Broad Technical Programme

(a) For tropical stations

The experience so far gained in the farms and neighbouring areas has indicated that many fruit, plantation and spice crops have already proven their merits and they can be considered for the standardisation of package of practices by laying out trials. Such important crops are:—

Fruit and vegetable crops—Sapota, mango, banana, pineapple, lemon, papaya, dioscorea and tapioca.

Plantation crops —Coconut, arecanut and cashew

Spice crops —Pepper and ginger

To start with the following trials can be taken up on individual crops :

- (1) Building up of a germplasm collection
- (2) Comparative yield trial of recommended varieties
- (3) Manurial trial
- (4) Demonstration plots on coconut based farming system.
- (5) Large scale planting of proven crops in the vicinity of the farm.

Introduction and trial cultivation of the following crops to test their adaptability in the region may be done.

Food crop —Tapioca varieties

Plantation crops —Oil palm and cacao

Spice crops —Clove and nutmeg

Essential oil and medicinal crops —Vanilla, Citronella, Japanese mint, Geranium, Chamomile and Patchouli.

(b) For Sub tropical stations

The work already done on fruit crops may be continued. But, the research on mango may be confined to stations located in tropical climate as the performance of mango varieties is not satisfactory in this region. Introduction of many more varieties of individual crops and screening them for their adaptability has to be done.

Detailed research work on banana, pineapple, coffee and pepper on the following lines is suggested.

- 1) Germ plasm collection of banana, coffee and pepper
- 2) Manurial trial on banana and pineapple
- 3) Population density trial on pineapple
- 4) Growth regulator trials on pineapple
- 5) Varietal trial on coffee
- 6) Shade trial on coffee
- 7) Demonstration plot on coffee based cropping system.
- 8) Manurial trial on pepper

9) Trial to identify suitable standard for pepper.

10) Varietal trial on pepper

Introduction and trial cultivation of the following crops are suggested:-
Sub tropical fruit and vegetable crops—All types & varieties including
tapioca & dioscorea.

Plantation crops

Spice crops

Essential oil & Medicinal crops

—Coffee

—Pepper, clove, nutmeg, ginger,
cardamom and cinnamon

—Vanilla, dioscorea, *Java citro-*
nella, Palmarosa, black pepper-
mint, Geranium, Pyrethrum,
Belladonna, Chamomile and
Patchouli.

c) *For Temperate Stations.*

The work already on hand on existing crops may be continued. The research work on apple is to be intensified especially with regard to varieties and root-stocks. Introduction and trial cultivation of the following crops are suggested:-

Temperate fruits

Plantation crops

Spice crops

Essential oil &

Medicinal crops

—enriching the collection.

—Coffee (in low elevations)

—Cardamom varieties, cinnamon species, pepper
(in low elevations)

—Pyrethrum, Geranium and Black Peppermint.

Maximum stress on cardamom cultivation is necessary. After finding out suitable variety/ varieties of cardamom, detailed research for evolving package of practices has to be taken up. This should be done as a time bound programme.

II.ii. Suggestions for improvement of existing stations/ new stations.

- (i) The stations may be redesignated as Research Station cum demonstration farms.
- ii) Where ever area available is inadequate, further acquisition of area has to be done. Each station should have atleast 100 ha. of land.
- iii) The stations may be provided with all infrastructure facilities such as staff, laboratory, threshing floor, quarters, etc.
- iv) In staff structure, disciplines of Horticulture, Agronomy, Botany, Chemistry, Plant Pathology and Entomology should be given representations.
- v) Provision of irrigation wherever possible, roads and bridges may be necessary.

- vi) If regular electricity is not available, generator has to be provided.
- vii) The stations should be made responsible to popularise the cultivation of proven crops in the near vicinity of the stations besides undertaking training of the cultivators. Targets to this effect may be fixed for each scientist.
- viii) To start with, the scientists selected for the station work have to be given intensive training on all aspects of different crops. Training will have to be arranged with KAU, Regional Research Laboratory, Jorhat (Assam) and National Botanical Gardens, Lucknow. This item of work may be given top priority.
- ix) Rice Research Stations may be started in different regions.
- x) Research stations may be started in each Agro-climatic zone for other crops.

Appendix III

DETAILS OF SOME OF THE IMPORTANT NON-TRADITIONAL CROPS

III. i. Plantation Crops.

III. i. i. Tea (*Camellia sinensis*)

Eventhough export prospects and internal demand are good for tea, growing of tea by individual cultivators may not be possible at present. A start has been made by the Manipur Plantation Crop Development Corporation to cultivate tea at Jiribam which enjoys a tropical climate. This has figured probably due to the experience gained in the adjacent areas of Assam district in tea cultivation. Eventhough, the venture is started late, there is necessity to speed up planting keeping the time schedule.

Under cultivation, tea is confined mainly to the subtropics and the mountainous regions of the tropics. Near the equator, elevations where it is grown are usually 1220 to 1830 metres. Tea requires equable temperatures moderate to high rainfall and high humidity throughout the greater part of the year, it will not tolerate frost. China teas are more tolerant of colder conditions. Best quality tea is produced in a cool climate. Eg. Himalayan foot hills of north eastern India. The mean minimum temperature should not fall below 9.4°C nor mean maximum temperatures go above 21.7°C. rainfall below 104.30 cm per annum is marginal and should not fall below 5 cms per month for any prolonged period. Hail can cause much damages. The best soils for tea are deep, permeable, well drained, acid soils and are often tropical red earths. The pH of soil should be between 4.5–6.0. Tea is a calcifuge and is an aluminium accumulator and *Albizia* spp are sometimes used as indication plants in selection soils for tea.

If the aforesaid ecology of tea is taken into consideration, it can be stated that many locations apart from Jiribam may offer scope for cultivating tea. Considering the prevailing rainfall and temperature in various locations, it might be possible to grow tea in many locations of all the districts of Manipur. Therefore efforts to introduce tea cultivation on trial basis in all locations possessing ecological conditions suitable for tea cultivation appears necessary and this venture would be rewarding both from point of view of productivity and quality of produce.

III. i. ii. Rubber (*Revea brasiliensis*)

India is the fifth largest producer of natural rubber. Due to growing demand for natural rubber, good scope exists for its further development. There is not much scope for expansion of rubber cultivation in the traditional southern states. Studies have revealed that rubber comes up well in exceptional sub-tropical regions situated, between 22° and 29° North

latitude. Areas having less than the minimum required rainfall and experiencing low temperature below 9°C continuously for several weeks during winter season have to be avoided. Rubber cultivation is almost new to Manipur and only a start has been made in Jiribam. Unfortunately, most of the hills of Manipur are highly elevated and not easily accessible. Because of the high elevation and terrain, most of the forest areas located along the hills may not be conducive for rubber cultivation. However, certain locations possessing lesser elevations and hills (Eg. Western district of Manipur) are available for exploitation. Thus, Commercial cultivation of rubber can be thought of in foot hills and valleys in and around Jiribam and Noney along the Jiribam road. Growing of rubber by individual cultivators may be possible and should be encouraged. If suitable technical and financial assistance are given, many may come forward. Strategy in cultivation of food crops in inter spaces of rubber during the pre bearing period of rubber to tide over the difficulties in gestation period is to be worked out based on the taste and tradition of the people of each tract.

III.i.iii. Coffee (*Coffea* spp.)

Is concentrated now in the southern states of Kerala, Tamilnadu and Karnataka occupying about 99 per cent area wise in India. There is good scope for developing new export markets and expanding internal trade. On account of scarcity of land, there is limited scope in extending the area under coffee in southern states. The North eastern region offers good scope for coffee cultivation in the hilly areas which are under *jhummia* cultivation.

Arabica coffee is an upland species, occurring naturally as an understorey tree in forest between 1400 to 1850 m in Ethiopia at 6 to 9°N. The ideal conditions are found on the equator at approximately 1500 to 1850 metres with temperatures of approximately 60 to 75° C, a rainfall of about 200 cm annually which is well distributed, but with drier period of 2-3 months for initiation of flower buds and with deep, slightly acid, well drained fertile loam of lateritic or volcanic origin with reasonable humus content. Periods of mist and low cloud are beneficial. Strong winds are detrimental. In the sub-tropics, it is grown at sea level.

Robusta coffee is not so specific in its requirements as coffee Arabica. It has wider range of adaptability. It is best suited to lower altitudes and is grown from sea level to 1500 metres with an optimum altitude of 300 to 760 metres. It is grown under rainfall from 100 to 250 cms but 170 cms is probably optimal and temperatures of 22 to 40°C. It is more tolerant of adverse conditions and poor management than C. Arabica and most cultivars are resistant to Hemilia. (Rust disease).

In Manipur, the climatic and ecological conditions for growing different varieties of coffee may exist in selected areas. A good start has already been made by establishing coffee demonstration

farms in Pansang and Noneh. The Coffee Board is also establishing a coffee demonstration farm at Noneh. If the lacunae such as inadequacy of trained personnel, untrained labourers and improper cultivation practices are tided over, there is good scope for commercial cultivation of coffee. Instead of exploiting land for monocropping of coffee, it would be desirable to adopt coffee based cropping system comprising proven intercrops. Pepper and orange will prove as efficient intercrops and this venture will be more attractive to the farmers. In new plantations, if banana and dioscorea cultivation is done primarily as temporary shade, they will provide food also to tide over gestation period. Based on the performance of coffee, the following recommendation may hold good.

For elevations upto 670 metres provided rainfall is optimum, Dwarf Arabica (Slm. 7.2 and 7.3) and Robusta (S.274) may be cultivated. Locations having elevations from 670 to 1067 metres, Dwarf Arabica and Arabica selections 195 and 1934 may be cultivated. Beyond elevations of 1067 m coffee cultivation has to be discouraged under Manipur conditions. However, it might be possible to locate certain frost free ideal locations above 1070 m for Arabica cultivation which can be ascertained only through exploratory trials. Retention of natural forest canopy by proper thinning has to be aimed to avoid loss of valuable trees. In case shade is to be provided, shade trees of Albizia spp. silk cotton, dadap (*Erithrina lithosperma*) jack, tree bean and silver oak may be established as permanent shade. They will serve as standards for pepper also in a coffee based cropping system.

III.i.iv. Cashew (*Anacardium occidentale*)

Is an important plantation crop from the point of view of national economy. It is export oriented and industry based. India's production is awfully short to meet the demand of the factories. Till recently, India was importing raw nuts from African countries, but the same is not possible now as processing has been started in those countries. Therefore, there is every necessity to increase production of cashew by extending its cultivation. Unfortunately, due to pressure on land in Kerala the scope for expanding area under cashew is limited. Under the circumstances, it is desirable to exploit the non-traditional areas for its cultivation.

Cashew is adapted to warm humid tropical conditions. It can grow in almost all types of soil and upto an elevation of 600 to 700 m including waste lands of low fertility. Heavy clayey soils, poor drainage conditions, very low temperature and frost are unsuitable for the crop.

In Jiribam, a plantation of cashew in an area of 28.3 ha has been established. It is said that some trees in the plantation yields about 8 to 10 kg nuts per tree. The problems noticed are that the varieties (obtained from Ullal and Kerala) are late season ones which come to bearing during

peak rainy months. It was informed that the nuts germinate *in situ*. Considering these conditions, commercial cultivation of the already available varieties cannot be advocated. It should be possible to identify varieties of cashew which would flower and produce nuts much before the monsoon period. This would involve detailed study of all the available varieties for their behaviour under Jiribam and Moreh conditions before commercial cultivation is aimed at. So, it would be worthwhile to build up a germ plasm of all types and selections of cashew from Kerala, Karnataka, Andhra, Orissa and West Bengal and conduct detailed studies.

III.i.v. Coconut (*Cocos nucifera*)

Coconut is almost a new crop to Manipur. 135 plants of different varieties of coconut obtained from Ernakulam of Kerala are seen planted in Progeny orchard, Jiribam. The details of varieties are not known. They are generally called as Ernakulam Dwarfs and Green dwarfs. Based on the colouration of petioles and growth habits, the naming of varieties does not seem to be correct. The cultivation practices followed are also not scientific, because of which, plants have not borne any fruits. Coconut is an industry based crop and is a boon to homesteads and marginal farmers. So any attempt to standardise the varieties and cultivation practices is worthwhile. It is hence, necessary to introduce all the available varieties in Jiribam and Moreh locations to take up detailed studies and evolve strategy on coconut based cropping system.

III.i.vi. Arecanut (*Areca catechu*)

The performance of arecanut in Jiribam and adjacent localities has been found to be good. There is scope for popularising the cultivation of this crop. Varietal improvement programme by introducing all varieties including Assam, Mangla etc. is necessary.

III.i.vii. Cacao (*Theobroma Cacao*)

is a tropical beverage crop which might be suitable in Jiribam and Moreh areas. Experimental cultivation of 'Forestero' variety in Government farm is suggested.

III.i.viii. Oil palm (*Elaeis guineensis*)

The centre of origin of the oil palm is the tropical rain forest region of West Africa. An average rainfall of 200 cms or more evenly distributed is ideal for better results even though it is cultivated in regions of lesser rainfall. A mean maximum temperature of 32°C and a mean minimum of 21°C provide the most suitable temperatures. Seedling growth is arrested at temperature below 15°C. A high level of solar radiation is important for growth and bunch production. It can be grown on a wide range of tropical soils. Flat or undulating land is selected for cultivation to reduce cost of maintenance. Considering the ecology of the crop, trial cultivation of Dura and Tenera varieties of oil palm can be taken up in Chalpkrong and Jiribam regions of Manipur State.

III-ii. Spice crops

Among the perennial spice crops, cardamom, pepper, clove and nutmeg assume importance.

III.ii.i. Cardamom (*Elettaria cardamomum*)

Cardamom of Commerce is *Elettaria cardamomum*. It is a foreign exchange earner. There is every necessity to grow cardamom in far away places from Southern India due to disease incidence (Katte disease) Thus, the possibility of growing cardamom in Manipur is of significance. The true cardamom thrives at elevations ranging from 600 to 2500 metres with well distributed and fairly heavy rainfall and a cooler weather. Soil should contain organic matter. A dense tree cover is another requirement. Such conditions are available in quite a few places in Manipur State. Therefore experimental plantations are to be established in all locations where conditions are favourable. Based on performance studies, the following cultivars are recommended for different elevations:

Malabar —	for areas from 600 to 1200 metres
Mysore —	“ 900 to 1200 “
Vazhuka —	“ 900 to 1200 “

It is also worthwhile to introduce cardamom substitutes viz., *Aframomum* spp from Africa, *Amomum aromaticum* (Bengal Cardamom) and *Amomum subulatum* (Greater Indian or Nepal Cardamom).

III.ii.ii Pepper (*Piper nigrum*)

is one of the oldest and most important of all spices. It is a native of western ghats of India and performs well in the hills of Assam and North Burma. It requires a hot wet tropical climate and is usually grown in low altitudes. Though an annual rainfall of 250 cm is ideal for its proper growth it can also come up well in low rainfall areas where the pattern and distribution of rainfall is such that it suits the crop. The most important factor is that once the flushing and flowering are initiated there should be continuous rainfall until fruit development starts (June-July) or else the yields are reduced. Long spells of dry periods are unfavourable. The crop tolerates a minimum temperature of 10°C and a maximum of 40°C. It can be grown from sea level upto an altitude of 1200 metres but lower altitudes are preferable. Pepper prefers a porous, well drained soil rich in organic matter. It cannot withstand water logging and soils with high clay content are avoided. Slopes facing south should be avoided so far as possible.

Eventhough, Manipur State has not started commercial cultivation of pepper, the scope appears immense when existing conditions are considered. The team could see only 2 plants of pepper (variety-Panniyur-1) in the Progeny orchard, Jiribam. The standard used is Jack. Because of heavy shade and poor management, the production is poor. The variety

Panniyur-1 is more suited to open areas. There is good scope for introducing other varieties such as Karimunda, Arikulam mundi, Kalluvally, Balan-cotta and Kottanadan from Kerala besides varieties from Assam and Karnataka. Till results of study on varieties are obtained, commercial cultivation of pepper can be done using proper standards in locations upto elevations of 900 metres where there is no fear of frost. Varieties Panniyur-1 (for open situation) and Karimunda (for shady situation) may be popularised. The crop can be grown both as a pure crop and as an inter crop in coffee and fruit plantations. A rapid multiplication plot on pepper adopting bamboo method will solve the problem of production of large quantity of planting material. Pepper may also be introduced in all the stations and progeny orchards located in elevations upto 1200 metres to assess its adaptability.

III.ii.iii. Clove & nutmeg (*Eugenia caryophyllus* and *Myristica fragrans*)

River banks and sheltered valleys, are best suitable for nutmeg. Excessively dry and water logged soils are avoided. It can grow upto about 900 metres above MSL.

Clove requires a warm humid tropical to sub tropical climate with an annual rainfall ranging from 150-250 cm. It grows well from sea level upto an altitude of 800-900 metres. Deep loam soils with high humus content and black loams of semi Forest regions with good drainage are suited for the cultivation of clove.

As no standing trees of clove and nutmeg could be found in Manipur State experimental planting of these crops in different ideal locations is suggested.

III. ii. iv. Annual spices

Among annual spices, ginger (*Zingiber officinale*) and turmeric (*Curcuma domestica*) rank superior. Ginger is not a new crop to Manipur and its cultivation is in existence though not on organised scale. No known varieties suiting to the trade are cultivated. The variety/varieties cultivated are fibrous. The technique of production of dry ginger in which form Kerala exports ginger, is unknown to people. There is good scope in organising ginger cultivation both as a pure crop and as an inter crop. As dry ginger can be kept for long, there will be no difficulty in transporting the same for long distances. The following varieties are advocated for testing and large scale cultivation.

For dry ginger	— Maran and Wynad Manontoddy,
For vegetable	— Valluvanad, Ernad and Kuruppampady.
For extraction of oleoresin	— Rio-de-Jeneiro
For fibre less ginger	— Tafengiva and Taiwan.

For enhancing productivity, package of practices are to be evolved for this crop. When the cultivation is stabilised and production becomes

sizeable, a factory for extraction of oleoresin for export can be considered. Possibilities of artificial drying of ginger also are to be explored in places where the harvesting season is threatened by rains.

Turmeric has limited scope due to price fluctuations although it can be successfully grown under Manipur conditions. So, its cultivation has to be limited to internal consumption only. However, there is scope for testing the varieties—Duggirula, Tekurpetta, Sugantham, Kodur, Armour and Aleppey for their yield and Curcumin content. The processing of turmeric has also to be popularised.

Although both ginger and turmeric are tropical plants, they have adaptability to grow in regions of sub tropical climate. Rich soils with good drainage are to be preferred.

There is also scope for trial cultivation of minor spices such as Coriander (*Coriandrum sativum*), Cumin (*Cuminum cyminum*) etc which can be done in stations by introducing improved varieties.

III. iii. Essential oil and Medicinal plants

III. iii. i. Java citronella (*Cymbopogon winterianus*)

There are two distinct commercial types of citronella oil namely Java oil distilled from *Cymbopogon winterianus* and Ceylon oil from *C. nardus*. Java oil is superior in quality with about 85-95 percent geraniol content. This requires a heavy and well distributed rainfall, relatively high humidity of about 70 per cent and moderate temperature ranging between 10°C and 30°C. The valley areas and areas upto 1220 metres free from frost might be suitable for this crop. There is necessity to improve production to meet the internal demand at present.

III. iii. ii. Palmarosa (*Cymbopogon martini*)

Belongs to the same family of Citronella. The commercial cultivation of this perennial aromatic grass is done in areas free from frost having the average rainfall between 80 and 150 cm. If the rainfall is not well spread, irrigation becomes necessary. A well drained soil is to be preferred. The main constituent is geraniol used in perfumery, soap and tobacco industry. The present production is lower than the estimated demand. There is scope for improved production. Improvement of the quality of the field grown palmarosa oil is necessary. At present, Palmarosa is commercially cultivated in the forests of Maharashtra and Madhya Pradesh and a small extent in Andhra Pradesh and Kerala.

III. iii. iii. Japanese mint (*Mentha arvensis*)

is a perennial aromatic herb with creeping rootstocks. The plant *Mentha arvensis* sub species haplocalyx variety piperiscens is cultivated in the plains ascending upto 400 metres. An average rainfall of about 105 cm and well drained loose textured soil are the requirements. The crop is sensitive to water logging and drought. If pre-monsoon showers

fail, irrigation is necessary. The plant prefers a moderately cool and humid climate. In commercial planting, mint is planted afresh every year with due rotation with other crops.

The main constituent of mint oil is menthol of commerce which has medicinal value. The oil is used in the preparations like tooth paste, mouth washes, shaving creams, confectionery and cigarettes. The present production in India is insufficient and hence imported. The plain areas of the foot hills of Manipur state may be best suited for this.

III. iii. iv. Black pepper mint (*Mentha piperata*)

is a relative of the Japanese mint and is known as *Mentha piperata* variety *Vulgaris*. It is a perennial aromatic herb thriving in temperate and humid climate in open sunny situations. It prefers light calcareous or deep rich loamy soils. This is too sensitive to drought. Harvesting is done twice a year. It is a short duration crop and needs replanting. Manipur valley may be specially suited for this crop. The oil is used as a flavouring agent and in pharmaceuticals. The commodity is at present imported.

III. iii. v. Geranium (*Pelargonium graveolens*).

Is a small perennial shrub grown in temperate, subtropical and tropical climates of various altitudes. It prefers a porous open soil. It is sensitive to frost but can tolerate moderate drought. Two crops can be taken in the first year of planting and three crops subsequently upto five years.

Geraniol and citronella are the main constituents of oil. They are used in cosmetics and perfumery industries. The commodity is at present imported.

The cultivation is concentrated in Tamilnadu and Karnataka. Because of wide adaptability of Geranium, this may prove successful in slopes of hills. Before commercial cultivation, experimental plantations may be set up to prove suitability of the area chosen for development.

III. iii. vi Cinnamon (*Cinnamomum* spp.).

is a tree belonging to the same family of Guava and Eucalyptus. It prefers soils rich in organic matter. Soils and other environmental conditions affect quality. Cinnamon occurs wild in South Western India upto 1830 metres but is common in the low lands. It has wide adaptability. It occurs wild in Manipur hills also. This would have probably come from Burma and may be cassia or Chinese cinnamon (*Cinnamomum cassia*). There are two types cultivated viz., *Cinnamomum Zeylanicum* and *Cinnamomum tamala*. The true Cinnamon (of commerce) is *C. Zeylanicum*. The oil is extracted by distillation of bark as well as leaves.

For leaf oil, *Cinnamomum tamala* is preferred. Cinnamon trees are found to be growing wild in nature in the eastern part of Manipur.

Here, there is good scope for commercial cultivation of *Cinnamomum tamala* for the production of oil which is at present imported. Its requirement is also quite high.

III. iii. vii. *Dioscorea (Dioscorea spp.)*.

Different varieties are available and can be grown with ease in cooler climate. Manipur provides the requisite conditions for its growth especially in higher altitudes. Edible varieties are already grown using banana and fence posts as props. There is good scope to introduce *Dioscorea floribunda*. The underground tubers contain diosgenin which is used for the preparation of steroids and oral contraceptives. It has good demand all over world.

III. iii. viii. *Pyrethrum (Chrysanthemum cinerariae)*,

is a perennial herb growing at altitude between 1500 and 3000 metres above MSL. Prefers an annual rainfall of 100 to 125 cm. The main constituent is Pyrethrum which is used in insecticidal preparations. The production is low and hence imported. It is worth to cultivate on trial basis this crop in hilly areas of Manipur.

III. iii. ix. *Belladonna (Atropa belladonna)*.

The plant is a perennial bush herb. It grows in cooler localities at an altitude of 1800 to 3300 metres. It is also grown in the plains in India as inter crop. The crop is grown for the hyoscyamine content used in medicines. The belladonna leaves and roots are imported at present.

III. iii. x. *Chamomile (Matricaria chamomilla)*,

is grown for its flowers which yield the drug chamomile. As a drug, it has many uses especially for ailments of children. The plant grows to a height of about 0.75 metre and branched. It has a wide adaptability to soils and climate. It does not need very humid climate. It flourishes in altitudes between 300 and 1500 metres and can withstand cold weather (2° to 20°C). In plains, it can be grown as a winter crop. It is an annual crop. Flowers are dried on picking and distilled for oil. The average production is about 75 kg. dried flowers per hectare (2.5 kg oil). There is good demand for this oil in Germany, France and other European countries and hence the product is export oriented. The technology of its cultivation and processing have been developed by National Botanical Garden, Lucknow.

III. iii. xi. *Patchouli (Pogostenon patchouli)*,

Oil is obtained by distillation of the leaves. The plant grows to a height of 0.75 to 1.5 m and can be easily cultivated. The yield of oil is 2 to 3 percent. The crop requires almost the same conditions as required for Java citronella.

III. iii. xii. Vanilla (*Vanilla fragrans*).

is an important and popular orchid. The pods are harvested before they are fully ripe, after which they are fermented and cured. These beans are referred as Vanilla beans. Vanilla extract is obtained by macerating the cured beans in alcohol. Vanilla is extensively used to flavour ice cream, chocolate, beverages, cakes, custard, pudding and other confectionery. The flavour of vanilla varies due to climate, altitude, extent of pollination, degree of ripeness at harvesting and methods of curing. Artificial pollination is necessary to set pods.

In wild state, vanilla grows climbing on trees in wet low land forests. It thrives best in hot moist insular climate with frequent but not excessive rain. The optimum temperature varies from 21 to 32°C with an average around 27°C and with evenly distributed rainfall of 150 to 300 cm per annum with two drier months to check vegetative growth and bring the vines to flower. Regions with prolonged dry season may be avoided. Gently sloping lands with light friable soil with good drainage is preferred. A thick surface layer of humus or mulch of soil is necessary. Partial shade is also needed.

Manipur is a land of orchids, So, trial cultivation of vanilla in different locations is worth while as it is felt that this crop is definite to succeed commercially in foot hills of the state.

Appendix IV

COMPARATIVE STATEMENT SHOWING MONTHWISE RAINFALL IN MM IN DIFFERENT LOCATIONS OF MANIPUR.
AVERAGE FOR FOUR YEARS (FIGURES IN PARENTHESES INDICATE NUMBER OF RAINY DAYS)

Location	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Churcha- ndpur	12.0 (1.5)	31.5 (3.5)	16.85 (2.0)	98.0 (10.0)	102.1 (9.2)	240.6 (15.0)	155.6 (13.2)	208.6 (13.0)	109.7 (9.2)	128.8 (9.7)	98.9 (5.5)	0.0 (0.0)	1145.83 (87.3)
Chakpika- rong	33.9 (1.5)	33.1 (3.2)	3.9 (1.0)	91.1 (11.5)	145.3 (12.5)	138.0 (18.0)	143.6 (16.2)	248.4 (17.5)	133.8 (8.5)	144.1 (12.0)	66.9 (6.0)	2.3 (1.0)	1203.0 (112.0)
Thanlon	28.0 (2.0)	56.8 (3.2)	18.0 (3.0)	155.55 (12.5)	232.40 (15.5)	367.85 (17.0)	388.6 (22.0)	429.4 (21.0)	313.2 (16.0)	182.1 (10.0)	77.35 (6.0)	0.0 (0.0)	2105.6 (123.0)
Imphal	25.8 (3.0)	55.7 (4.75)	23.82 (5.0)	97.25 (11.0)	120.27 (11.0)	236.75 (17.0)	192.50 (18.0)	217.65 (18.0)	142.85 (10.0)	104.97 (11.0)	72.15 (7.0)	1.0 (1.0)	1220.76 (144.0)
Thengno- upal	8.18 (2.0)	12.9 (2.0)	12.1 (1.0)	31.2 (5.0)	121.4 (7.0)	440.30 (19.0)	414.40 (20.0)	347.95 (21.0)	228.0 (11.0)	105.7 (8.0)	80.1 (5.0)	2.85 (1.0)	2590.6 (110.0)
Maram	40.0 (2.0)	40.85 (5.0)	50.0 (2.0)	81.07 (10.0)	121.4 (10.0)	264.00 (20.0)	249.05 (21.0)	233.4 (21.0)	120.7 (12.0)	116.15 (10.0)	73.0 (3.0)	3.1 (1.0)	1229.8 (117.0)
Wanghal	10.8 (3.0)	40.6 (3.0)	9.3 (3.0)	81.45 (11.0)	101.6 (12.0)	179.2 (18.0)	202.7 (18.0)	144.9 (18.0)	81.1 (9.0)	89.3 (8.0)	38.3 (5.0)	0.6 (1.0)	954.06 (114.0)
Tinsong	17.7 (3.0)	46.07 (3.0)	21.2 (3.0)	148.7 (12.0)	262.2 (13.0)	469.9 (21.0)	407.1 (19.0)	483.5 (23.0)	286.6 (15.0)	203.75 (11.0)	51.6 (5.0)	0.0 (0.0)	2365.4 (125.0)
Kangchorp	51.55 (3.0)	64.6 (4.0)	79.9 (5.0)	101.8 (12.0)	147.3 (11.0)	345.6 (19.0)	314.5 (19.0)	238.05 (18.0)	107.7 (11.0)	152.5 (11.0)	66.9 (4.0)	0.0 (0.0)	1679.4 (109.0)
Ukrul	24.6 (3.0)	39.9 (3.0)	12.0 (2.0)	54.05 (9.0)	104.0 (9.0)	241.1 (18.0)	238.2 (22.0)	214.97 (18.0)	172.2 (15.0)	144.45 (9.0)	103.7 (6.0)	2.2 (1.0)	1361.8 (115.0)
Jiribam	14.97 (2.0)	42.6 (5.0)	77.8 (6.0)	257.3 (14.0)	278.1 (13.0)	455.9 (23.0)	413.3 (21.0)	407.1 (19.0)	353.0 (15.0)	188.5 (9.0)	70.7 (3.0)	1.75 (1.0)	2438.4 (130.0)

Appendix V

AVERAGE MAXIMUM AND MINIMUM TEMPERATURE IN CENTEGRADE AT IMPORTANT STATIONS IN MANIPUR Average for three years

Month	Churchandpur		Chakpikarong		Thanlon		Tegnoupal		Maram		Wanghal		Tinsong		Ukhrul		Jiribam	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Jan.	24.77	4.95	32.93	5.90	25.53	5.70	19.50	6.60	21.53	2.03	25.33	0.77	23.73	9.43	25.53	5.77	25.98	4.63
Feb.	27.00	2.67	39.23	4.77	27.20	7.00	20.50	6.47	24.37	2.53	27.57	5.37	27.15	10.55	24.03	5.67	26.90	6.43
Mar.	33.00	5.67	45.43	9.42	31.27	9.03	26.67	9.37	30.43	5.83	33.30	5.78	31.60	11.95	27.67	8.87	32.06	10.13
April	34.67	10.67	43.84	13.20	32.77	12.03	28.57	11.50	30.67	10.38	33.97	10.53	33.60	9.43	30.10	12.73	35.67	13.67
May	35.67	11.89	42.93	16.23	41.98	15.40	35.23	12.13	31.93	13.80	34.27	15.17	30.50	15.67	35.67	16.30	39.00	17.20
June	34.67	17.67	41.27	19.27	32.37	19.73	32.33	17.27	31.70	16.83	36.37	17.20	31.70	17.93	32.93	17.80	39.90	19.40
July	35.00	19.67	40.73	21.47	32.23	17.67	31.07	17.27	31.80	19.23	37.63	18.83	35.10	16.23	31.80	18.19	40.00	21.40
Aug.	32.67	19.00	39.63	23.30	32.57	16.69	29.93	18.10	35.03	19.03	34.03	18.43	31.60	18.70	30.70	18.33	37.10	22.10
Sept.	31.67	17.67	39.77	19.23	32.93	18.80	28.70	17.30	32.47	19.83	34.64	18.30	31.02	14.55	33.30	16.47	34.00	21.07
Oct.	30.67	18.00	31.18	14.40	32.20	15.25	24.67	10.60	31.53	17.13	33.30	11.40	31.10	15.50	32.00	1.67	33.40	16.03
Nov.	29.50	7.50	42.20	10.00	27.75	14.40	20.80	8.60	34.15	15.95	31.35	6.10	28.30	11.10	29.70	11.70	29.00	10.50
Dec.	24.50	0.50	38.85	4.40	21.60	9.40	20.25	5.00	23.00	3.30	30.80	1.40	29.90	10.00	28.55	6.70	26.20	5.10
Aver.	31.15	10.88	40.64	15.28	38.50	13.26	26.43	11.68	28.22	12.15	32.71	10.77	30.35	13.42	30.17	12.52	32.33	12.35

Appendix VI

FORM OF PROJECT PROPOSALS

1. Title of the Scheme :
2. Location
 - a) Name and address of Institute:
 - b) Name and address of Department / Division :
 - c) Actual location of Scheme :
3. Objectives
4. Practical / scientific utility :
5. Review of work conducted :
6. Technical programme (Methodology, experimental design, yearwise plan of work, observations to be recorded, collaboration with other organisations etc. to be mentioned)
7. Facilities
 - a) Already available :
 - b) Additional facilities required
 - i) Equipment and apparatus :
 - ii) Area of land etc.
 - iii) Laboratory and Office Furniture etc. :
 - iv) Buildings :
8. Duration :
9. Staff requirements (Give details of scientific, technical and ministerial staff actually required with yearwise phasing)

Designation of post	No.	Scale of pay	Qualifications
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10. Estimates and costs :

(Make yearwise estimates for the total period of the scheme giving details as indicated below)

Sl. No.	Name of post	Scale of pay	No. of posts	I year	II year	III year	Total
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- i) Pay of officers :
- ii) Pay of establishment :
- iii) Allowances and Honoraria:
- iv) Contingencies:
 - a) Recurring (with details such as glassware and chemicals and other contingencies.)
 - b) Non-recurring (with details)

II Reciepts anticipated.

Signature
Designation

Note: When pay of staff is calculated, the middle rate of scale of pay may be reckoned for first year calculation and increments added for subsequent years.

Appendix VII (a)

SPECIMEN PROJECT PROPOSAL

- 1 Title of the Scheme :- Coffee Based Cropping system.
- 2 Location :
 - a) Name and address of the institute : Department of Horticulture, Manipur State
 - b) Name and address of Department / Division : Research Wing, Department of Horticulture, Manipur State
 - c) Actual location of the Scheme : Horticultural Research and Demonstration Farm, Noneg (Longmai), Manipur State.
- 3 Objectives : To evolve an economical coffee based cropping system with coffee as primary crop and orange & pepper as secondary inter crops, under Manipur conditions.
- 4 Practical / Scientific utility : Manipur has a programme to extent and intensify coffee cultivation in the State. The productivity from a unit area is to be increased in the interest of small and marginal farmers and for profitably utilizing the shade trees and interspaces, that too ensuring better and stable income to the cultivators. Evolution of an efficient coffee based cropping system, will be a boon to growers. Thus, the study will help to popularise the technique among farmers for large scale adoption.
- 5 Review of work done : No Work has so far been done in Manipur State in this regard. The experience in southern state has proved that many intercrops can be grown profitably in coffee plantation. This system has helped the small growers very much as more that 90 percent of the coffee growers possess only coffee plantations below 2 hectares, which are not sufficiently productive to maintain their families. This has led to the adoption of different cropping systems in coffee in southern states.

6 Technical Programme

Design

Treatments

: Randomised block design.

: 6

T1—Coffee alone

T2—Pepper alone

T3—Orange alone

T4—Coffee + Pepper

T5—Coffee + Orange

T6—Coffee + Pepper + Orange

Lay out.

T1	T5	T2	T3	T4	T6	—Rep I
T6	T4	T5	T1	T3	T2	—Rep II
T3	T2	T4	T5	T6	T1	—Rep III
T2	T1	T6	T3	T5	T4	—Rep IV

No. of replications — 4

Plot size — 0.08 ha

Total area of the experiment — 1.84 ha.

Observations to be recorded:—

- 1 Height, girth and spread of plants at six monthly intervals.
- 2 Extent of shade in plantation at intervals.
- 3 Fertility and moisture status of soils at intervals.
- 4 Pest and disease incidence.
- 5 Yield
- 6 Cultivation sheet containing expenditure, income and cost benefit analysis
- 7 Collaboration : Collaboration with the various department of Agricultural College, Manipur, Coffee board and KAU for guidance and analytical work is necessary.

8 Facilities

a) Already available : There is a Coffee Development and Nursery farm at Noneh (Longmi) whose already available facilities will be utilized.

b) Additional facilities required.

i) Area of land : An area of two hectares has to be made available for this research project at Coffee Development Farm, Noneh, which is proposed to be redesignated as Horticultural Research and Demonstration Farm.

ii) Equipments & Apparatus : Facilities available in the College of Agriculture, Imphal will be utilized. At longmai, only a field laboratory is to be established. A type writer has to be provided as office equipment for which provision has been made.

iii) Laboratory & Office furniture

: For use of staff and storage purposes, furniture has to be provided. The field laboratory and the College of Agriculture are to be strengthened with minimum of glass wares, chemical etc. for analytical work. As disposal of coffee as parchment is desirable, a coffee curing machine, (Pulper with accessories) is to be provided in the third year. Provisions for the above have been contemplated.

iv) Buildings: —

: The following constructions/buildings and other infrastructural facilities are absolutely essential and to be provided,

- 1) Potting shed cum green house.
- 2) Laboratory cum Office Building.
- 3) Store Building (Rat and insect proof)
- 4) Threshing floor cum drying yard.

A provision of Rs. 3,35,000 is provided for the purpose. These facilities will become common amenities to the station and help for conducting other research programmes also.

9 Duration of Project:

: The Project is a long term one, continuing for more than 25 years and is economically viable. To start with, the duration of the project is kept as 5 years i.e., seventh plan period, as even after obtaining results, the project will have to be continued as the plantations are of perennial nature.

10 Staff Requirements:

Designation	No.	Scale of pay	Qualification	Remarks.
Horticulturist (Deputy Director) Assistant	1	Rs. 850-1450	M.Sc. (Agri)/Hort	See Note below
Horticulturist Assistant	1	Rs. 750-1200	-do-	
Agronomist Farm Assistants	1	Rs. 750-1200	M.Sc. (Ag) Agron.	
Clerk cum Typist	2	Rs. 450-750	S.S.L.C. & training in Agriculture.	
Store Clerk	1	Rs. 450-750	S.S.L.C.	
Messenger	1	Rs. 250-450	

Note:— The posts of Horticulturist, Clerk cum Typist, Store Clerk and Messenger eventhough have been shown in this Project, will attend to other items of farm work also. The Horticulturist will be the head of station who will exercise the technical and administrative control over all functions of the farm. As a lot of planning, laying out and planting of experiment etc are to be done, the staff shown is the minimum required.

11. Estimate of cost

The total out lay of the project for 5 years is Rs. 15.99 lakhs (Rounded to Rs. 16 lakhs) and for the first year Rs. 4.63 lakhs.

The year wise expenditure is as follows:

First year	:	Rs. 4.63 lakhs
Second year	:	Rs. 3.57 lakhs
Third year	:	Rs. 3.03 lakhs
Fourth year	:	Rs. 2.41 lakhs
Fifth year	:	Rs. 2.36 lakhs
Total	:	<u>Rs. 16.00 lakhs</u>

The detailed estimate of cost is appended.

Detailed Estimate of cost

Sl No.	Name of Post	Scale of pay	No.	I year	II year	III year	IV year	V year	Total
1	2	3	4	5	6	7	8	9	10
1	Horticulturist	850-1450	1	13,800	14,400	15,000	15,600	16,200	75,000
2	Asst. Horticulturist	750-1250	1	12,000	12,600	13,200	13,800	14,400	66,000
3	Asst. Agronomist	750-1250	1	12,000	12,600	13,200	13,800	14,400	66,000
4	Farm Assistants	450-750	2	14,400	14,880	15,360	16,320	16,320	77,280
5	Clerk cum Typist	450-750	1	7,200	7,420	7,680	7,920	8,160	38,380
6	Store Clerk	450-750	1	7,200	7,420	7,680	7,920	8,160	38,380
7	Messenger	250-450	1	3,900	4,080	4,260	4,440	4,620	21,300
1	Pay of Officers			37,800	39,600	41,400	43,200	45,000	2,07,000
2	Pay of Establishment			32,700	33,800	34,980	36,600	37,260	1,75,340
3	Allowance, Honoraria etc.			40,120	41,930	43,790	45,680	47,590	2,19,110
Total pay and allowances				1,10,620	1,15,330	1,20,170	1,25,480	1,29,850	6,01,450

(The pay scales shown are only illustrative)

4. Contingencies

a) Non-recurring :									
i) Equipment & apparatus :									
Type writer	one	6,000	—	—	—	—	—	—	6,000
ii) Laboratory & Office furniture		10,000	5,000	—	—	—	—	—	15,000
Other Laboratory articles		5,000	5,000	5,000	5,000	5,000	5,000	5,000	25,000
Coffee curing machine (Pulper etc)		—	—	50,000	—	—	—	—	50,000

1	2	3	4	5	6	7	8
iii)	Buildings:						
i)	Potting shed cum green house 1	50,000	50,000	—	—	—	1,00,000
ii)	Laboratory cum office building 1	1,00,000	50,000	—	—	—	1,50,000
iii)	Store building (Rat & insect proof) 1	—	25,000	25,000	—	—	50,000
iv)	Threshing cum drying yard 1	—	15,000	10,000	10,000	—	35,000
	Total non-recurring contingencies	1,71,000	1,50,000	90,000	15,000	5,000	4,31,000
b)	Recurring						
i)	Office expenses including miscellaneous	5,000	5,000	5,000	5,000	5,000	25,000
ii)	Cultivation & Operation cost	1,73,000	81,310	84,970	92,160	92,880	5,24,320
iii)	Glasswares, chemicals etc.	3,000	5,000	3,000	3,000	3,000	17,000
	Total recurring contingencies	1,81,000	91,310	92,970	1,00,160	1,00,880	5,66,320
	Total contingencies	3,52,000	2,41,310	1,82,970	1,15,160	1,05,880	9,97,320
	Grand Total	4,62,620	3,56,640	3,03,140	2,40,640	2,35,730	15,98,770

Note:

(Basis for the calculation of cultivation and operational costs)

1) Cost of cultivation of Crops/ha

	I year	II year	III year	IV year	V year
Coffee	13,740	6,160	6,430	7,080	7,180
Pepper	15,720	8,300	8,700	8,700	8,700
Orange	7,400	3,400	3,400	4,200	4,200

- 2) Inter-cropping programme, 1/3rd of the cost of cultivation of the concerned crop per hectare is reckoned as the population will be lesser compared to pure crop. Coffee is the primary crop and pepper and oranges are intercrops.
- 3) Wages calculated is at the rate of Rs. 20/- per day per member.
- 4) The estimates are as prevalent in Kerala.

Signature

Designation

Appendix VII (b)

SPECIMEN PROJECT PROPOSALS

1. Title : Manipur Hill area extension (Diagnosis and Design) Project—MHAЕ (D & D) Project.
2. Location: Hill districts of Manipur.

Name and address of agency:

Agricultural Development Board (proposed). The Board will comprise of Chief Minister as Chairman, Ministers in charge of Agriculture, Animal Husbandry, Forestry, Tribal Welfare, Development, Irrigation and Public Works and their Secretaries, Principal Secretary, Development, as Convener.

3. Background

3.1 Jhumming is a world wide problem in all the hilly areas. It is specially acute in Manipur State. Previous attempts to check the intensity of jhumming had met with little success. Due to various reasons, the cycle of jhumming has been reduced from 10 to 4 years. Many socio-economic factors are also involved in the process. The tribal people still own the land and their possession is protected by special laws. Land tenure systems are rigid, and integrally part of ethnic value systems. Agricultural practices are also sanctioned by tribal custom and tend to be conservatively preserved as part of the folklore.

3.2 It has been widely accepted that jhumming is a wasteful and hurtful practice. The soils in the hilly regions of Manipur have hardly any rock sub-strata, thus making them easily erodible. The recurrent firing of the areas results in the extermination of a rich gene pool of endemic rare genera. As the fertility decreases, more area is brought under the practice, and/or the jhumming cycle is shortened, thus preventing natural restoration of soil nutrient status. A vicious circle is created from which there is no escape unless innovations are internalised by tribal communities.

3.3 Various technical and socio-legal solutions are possible. Increase of productivity by application of soil nutrients, reduction of the intensity of tillage, agro-forestry practices like taungya, sylvi-horticulture, animal husbandry for meat production, by adoption sylvi pasture systems, soil and moisture conservation measures like strip cropping etc., are a few technical solutions. Experiments in partnership between the Government and tribal communities as at Jiribam are evidences of alternatives culturally acceptable to ethnic values. It is also understood that Government are contemplating legal enactments to democratise tenure systems of certain communities where ownership of land is vested exclusively in

chieftains or headmen. Thus the stage is set for a vital transformation. In order to achieve impetus, these programmes have to be spear-headed by dedicated extension efforts. The present project is an adaptation of the T & V system and includes some elements of NARP to meet the special needs of the Hill Districts of Manipur.

4.0 Objectives:

- a) To transform agricultural practices in the Hill Districts of Manipur by increasing productivity so that the economic imperative to resort to jhumming is removed;
- b) To develop suitable location-specific models of sylvi-horticultural and sylvi-pastoral land use and minimum tillage systems;
- c) To make available the services of trained professional Agricultural Scientists on a permanent residential basis to tribal communities;
- d) To provide "single window" agricultural services including supply of inputs through the above said residential Agricultural Experts. The essence of the Project is thus to:

1. Create a cadre of officers to be designated as Resident Agricultural Experts (RAE) who will be located in a, or a group of, contiguous and ethnically homogenous tribal settlements ("hamlets") and will normally have a tenure there of not less than three years.

2. Use the RAE as the single recourse for channelising technical advice, input supply, credit and marketing by liaising with the various concerned departments, e. g., Agriculture, Horticulture, Forest, Tribal Welfare, Animal Husbandry and the Plantation Corporation.

3. Continually upgrade the technical skills of the RAE by making him conduct applied research, maintain demonstration farms and back-stopping from subject matter specialists and the Manipur University.

5.0 Practical/Scientific utility

9/10 of the area in Manipur is in the hilly region. The entire area is occupied by tribal hamlets. They practise shifting cultivation in an area of 200—250 hectares at a time. When the productivity decreases in about 4 years, they shift the cultivation to neighbouring forest areas. The only way to settle jhummiadars is to provide a sustainable income from their lands occupied at the first instance. It is proposed to provide one Resident Agricultural Expert (RAE) for each tribal hamlet, or a group of them such that they are geographically and ethnically homogenous. The various agricultural extension programmes can be introduced through this single window i. e., RAE. If implemented, this programme will also give job opportunities for large number of unemployed agricultural graduates. Ultimately the programme will help in preventing the excessive deforestation, at the same time sustain productivity of jhummed lands. The experience gained can lead to scientific advance in dealing with such problems.

6.0 Review of work conducted

The T & V system as practised in other States will not be as such applicable in Manipur because of the remoteness and inaccessibility of the tribal hamlets. Some attempts have been made by way of social forestry, distribution of improved cultivars and planting materials at subsidy rates which have not made much headway. Shifting cultivation is practised in many other States, but in a different way. Suggestion here is a variation of the T & V system, incorporating its essence in a RAE. Some experiments at a technico-legal partnership as in Jiribam Tea Estates have been very successful. Probably, the approach will have to be further amplified by providing equitable distribution of profit with tribal communities through ADB. An equitable arrangement could be one when Government could raise forest in tribal land, engaging and paying for tribal labour and agreeing to share a fair portion of the proceeds of the final cut as a royalty or dividend to the tribal owners. The tribal people could also be allowed to raise taungya cultivation in the forest lands and retain full rights to Minor Forest Produce.

7.0 Technical Programme

- a. Identification of specific jurisdiction
- b. Appointment of agricultural scientists as Resident Agricultural Experts (RAE)
- c. Training of RAE in techniques of agriculture extension, tribal value systems, agro-forestry, farm economics and input management.
- d. Back stopping arrangements through various Subject Matter Specialists and ultimately Agricultural College, Life Science Department, of the Manipur University.
- e. Demonstration of models RAE will have to lay out and demonstrate modes of improved productivity from shifting cultivation through various agricultural techniques such as minimal/zero tillage, judicious use of herbicides, fertilisers, plant protection, selection and introduction of the screened and high yielding varieties, strip cropping, contour planting etc.
- f. Providing inputs
- g. Training in and imparting training in processing of agricultural produce
- h. Assistance in marketing

Research support has to be provided in the existing research farms in hill areas, agricultural college as well as in Manipur University.

8.0 Assessment and Monitoring

Reduction of shifting circuit and conversion of jhummed lands to perennial tree crop will be ultimate criteria to judge success. Elements in this will be the progressive increase of productivity in the shifting

circuit, so that the same or an increased output of traditional food and subsistence crops will be achieved from proportionately smaller areas of land, making available the rest of the area for high value plantation tree crops.

9.0 Facilities

A suitable hamlet or a group of them in hill districts selected for the purpose; eg in Ukhrol District the following areas can be selected.

Ukhrol
Chingori
Kasom Khullew
Kamjong
Phumkyar etc.

There should be a mobile soil testing laboratory and seed testing facilities. A meteorological observatory should be set up in each contiguous area. Minimum facilities for analysing physical and chemical properties of soil and quality of the produce should be provided. The entire area occupied by a community will be taken for improvement by each officer.

Residential accommodation, laboratory facilities, conveyance facilities and incentive allowances for serving in remote areas etc. will have to be given.

10.0 Duration

This programme has advantages of phase-wise implementation; each phase can be a district, specific location, a set of hamlets in different districts or any combination of the above. ADB may decide the actual location and phasing. Staff requirements are worked out on the basis of a unit of one RAE.

11.0 Staff requirement

1. Resident Agricultural Expert	—	1
2. Demonstrators	—	5
3. Store Keeper	—	1
4. Watchman	—	1
5. Cashier	—	1

12.0 Housing and Transport

As the essence of the programme is that the RAE will live in his jurisdiction residential accommodation of the same type as for a moderately affluent tribal family should be provided. Tribal type housing should be provided for the demonstrators as well. The Storekeeper, Watchman and Cashier should be recruited from the local tribal people. Minimum transport facilities, eg., bicycles, mobikes or riding ponies should be provided to RAE as suitable.

13.0 The financial implication of the project may be worked out as has been given in Appendix VII (a).

Appendix VII (c)

SPECIMEN PROJECT PROPOSAL

1 Title

Improving productivity of Jhummed lands

2 Location

- a) Department of Agriculture/Horticulture
- b) Any of the hill districts in Manipur.

3 Objectives

Productivity of jhummed lands has gone down considerably due to intensive cultivation without following any scientific principles. The Project aims at (a) reducing soil loss due to removal of forest; (b) reducing nutrient depletion due to intensive cultivation of cereals/non-legumes; (c) increasing water storage capacity of soil; (d) increasing organic matter content; (e) increasing inherent fertility of soil; (f) devising water harvesting techniques and (g) increasing overall productivity of jhummed lands.

4. Practical/Scientific utility

Jhummed lands are the only source of livelihood for the tribal communities. They produce various commodities to satisfy different needs of cereal food, protein food, firewood and horticulture produce. They follow most unscientific method with the result that productivity of Jhummed land decreases within a short period and they go for fresh area for jhumming. This investigation will help them to maintain the productivity, thereby the jhumming cycle will be lengthened, or they will be in a position to permanently settle in a particular locality. The suitable cropping system identified will bring more money, food and, at the same time, maintain soil productivity.

5 Review of work conducted

Shifting cultivation is practised extensively in north-eastern region. Cycle of jhumming has been consistently decreasing over a period of time in all the States. No serious attempt has been made to evolve a suitable technology as it involves the availability of tribal lands for cultivation (Land Tenure system), communication gap, and inaccessibility of tribal hamlet.

Some studies conducted at the Kerala Forest Institute, Peechi, have shown the deforestation of lands in cultivating non-tree species without adequate land management practices have led to wide scale soil erosion, nutrient loss in a short time. Studies conducted at the Kerala Agricultural University also have indicated the large scale erodability of the soil, particularly fine soil particles which contribute to soil fertility,

leaching loss of nutrients from the soil when the slopy lands are cultivated unscally. Possibilities of reducing these losses by appropriate land management, cropping system and soil conservation measures have been suggested.

6 Technical Programme

- 1) Reproachment (familiarisation). Understanding tenure and leadership of tribal community, achieving acceptance and confidence of tribal community.
- 2) Detailed soil survey, testing and preparation of soil capability map
- 3) Formulation of land use prescription such as mixed cropping, contour cultivation, sylviculture and soil conservation by engineering and agronomic methods.
- 4) Field trials to formulate agronomic practices for various crop mixes and land use pattern. Here the emphasis is given on minimal/zero tillage, strip cropping, contour planting, staggering of harvests for constant cover along contour.
- 5) Soil moisture conservation by mulching, cover cropping and organic residue replenishment, contour tillage.
- 6) Appropriate inclusion of legumes to maintain N balance.
- 7) Introduction and popularisation of cultivars specially suited for jhummed lands after stringent tests. Special attention should be given against introduction of seed born pests and diseases along with new cultivars.
- 8) Identifying crops for extraction of nutrients and moisture from different depths of soil to enable rotational feeding.
- 9) Monitoring of the soil fertility and productivity in the different cropping systems.

7 Collaboration

The Anthropology Department of the Manipur University may be consulted for understanding the tribal problems, dialect, way of living, so as to implement the scheme effectively. The Life Science Department and the College of Agriculture should also collaborate with this project.

8 Facilities required

Land can be made available either in one of the Horticulture Research Stations or by taking on lease from tribal communities as is done by Plantation Corporation for cultivation of coffee in Pangsang. Laboratory facilities should include convenience for physical, chemical and biological analysis of soil. Measurement of soil and water loss should

be done by lysimeter studies. Provision should be made to assess root distribution and ramification by isotopic studies. Qualitative analysis of different crop produce should also be planned.

9 Duration

Since this investigation envisages growing of crops of perennial nature productivity parameters are being replenished over a long period of time. Scheme should function at least for a period of twenty years till the tree species are well established and start giving usufructs.

10 Staff requirements

Senior Agronomist	—	1
Senior Chemist	—	1
Agronomist	—	1
Chemist	—	1
Asst. Agriculture Engineer	—	1
Microbiologist	—	1
Senior Research Assistants		
a) Agronomy	—	2
b) Chemistry	—	2
c) Microbiology	—	1
d) Biochemistry	—	1
e) Agriculture Engineering	—	2
Field Assistant	—	10
Laboratory Assistant	—	5
Supporting staff like clerks, typists, peons etc.	—	As per norms

11 The financial statement may be prepared based on the model given as appendix VII (a) adopting the prevalent rates for various categories.

