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DIFFERENTIAL ADOPTION OF PLANT PROTECTION TECHNOLOGY BY FARMERS OF KERALA - A CRITICAL ANALYSIS

BY
B. MEERA, M.Sc. (Ag.)

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H.H. SWAMY BODHANANDA SARASWATHY

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Chairman

Dr. G. Thyagarajan Nair

Members

1. Dr. C. Bhaskaran

2. Dr. S. Bhaskaran

3. Dr. A. Visalakshi

4. Dr. P. Saraswathy

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DECLARATION

I hereby declare that this thesis entitled, **Differential adoption of plant protection technology by farmers of Kerala - A critical analysis,** is a bonafide record of research work done by me during the course of research work and that this thesis has not previously formed the basis for the award to me of any degree, diploma, associateship or any other similar title of any other University or Society.

Meera

Vellayani,

10.06.1995.

B.MEERA

CERTIFICATE

Certified that this thesis entitled **Differential adoption of plant protection technology by farmers of Kerala - A critical analysis** is a record of research work done independently by Smt. B. Meera under my guidance and supervision and it has not previously formed the thesis for the award of any degree, fellowship or associateship to her.

Vellayani,
10.06.1995.

~~Dr. G.~~ THYAGARAJAN NAIR
Chairman,
Advisory Committee,
Professor and Head, (KH)
Department of Agricultural Extension,
College of Agriculture,
Vellayani.

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ABBREVIATIONS USED IN THE STUDY

A L P A	-	Alappuzha
B P H	-	Brown Plant Hopper
E T L	-	Economic Threshold Level
I P M	-	Integrated Pest Management
I R D P	-	Intensive Rural Development Programme
K A U	-	Kerala Agricultural University
P P	-	Plant Protection
Sq.m.	-	Square metre
T V M	-	Thiruvananthapuram

INTRODUCTION

INTRODUCTION

"Pleasant be thy hills, O earth,

Thy snow clad mountains and thy woods

O earth-brown, black, ruddy and multi-coloured

O purifier, may we not injure thy vitals or thy heart"

— *Atharva Veda*

Ancient Indian sages had recognised that the characteristics of the earth were not uniform but marvelled with variety and varied over time and space. They revered earth as 'Bhumi Devi' or 'Mother Earth', in whom food and plants have come to be, who bears in many forms the breathing and moving life. There is an urgent need to revive the ancient knowledge.

It is amazing that today, in the late twentieth century too, scientists have no doubt to agree with the ideas exposed by the seers in about 500 B.C. Modern scientists agree that the basic ideas so profoundly and poetically put forward ages back, in *Atharva Veda* hold true even today. When man appeared on earth, plants along with their pests were already present. Today when human population is crossing its limits, the task of feeding the large population, growing at a phenomenal rate of 2.3 per cent per year is the main problem of Indian agriculture.

With the introduction of high yielding varieties, Indian agriculture has undergone intensive farming. In the last decade the country has been able to achieve a commendable increase in food production. It is significant that this happened through improvement in productivity rather than expansion in the area under cultivation.

Changes in agriculural practices and maximising output by using the high yielding varities have brought environmental changes to the fore, upsetting the living organisms to their surroundings more so with pest complexes. This has given rise to challenging problems in all spheres of agriculture including plant protection, warranting extensive and intensive use of plant protection chemicals. Intensive and extensive use of pesticides as the main technology to control pests and diseases resulted in pest residues, health hazards, environmental pollution and ecological imbalance.

Inspite of disputable merits of insecticides and fungicides in increasing agricultural production, a number of limitations and adverse side effects of these toxicants in the human environment have thus been identified recently. The haphazard way of using these chemicals results in heavy contamination of the human system. Many monitoring reports are available pointing to the extent to which the human environment is contaminated with pesticide residues such as human blood, fat,breast milk and also the food commodities.(Kalra and Chawla, 1983).

The studies on contamination of the Indian environment by pesticides revealed that pesticides were the major contaminants in all food commodities and also the human system, blood, fat and milk (Visalakshi et al.,1989 and Visalakshi et al.,1990).The monitoring reports on vegetables revealed high level of contamination of the pesticides in vegetables consumed by people in Kerala (Mathew et al., 1990).

The consumption of pesticides in Kerala was 586 tonnes during 1974-75 with 0.2 kilograms consumption per hectare of cropped area and it has increased to 1200 tonnes by 1986-87 with 0.4 kilograms consumption per hectare of cropped area. Thus, an increase of 200% in the consumption of pesticides per hectare of cropped area is noticed (Vijayalaxmi and Babu, 1991). Irrational use of plant protection chemicals is still on board in literate Kerala and is also due to lack of adequate knowledge and favourable attitude towards scientific plant protection measures. A good agricultural practice with a sound knowledge about the pollution problems has never been reported to be hazardous. Swaminathan (1986) stressed the neeed for mobilising the mass media for stimulating awareness and its essentiality in the spread of knowledge in intensive and ecologically sustainable agriculture.

The release of a large number of agricultural innovations are being communicated to farmers by a number of agencies and change agents through variety of channels and the effect of such innovations and the communications is not always well pronounced as envinced by farmers' inadequate knowledge, understanding skills and some times unfavourable attitude leading to delayed or no action by farmers.

Many scientists have reported that in contrast to the package of practices recommendations for protecting vegetable crops from insect pests the farmers were found to apply chemicals of their own choice. They have also pointed out that transfer of technology to the commercial farmer needs to be improved by strengthening the rapport between Kerala Agricultural University scientists and farmers.

Knowledge gap was high for majority of respondents in taking up plant protection and if this is taken up properly we can gain both from the reduction in expenditure and increase in the value of produce (Velumani 1988). However efficient the production technology is,it would be of no use unless it is communicated effectively to the farmers.

Most of the adoption studies hitherto concentrated on the acceptance of general package of practices by farmers as studied by Ambastha (1974), Ambalavanan (1986), Anandarao (1988), Selvakumar (1988), Athimuthu (1990), Ramachandran (1992) and Jnanadevan (1993). On plant protection practices, few researchers had attempted to study the adoption as a separate entity like Ganesan (1982), Sisco et al.(1983), Sechser (1989) and Govind (1992).

It is high time to think about an environmentally biased pest control strategy with numerable control tactics which are practical and cost effective in a given ecosystem.

The studies enlisted above mostly give much importance to the general cultivation practices and only very few investigated the adoption of plant protection technology. The present study was formulated as a pioneer attempt with an intention to study the differential adoption of plant protection technology in important crops like paddy and vegetables by the farmers, realising the felt needs at the grass root and research level. In addition, the study will be explaining the variations in cognitive,affective and connative components of behaviour of farmers in the use of plant protection technology in a detailed manner with a selected set of variables and also providing an insight into the major constraints in their effective use.

Against this background, the present study was formulated with the following specific objectives.

1.1 Objectives of the study

1. To study the characteristics of farmers of Thiruvananthapuram and Alappuzha districts.
2. To study the level of knowledge of farmers about plant protection methods.
3. To study the attitude of farmers towards chemical method of plant protection.

4. To analyse the extent of adoption of plant protection methods by the farmers.
5. To determine the utility and practicability perception of farmers about the plant protection methods.
6. To find out the relationship of the characteristics of farmers with knowledge , attitude, adoption, utility and practicability perception about plant protection methods.
7. To study the indigenous practices of plant protection followed by farmers.
8. To analyse the perception of farmers about the impact of pesticides on environmental aspects.
9. To identify the constraints encountered in the adoption of plant protection methods by farmers.
10. To draw the suggestions of farmers as well as experts in the field of plant protection to overcome the constraints in the adoption of plant protection technology.
11. To suggest a strategic model for popularising effective plant protection technology.

1.2. Scope of study

It is a pioneer attempt to identify the various practices related to different plant protection methods in paddy and vegetables, which could be utilised as a ready reckoner for informations.

More over, the study throws light on the prevailing condition with regard to the level of knowledge, attitude, extent of adoption and utility and practicability perception of farmers about plant protection methods which would reveal the efficacy of the ongoing extension activities. These findings and the suggested strategy would help the planners, policy makers, scientists and administrators in designing and popularising effective plant protection technology in the field of agriculture.

1.3. Limitations of the study

The present research formed a part of the doctorate degree programme which was a single student investigation and hence it has all the limitations of time, finance mobility and other resources. These limitations determined the restricted selection of sample size. Inspite of these limitations, every effort was made by the researcher to carry out the study as systematic and objective as possible.

1.4. Presentation of the study

Besides the present chapter Introduction, the second chapter viz. Theoretical Orientation deals with the review of selected important variables and related studies in the field of the present investigation.

The third chapter presents the Methodology used in the study. The location of the study area, sampling procedure followed, quantification of the variables selected for the study, statistical techniques employed etc. are dealt with in this chapter.

The fourth chapter brings out the Results and Discussion of the study.The last chapter summarises the study, with a brief resume, strategic model for popularising effective plant protection methods and suggested areas of future research.

THEORETICAL ORIENTATION

2. THEORETICAL ORIENTATION

The theoretical framework presents the theoretical background for the investigation, explaining the ways and significance of the problem under study. A review of literature has been made to have a sound and meaningful relation to the research problem with the available findings to select and operationalise relevant variables enabling data collection.

In accordance with the objectives of the present study, the literature collected is furnished under the following subheads.

2.1. Knowledge of farmers about plant protection technology.

2.2. Attitude of farmers towards chemical method of plant protection technology.

2.3. Differential adoption of plant protection technology.

2.4. Dimensions of practices in plant protection technology.

2.5. Perception of farmers about the utility and practicability of plant protection methods.

2.6. Relationship of the selected characteristics of farmers with the dependent variables.

2.7. Constraints in the adoption of plant protection technology.

2.8. Theoretical model of the study.

2.1. Knowledge of farmers about plant protection technology

English and English(1961) defined knowledge as a body of understood information possessed by an individual or by a culture. Knowledge is one of the important components of behaviour and hence it would play a vital role in performing the job.

Singh(1970) observed that the success of the sophisticated technical programme depends on farmers' adequate and correct knowledge on the concerned field. Rogers and Shoemaker(1971) recognised the knowledge function as one of the four functions in the innovation decision process.

Mayani and Sheth(1978) found that knowledge about plant protection measure was poor among the small farmers. Litsinger et al.(1980) stated that farmer's knowledge level was found to be high in cultural control practice of pests like planting in time, crop rotation, and synchronised planting.

Hiranand and Singh(1981) reported that none of the dry land farmers knew the integrated control measures recommended by the scientists. Ganesan(1982) observed that no paddy growers knew about biological control of pests whereas cotton growers(44.00%) had knowledge about the role of nuclear polyhedral virus to control prodenia pests.

Marimuthu(1982) found that a majority of small farmers(50.00%) and big farmers(52.50%) possessed only medium level of knowledge about the pest management practices. Senthil(1983) revealed that majority of hybrid cotton seed growers(55.46%) possessed medium level of knowledge about hybrid seed production. He stated that 19.09 per cent had low knowledge level and 25.45 per cent had high knowledge level.

Jeyakrishnan(1984) found that 61.82 per cent of the paddy farmers had medium level of knowledge, 21.82 per cent had high level of knowledge and 16.36 per cent had low level of knowledge.

Godhandapani(1985) stated that majority of the irrigated groundnut growers had a medium level of knowledge about nutrient recommendations. The farmers lacked knowledge about the quantity of fertilizers to be applied and advantage of soil testing for application of fertilizers.

Subrahmanyam(1985) reported that two-thirds of paddy growers(66.83%) possessed medium level of knowledge, 21.67 per cent had high level of knowledge and 17.50 per cent had low level of knowledge in paddy cultivation. Ambalavanan (1986) inferred from his study that there was no difference in the level of knowledge in respect of package of practices for IR 20 paddy among marginal and small farmers.

Satapathy and Patnaik(1986) found that farmers possessed very little knowledge about the control measures against the pests viz., leaf hopper and case worm of paddy.

Chenniappan(1987) reported that the majority of irrigated cotton growers had medium knowledge level on the practices recommended for irrigated cotton. The trend was from medium to high level of knowledge in general. Palani(1987) reported that majority of paddy farmers(51.67%) had medium level of knowledge about integrated pest management practices.

Patil and Jadhav(1987) in their study about onion growers reported that most of the farmers did not have accurate knowledge of fertilizer requirements, pests and diseases and the appropriate control measures to be undertaken.

Adalla and Rola(1988) elucidated that the level of knowledge and perception of farmers regarding pests and their subsequent damage to crops was relatively very low. In addition, farmer's knowledge about rice pest control appears very limited that even natural enemies are being sprayed on sight.

Velumani(1988) elucidated that 89.30 per cent of the cotton farmers had knowledge about chemical requirement and 19.16 per cent, about mixing the spray solution and 71.66 per cent, about re-loading the tank etc.

Singh(1990) revealed that majority of the farmers had very poor knowledge of improved paddy and maize practices.

Juliana et al.(1991) reported that most of the marginal and small farmers possessed only medium level of knowledge about integrated pest management practices. More than half of the big farmers possessed high level of knowledge. In contrast to this, only 2.50 per cent of marginal farmers and one fourth of small farmers had high level of knowledge.

Binoo(1991) observed that majority(67%) of commercial vegetable growers had medium level of knowledge on improved vegetable cultivation practices.

From the above studies it is clear that farmers possess different levels of knowledge and knowledge plays an important role in shaping the behavioural pattern of farmers. Hence knowledge was included in the study as a dependent variable.

2.2. Attitude of farmers towards chemical method of plant protection technology.

Allport(1935) defined attitude as a mental and neural state of readiness organised through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related.

Thurstone(1946) defined attitude as the degree of positive or negative affect associated with some psychological object towards which people can differ in varying degrees.

Newcomb(1950) speaks of attitude as a state of readiness for motive arousal and an individual's attitude towards something in his pre-disposition to perform, perceive, think and feel in relation to it.

Rossenberg(1956) stated that an attitude is a relatively stable affective response to an object .

Katz and Scotland(1959) defined attitude as a tendency or disposition to evaluate an object or symbol of the object in a certain way.

Kuppuswamy(1964) stated that attitudes are learned in the course of life experiences which make the individuals behave in characteristic ways towards persons, objects or issues to which they get related.

Dahama(1970) opined that attitudes are learned responses and that since they are always found in relation to objects, ideas and persons they play an important role in determining human behaviour.

Clifford and Richard(1971) defined attitude as a learned orientation or disposition towards an object or situation which provides a tendency to respond favourably or unfavourably to the object or situation.

Vasudevan(1976) defined attitude as an enduring organisation of evaluative belief and a learned technology to react positively or negatively, varying in degrees to certain class of objects, which determine the actual and potential responses of the individual.

Guilford(1974)stated that as a result of social learning and interaction every one acquires certain attitude towards persons, things, situations and issues.

Many researchers have established the positive and significant association of attitude with adoption of farm practices(Garrett,1966; Somasundaram, 1976; Balasubramonium, 1977; Tripathy,1977; Pillai,1978; Mohanadasan, 1979; and Singh, 1988).

Singh(1990) reported that the farmers in both Meghalaya and Sikkim showed slightly favourable attitude towards modern agricultural practices. He also revealed that the farmers did feel the advantages of modern agricultural technology over the existing and traditional practices.

Nelson(1992) found that majority of farmers had favourable attitude towards KrishiBhavans in Kerala.

The above studies revealed that farmers possess varying degrees of attitude towards agricultural technology. Attitude largely determines behaviour of farmers and inclusion of this variable was found to be very important and hence selected attitude as a dependent variable while studying of the differential adoption of plant protection technology by farmers.

2.3. Differential adoption of plant protection technology

Innovation adoption is different from individual to individual according to their characteristics, familiarity with the techniques and availability of the resources. Though the plant protection methods are recommended scientifically by the field functionaries to obtain maximum benefit all the farmers are not adopting all the practices uniformly. Wide differences exist among farmers in the level or extent of adoption. Differential adoption of plant protection technology has been a growing concern amongst researchers as well as extension functionaries. It is an outcome of multifacet factors, operating in the field situation besides various other factors. Leagans(1985) stated that adoption behaviour would be specific to particular innovations, individuals and environments. But there are some characteristics in general as follows.

1. It is an adult behaviour such as idiosyncratic. Adoption behaviour varies as individual circumstances also vary.
2. Effect of communication ie. what, why and how of the technical ideas is a component.
3. Traditional socio-economic factors such as size of farm, age, education, income, family size etc. generally influence the adoption of an agricultural innovation.
4. Socio-psychological factors significantly influence the adoption of an innovation.

2.3.1. Extent of adoption

Sharma (1974) reported that the adoption of insect pest management stemmed mainly from the serious inadequecies and disturbances which arose from the sole reliance on chemical pesticides. He also reported significant difference among small and large farmers in the adoption of insecticides. In the case of high yielding varieties of paddy, the percentage of big farmers was higher in adoption than the small farmers.

Sawant and Thorat(1977) observed that rationality does not bring about critical differences in decision making in adoption of various categories, except those who are the last to adopt an improved farm practice. Differential adoption of farm innovations by farmers was generally observed and it was attributed to some of the personal, social and economic characters of farmers. Appavu(1979) reported that 50.00 per cent of the nearby farmers of compact demonstration did not follow the plant protection practices and balance half of the respondents adopted the plant protection measures at 75 to 100 per cent level.

According to Litsinger _et al._(1980) peasants employed a variety of traditional methods, cultural methods, use of resistant varieties and chemical control. Many farmers used pesticides, however effective control was not attained due to the use of improper dosages and mistiming of application. Manivannan(1980) reported that about three-fourth of the farmers(72.50%) had adopted half of the recommended dose of plant protection measures.

Asaithambi(1981) reported that one-fourth of the big farmers and negligible percentage(2.50%) of small farmers had adopted the plant protection measures.

Mariappan(1981) found that 55.00 per cent to 89.10 per cent of respondents had adopted spraying of recommended pesticides. Ganesan(1982) reported that hand picking of insect was followed by 62.00 per cent of cotton growers. He further reported that 72.00 per cent of paddy growers and 84.00 per cent of cotton growers used light trap and cent per cent of the farmers had adopted the chemical control of practices. Goodell et al.(1982) reported that farmers had reduced excessive frequency of insecticide application to low dosage by adopting IPM technology.

Litsinger et al.(1982) reported that 47.00 per cent of the farmers used insecticides. The most flaring fact regarding insecticide use was the low dosage. Farmers used dosage 10.70 times less than recommended, and applied insecticides in very low spray volumes on an average of 80 litres per hectare which are sublethal to insects. Marimuthu(1982) reported that the same percentage of the small farmers and big farmers(55.00%) were found to be medium adopters, in his study on adoption of pest management practices by chilli growers. Most of the farmers except few small farmers adopted both the cultural and chemical practices in full. Both the big and small farmers did not adopt the biological practice. The mechanical practice was adopted by few of the small farmers(12.05%) and 32.50 per cent of big farmers. Rajapandi(1983) reported that about 73.00 per cent of wet land farmers had medium level of adoption of water management practices.

Sisco et al.(1983) reported that IPM farmers were more inclined to be sure that there was an insect threat before applying insecticides to cotton. These farmers were less likely to apply insecticides as prophylatic treatments, Jeyakrishnan(1984) inferred that majority of the paddy growers had medium level of adoption of the low cost technology.

Nanjaiyan(1984) reported that 64.00 per cent of farmers had medium level adoption in cultivation of IR 20 paddy. Rajagopalan(1986) reported that 57.30 per cent of farmers adopted the technology of application of nitrogenous fertilizers to the nursery and 67.30 per cent of farmers adopted the split dose of application of nitrogen to the rice crop. Rathinasabapathi(1987) reported that 50.67 per cent of farmers were medium level and 28.20 per cent of farmers were high level in extent of adoption for IPM practices.

Venkataraman(1987) reported that maximum technological gap(98.88%) was noticed for IPM, followed by the use of fungicide to control blast(72.22%) and use of pesticides to control leaf folder(61.44%) in paddy.

Anandarao(1988) reported that the practices of summer ploughing and fertilizer application were adopted in higher level by more number of contact farmers than their counterparts. Grieshop et al.(1988) postulated that 26.00 per cent had adopted the IPM practices for tomato crop. Jeyaraman(1988) reported that 80.00 per cent of farmers adopted the technology of neem coated urea for paddy. Kenmore(1988) mentioned that the use of insecticide in rice fields per hectare dropped from an average of 4-5 application per season in 1986 to an average of 0-5 application in 1988. The exposure of Indonesia's environment to these pesticides has been reduced by 60.00 per cent.

Norton and Heong(1988) reported that only few farmers used standard operating procedures or spray schedules recommended by the agricultural authorities for insect pests, such as BPH and rice bugs. Seetharaman(1988) reported that the practices,viz., selection of variety and plant protection measures in main field were adopted by all the paddy growers in full. Top dressing main field in split application was adopted by 80.00 per cent of the small farmers. Selvakumar(1988) reported that 72.50 per cent of contact farmers and 48.75 per cent of non-contact farmers were high adopters of white fly control practices in cotton.

Singh(1988) while studying the impact of the Special Rice Production Programme(SRPP) reported that the extent of adoption of improved varieties was significantly higher in the intensive programme blocks than in both the extensive programme and control blocks. Theodore(1988) reported that there was significant difference in the extent of adoption of farming practices among contact and other farmers. Venkatapirabu(1988) stated that adoption of water management practices in paddy was found to be higher.

Gogoi and Gogoi(1989) pointed out that the practice of chemical control measures in nursery and mainfield was found to be fully adopted by 40.00 and 48.14 per cent of paddy farmers respectively.He further reported that 50.00 per cent of the respondents were low adopters of recommended plant protection practices followed by 36.36 per cent medium adopters and 13.64 per cent high adopters. Saxena _et al_.(1989) reported that almost all the farmers in Kendu Bay practised thinning and weeding their crops and majority of the farmers did not take any measure to control insect pests. Hand picking and killing of insect pests was adopted by 9.00 per cent. Only 4.00 per cent farmers used both mechanical/physical methods in combination. Crop rotation was used as a pest control measure by 32.00 per cent farmers. Only 39.00 per cent reported use of pesticides to control pests of various crops.

Venkataranga and Sethu(1989) observed that the chemical plant protection was found to be more and nearer to the recommended levels in adopted village when compared to non-adopted village in Mysore.

Saxena _et al_.(1990)reported that 17.60 per cent of farmers adopted the recommended package of practices in full while 49.60 per cent adopted partially and 32.80 per cent followed recommendations to the minimum level on their fields. He also reported that the plant protection measures had been adopted by less percentage of farmers.

Juliana *et al.*(1991) reported that 50.00 per cent of marginal farmers, 47.50 per cent of small farmers and 52.50 per cent of big farmers were medium adopters of IPM practices while 5.00 per cent of marginal farmers, 22.50 per cent of small farmers and 42.50 per cent of big farmers were higher adopters.

Govind(1992) reported that there was wide variation in the adoption levels of cultural, chemical and specific IPM practices of selected pests among IPM and non-IPM farmers for paddy cultivation.

2.4. Dimension of practices in plant protection technology.

Boutwell and Smith(1981) studied five sub-items viz., field monitoring, utilizing treatment thresholds and beneficial insects, utilising proper insecticide application techniques, and utilising recommended control practices and utilising other recommended practices that affect insect management under insect management practices for Alabama cotton production. Ganesan(1982) studied the pest management practices for paddy farmers under cultural, mechanical, physical, biological, chemical and traditional methods.

Goodell et al.(1982) studied different practices for observing pest control operations done by farmers viz., use of resistant varieties, removing infested weeds and synchronous planting.

Litsinger et al.(1982) identified chemical control, cultural control, role of natural enemies, concept of insect-resistant varieties and rodent control as sub-practices for his study on controlling pests for paddy cultivation. Marimuthu(1982) identified three sub - items viz., cultural practices, mechanical practices and chemical practices to study the pest management practices adopted by chilli growers. Douce et al.(1983) evaluated integrated pest management programmes using the characteristics like proportion of proper to total insecticide applications, proportion of economic thresh -olds treated, proportion of properly timed insecticide sprays to total insecticide sprays and proportion of applications not identical across all fields relative to the total number of applications made. Rajapandi(1983) identified four irrigation practices in his study on water management for paddy. Jeyakrishnan(1984) studied the use of recommended seed rate in his study on adoption of low cost technology among paddy farmers.

Kunnal *et al.*(1984) identified different dimensions of dry farming technology as soil and water conservation practices, improved varieties, fertilizer application, plant protection measures, after care operations and cropping patterns in his study on adoption of new technologies in dry land sorghum crop production. Thamilmani(1985) had split the major practice blue green algae application into 15 sub-items inorder to test the knowledge level of respondents. Krishnaiah(1986) studied pest surveillance and timing of pesticide application, chemical control, resistant varieties, conservation of natural enemies and natural control as components of IPM in paddy. Rathinasabapathi(1987) identified 14 technological dimensions under adoption of integrated pest management for cotton. Theodore(1988) identified the components for the adoption of farming viz., summer ploughing, application of farm yard manure, use of variety, seed rate, direct sowing, conversion into wet paddy and fertilizer application.

Gogoi and Gogoi(1989) studied different components of adoption practices for plant protection in rice viz., seed selection, seed treatment, growing tolerant/resistant variety, chemical prophylatic measures in nursery bed and main field.

Sangha and Dhammu(1989) studied the adoption of package of practices of winter maize under 15 components of practices related maize cultivation.

Govind(1992) identified 20 plant protection practices and grouped under four methods viz., cultural, chemical, biological and physical methods of IPM technology while studying the achievements and oppurtunities of IPM in rice.

2.5 Perception of farmers about the utility and practicability of plant protection methods.

Crowe and Crowe(1956) defined perception as the meaningful sensation that assumes an important role in the life of an individual. It refers to the ways by which the individual receives, interprets and responds to the stimuli picked by his sense organs.

According to Blalock(1963) perception has the following characteristics.

a. It is an individual matter. Thus there may be as many perceptions as there are individuals.

b. It must be dealt with in terms of what an individual actually experiences.

c. It involves not only perceiving the stimuli but also interpreting and describing these stimuli in terms of that are meaningful to the individual.

d. Various internal and external factors may influence both the interpretation of the stimulus and the response it is likely to provoke.

e. It is a dynamic phenomenon that may be continuously changing with an individual.

Bhatia(1967) stated that perception is sensation plus meaning, sensation means quality and perception means an object suggested by that quality. Sensation can give us form, shape, colour, taste, smell or sound but perception tells us what they mean and what object they stand for.

Theodorson and Theodorson(1970) opined that perception is the selection, organisation and interpretation by an individual of specific stimuli in a situation according to prior learning activities, interest, experience etc.

Rogers and Shoemaker(1971) stated that all innovations were not equivalent units of analysis. The several characteristics of innovation as perceived by the receivers contribute to their rate of adoption.

Viswanathan(1972) found that compatibility with traditional methods, high cost, more technical skill and more labour were significantly related with adoption level.

Chandrakandan(1973) found that if the farmers perceived a method to be more efficient in saving time, labour and money in producing more, it increased their adoption.

Sharma(1974) in a study found that compatibility with traditional methods, high cost, more technical skill and more labour were significantly related with adoption level.

He also reported that technology that was both transferable and appropriate might not be acceptable due to difficulty in understanding. This would be particularly true for complex technology evolved through multi-disciplinary efforts.

Muthukrishnan(1982) found that majority of the users(93.00%) of biogas plants had better perception towards the attributes of biogas plants.

Sundaram(1986) reported that while majority(75.00

per cent) of the farmers had medium level of perception, 14.00 per cent and 11.00 per cent of the respondents respectively had low and high level of perception about the effectiveness of soil conservation practices. Regarding the perception of utility of soil test recommendations, Balan(1987) reported that majority of farmers belonged to the medium perception category.

Verma(1986) reported that 85.00 per cent of the women beneficiaries of IRDP felt that their economic status had been raised and 88.00 per cent felt that their social status in the village had also been raised due to IRDP.

Khanna(1987) found out that 90.70 per cent participants of IRDP felt that as a result of IRDP their employment had increased, 77.00 per cent felt their consumption level had increased and 64.00 per cent felt that their overall status in the village society had been elevated.

In a study conducted by Sudha(1987) on the perception about Lab-to-Land programme, it was found that about 55.00 per cent of the non tribals and 75.00 per cent of the tribals belonged to the high perception group.

From the above review of literature it is understood that farmers possess different levels of perception and utility and practicability perceptions have important roles in deciding the behavioural pattern of an individual and hence utility and practicability perceptions were included for the study as dependent variables.

2.6 Relationship of the selected characteristics of farmers with the dependent variables

The dependent variables viz. farmers' knowledge about,attitude towards, adoption of and perception about utility and practicability of, plant protection technology were conceptualised as being influenced or determined by a number of farmer's characteristics called independent variables, such as family educational status, farm size, annual income,farming experience, cosmopoliteness, crop yield index, economic motivation, contact with extension agency, information source utilisation, scientific orientation, risk orientation and management orientation. The characteristics of farmers are important in understanding and predicting their behaviour. In the absence of direct studies examining the influence of such characteristics on the dependent variables, the results of other closely related studies available on these lines have also been organised and presented below.

2.6.1. Family educational status

Family educational status could be an important aspect which could influence one's outlook about the world around him. An individual's behaviour could be influenced by the family background to which he belongs. Hence it was desirable to find out whether the family educational status of farmers would exert any significant influence on their knowledge about, attitude towards, adoption of and perception about the utility and practicability of plant protection technology.

Deepali(1979) found that the family educational profile was positively related with the degree of participation of rural women in the adoption of agricultural operations.

Seema(1986) reported a non - significant relationship of family educational status with role perception. Latha(1990) reported that family educational status did not have any significant association with the perception of users about efficiency of biogas technology. Sushama(1993) observed a non significant relationship between family educational status and evaluative perception of certificate holders in vocational higher secondary education in agriculture.

2.6.2. Farm size

Farm size has an important bearing on farmer's economic conditions which speaks of the farmer's capacity of input utilisaion reflecting upon his behaviour.

Haraprasad(1982) and Jeyaraman(1988) reported a positive and significant relationship between farm size and knowledge of farmers about improved farming practices. Godhandapani(1985), Rathinasabapathi(1987) and Venugopalan (1989) reported a non-significant relationship between farm size and knowledge level of farmers.

Mani(1980) observed a positive and significant association between farm size and attitude of turmeric growers towards regulated market. Pathak(1981), Chenniappan(1987) and Latha(1990)reported that farm size had positive and highly significant relationship with attitude of farmers towards agricultural practices.

Prakash(1980) reported that there was no significant relationship of farm size with farmers' attitude towards settled agriculture. Ravichandran(1980), Prabhu(1988) and Sajeevchandran(1989) also reported similiar findings.

Prakash(1980) and Rajapandi(1983) reported positive and significant relationship between farm size and adoption behaviour of farmers. Similiar findings were also reported by Nirmalkumar et al.(1969), Vijayakumar(1983), Chenniappan(1987), Palani(1987), Uddin (1987), Aziz(1988), Gogoi and Gogoi(1989), Sajeevchandran (1989), Vijayan(1989) and Athimuthu(1990).

Chandrakantan(1973), Ravichandran(1980), Meera(1981), Godhandapani(1985), Rathinasabapathi(1987), Grieshop et al.(1988), Selvakumar(1988), Theodore(1988), Govind(1992) and Jnanadevan(1993) reported a non-significant relationship between farm size and extent of adoption.

Latha(1990) reported that farm size did not have any significant association with the perception of users about efficiency of bio-gas technology.

2.6.3 Annual income

Annual income has an important role in making available the required amount of money essential for various farming operations. Availability of money may influence the various farming and related activities of farmer.

Patil(1985) and Chenniappan(1987) reported a significant relationship between knowledge and annual income of farmers. Venkatapirabu(1988) reported a significant and positive relationship of annual income with knowledge of farmers.

Venugopalan(1989) interpreted that annual income showed a non-significant relationship with level of knowledge among small and big farmers.

Rajapandi(1983), Viju(1985), Palani(1987), Aziz(1988), Napit *et al*.(1988), Athimuthu(1990) and Govind(1992) found that annual income had positive and significant relationship with extent of adoption whereas Theodore(1988) reported a negative relationship between annual income and adoption.

Latha(1990) revealed that annual income had a positive and significant relationship with the extent of adoption.

Muthukrishnan(1982) and Balan(1987) observed that annual income and perception had positive relationship with each other.

Sudha(1987) and Latha(1990) stated that income had a positive and significant association with the perception of farmers.

2.6.4. Farming experience

Farming experience is related to the farmer's exposure and expertise in farming and related activities. Farming experience influences the farmers in taking efficient decisions and execution which reflects upon the behaviour of farmers.

Jeyakrishnan(1984) and Jnanadevan(1993) stated that farming experience showed positive and significant relationship with knowledge. Marimuthu(1982), Rathinasabapathi(1987), and Venugopalan(1989) reported that farming experience showed non-significant relationship with knowledge level of farmers.

Godhandapani(1985) revealed that farming experience was found to be negatively and significantly related with knowledge.

Ravichandran(1980) revealed that farming experience had a positive and significant relationship with attitude of registered sugarcane growers towards sugar factory. Jnanadevan(1993) reported a positive and significant relationship of farming experience with attitude of farmers.

Krishnakumar(1987) and Prabhu(1988) reported that farming experience had no significant relationship with farmer's attitude towards soil conservation practices.

Kumbar(1983), Godhandapani(1985), Palani(1987) and Grieshop et al.(1988) reported a positive and significant relationship between farm experience and extent of adoption. Binoo(1991) observed that experience in vegetable cultivation had significant positive association with extent of adoption of improved vegetable cultivation practices. Jnanadevan(1993) reported a positive and significant relationship between farming experience and adoption of recommended practices.

Ravichandran(1980), Sridaran (1981), Marimuthu(1982) and Ramaswamy(1983) observed a non-significant association between farm experience and extent of adoption. Similiar findings were also reported by Uddin(1987), Rathinasabapathi(1987), Selvakumar(1988), Theodore(1988) and Athimuthu(1990). Jaleel(1992) observed a negative and significant correlation between farm experience and adoption.

2.6.5. Cosmopoliteness

The extent of contact of farmers with outside village such as visiting the nearest town, the purpose of visit and the membership in organisations outside the village may influence their behavioural pattern.

Vijayakumar(1983) and Swamy(1988) reported that cosmopoliteness of farmers had a significant relationship with their attitude.

Kamarudeen(1981) stated that cosmopoliteness was non-significantly related to attitude in the case of neighbouring farmers.

Ahamed(1981), Kamarudeen(1981), Ferreira *et al.*(1983), Vijayakumar(1985), Viju(1985), Mahadevaiah(1987), and also Uddin (1987) and Olowu *et al.*(1988) reported positive relationship between cosmopoliteness and adoption. Jaleel(1992) and Ramachandran(1992) observed positive and significant correlation between cosmópoliteness and adoption.

Kamarudeen(1981), Oka (1988) and Syamala(1988) observed the relationship between cosmopoliteness and adoption as non-significant.

2.6.6. Economic motivation

Economic motivation acts as a striving force to a farmer to make more money out of his farming and other related activities. It is a process directed towards profit augmentation and farmers with different levels of economic motivation may show varied patterns of behaviour.

Janakiramraju (1978) and Jeyakrishnan(1984) observed positive relationship between economic motivation and knowledge of farmers about agricultural practices.

Jayavelu(1980) observed a positive and significant relationship between economic motivation of cotton growers and their attitude towards regulated market. Jnanadevan(1993) reported a positive and significant relationship of economic motivation with attitude of farmers. Fathimabi(1993) reported that economic motivation had non-significant relationship with attitude.

Nair(1969) and Rajendran(1978) reported a positive and significant relationship between economic motivation and adoption behaviour. Similiar results were also reported by Sukla (1980), Krishnamoorthy(1984), Balan(1987), Sajeevchandran(1989), Pillai (1989) and Juliana et al.(1991). The studies of Balu(1980) and Anithakumari(1989) revealed that economic motivation had a non-significant association with adoption. Manivannan(1980), Gogoi and Gogoi(1989) and Jnanadevan(1993) reported negative relationship between economic motivation and adoption behaviour.

2.6.7. Crop yield index

Crop yield index gives an idea about the per acre yield of major crops of the farmers or the average yield of those crops in the village and it may have an influence on the farmers' behaviour.

Channegowda(1971) reported a significant correlation between crop yield index and adoption behaviour of farmers. Similar findings were also reported by Samantha(1977), Ramalingagowda(1978), Bhaskaran(1979), Rannorey(1979), Sreekumar(1985), Mahadevaiah (1987), Syamala(1988) and Ramachandran(1992).

2.6.8. Contact with extension agency

Contact of farmers with extension agency could influence very much their farming behaviour. Farmers gain a lot of information through their contacts with extension agencies which would help them to implement profitable technologies in their farms.

Manivannan(1980), Kamarudeen(1981), Marimuthu (1982), Senthil(1983), Jeyakrishnan(1984), Krishnamoorthy (1984), Anandarao(1988), Jeyaraman(1988), Syamala(1988), Govind(1992) and Jnanadevan(1993) found positve and significant correlation between contact of farmers with extension agency and their level of knowledge. Venugopalan(1989) interpreted that contact with extension agency showed a non-significant relationship with extent of knowledge among small farmers.

Ravichandran(1980), Kamarudeen(1981), and Nelson(1992) revealed that degree of contact with extension agency had a positive and significant relationship with attitude of farmers. Jayavelu(1980) reported that farming experience had a negative and significant relationship between the degree of contact with extension agency and their attitudes. Fathimabi(1993) reported that contact with extension agency had a non-significant relationship with attitude.

Venkataraman(1987), Jeyaraman(1988), Krishnamoorthy(1988), Selvakumar(1988), Syamala(1988), Vijayan(1989), Juliana et al.(1991), and Govind(1992) observed positive and significant relationship between extension agency contact of farmers and adoption of integrated pest managment technology. Jnanadevan(1993) found that contact with extension agency was negatively and significantly related with adoption behaviour of farmers.

2.6.9. Information source utilisation

Various plant protection practices evolved at research stations or national centres are often different from farmer's actual practices. Information sources have important role in shaping the behaviour of farmers. Kamarudeen(1981) reported that information source utilisation had a positive and significant relationship with attitude of farmers.

Prakash(1980), Viju(1985), Sagar and Pal(1986), Theodore(1988), Athimuthu(1990) and Govind(1992) reported a positive and significant relationship between information source utilisation and adoption behaviour of farmers.

2.6.10.. Scientific orientation.

The scientific inclination of farmers help to motivate them to attain excellence in cultivation. Farmers with high scientific orientation are more inclined to new ideas and methods of scientific nature.

Manivannan(1980), Kamarudeen(1981), Senthil(1983), Syamala(1988) and Jnanadevan(1993) reported that knowledge level of farmers had postive and significant correlation with scientific orientation.

Subburaj(1980) reported that scientific orientation was positively and significantly related to attitude of regular credit users. Nelson(1992) reported that scientific orientation of Karshika Vikasana Samithi members had positive and significant association with their attitude towards Krishi bhavans. Reddy(1987) and Jnanadevan(1993) reported positive and significant relationship of scientific orientation with attitude of farmers.

Jayapalan(1985), Krishnaiah (1986) Prasannan(1987), Anithakumari(1989) and Sajeevchandran(1989) reported positive and significant relationship between scientific orientation and adoption behaviour. Similiar findings were reported by Umale _et al_.(1991), Ramachandran(1992) and Jnanadevan(1993). But Swaminathan(1986) reported the relationship as not significant. Binoo(1991) observed that scientific orientation had a significant and negative relationship with adoption of improved vegetable cultivation among farmers.

2.6.11. Risk orientation

Farming operations suffer from certain inherent risks. Farmers have to plan production and resources use in an atmosphere of imperfect knowledge. Farmers are different in their capacity to take risks which may reflect upon their behaviour in total.

Kamarudeen(1981) found positive and significant correlation between risk orientation and level of knowledge of farmers. Jeyakrishnan(1984) also reported that risk orientation showed positive and significant relationship with knowledge. Krishnamoorthy(1984), Rathinasabapathi(1987), Anandarao(1988) and Govind(1992) also reported similar findings, while Venugopalan(1989) reported that risk preference showed a non-significant relationship with extent of knowledge among small farmers.

Nair(1969) reported a positive relationship between risk orientation and adoption behaviour of farmers. This was also reported by Singh and Sahay(1970), Anithakumari(1989), Juliana et al.(1991),Jaleel(1992) and Govind(1992) Jeyakrishnan(1984), Nanjaiyan(1985) and Rathinasabapathi(1987) found that risk orientation had positive and highly significant relationship with extent of adoption.

Non significant relation between risk orientation and extent of adoption was reported by studies conducted by Balu(1980), Anandarao(1988) and Selvakumar(1988). Theodore(1988) reported similar findings among both contact and non-contact farmers.

2.6.12. Management orientation

Farmers differ in the degree to which they are oriented towards scientific farm management. Effective management of farm is essential to secure maximum continuous profit. Farmer's orientation to management may influence behavioural pattern in turn.

Kamarudeen(1981) found positive and significant correlation between management orientation of farmers with their level of knowledge. Anantharaman(1991) found that managerial efficiency of the farmers was related to their knowledge level.

Bhaskaran(1979),Kamarudeen(1981), Thimmappa(1981), Patil(1985), Sreekumar(1985), Syamala(1988), Saed(1989) and Ramachandran(1992) found significant relationship between management orientation and adoption behaviour. of farmers, while Al-Mogel(1985) reported contradictory results in this regard. Ramachandran(1992) reported that management orientation showed positive and significant relationship with the adoption of recommended practices by the participant farmers.

All the independent and dependent variables, mentioned above showed different types of relationship with each other. The individual characteristics mentioned accounts for most of the variability in human behaviour. Hence it was decided to include these variables in the study.

2.7. Constraints experienced by farmers in the adoption of plant protection technology

Lanjewar and Kalantri (1985) had treated any problems faced by farmers in their farming activities of production, credit and marketing as managerial problems.

Pandya and Trivedi(1988) defined constraints as those items of difficulties or problems faced by individuals in adoption of technology.

Problems in the adoption of plant protection technology felt by farmers were reviewed and presented here, along with certain closely related studies.

Tripathy et al.(1982)found water management as the most important crucial factor(20.34 per cent) followed by disease and pest control(17.92 per cent) and nitrogen application(12.37 per cent) in rice cultivation.

Prasannan(1987) found that non-availability of inputs in time, non-availability of plant protection equipments in time, non-availability of labour, high labour cost involved and high cost of materials were the constraints experienced by contact farmers for adoption of messages on coconut cultivation.

Theodore(1988) identified 'no previous experience of summer ploughing', 'high cost and non-availability of recommended variety', 'not practised by neighbouring farmers', 'no knowledge, complexity', 'no interest and lack of guidance' as problems in adopting seed treatment with fungicide.

Venkatapirabu(1988) stated that lack of adequate and timely supply of water was the major constraint in adoption and improper drainage was also expressed as a problem in cultivation

Prakash(1989) identified high wage rate, small sized holdings, incidence of pests and diseases and non-availability of inputs in time as the major constraints in rice cultivation.

Tantray and Nanda(1991) identified that the major constraints felt by rice farmers in employing the full potential of advanced technology were economic difficulties and lack of timely input availability. Govind(1992) observed that lack of assured irrigation was found to be the most serious constraint among both the IPM and non-IPM farmers. Inadequacy of inputs and package deals along with subsidy were found to be the second and third important constraints experienced by a larger percentage of farmers.

Ramachandran(1992) reported that the major constraints felt by participant farmers were lack of input supply in time, lack of timely guidance and supervision, lack of information regarding the package of practices recommendations of the variety and poor quality of seeds.

2.8. Theoretical model of the study.

The theoretical model of the study developed based on the objectives and the theoretical orientation presented, is diagramatically represented in FIG. 1. The outermost circle with twelve segments represents the twelve independent variables encompassing the characteristics of farmers. These characteristices are connected to the five inner concentric segments which represent the dependent variables, viz., knowledge, attitude, adoption, utility perception and practicability perception. These are again connected to the inner most circle representing the six methods of plant protection technology indicating that plant protection technology would be influenced by the dependent variables which would in turn be determined by the

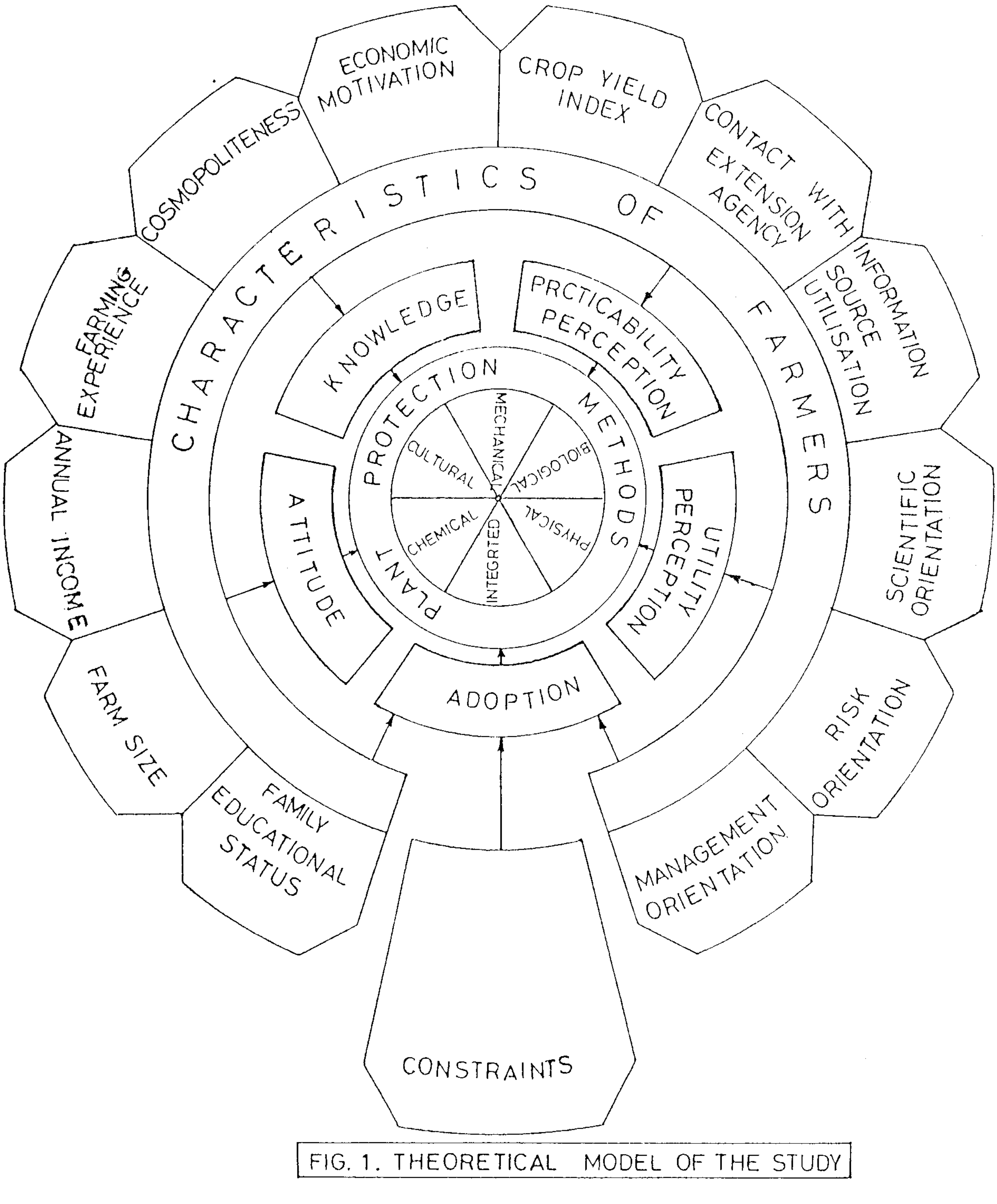


FIG. 1. THEORETICAL MODEL OF THE STUDY

independent variables. The outermost, one segment, representing constraints is connected to adoption indicating that constraints are supposed to influence the adoption of plant protection technology.

METHODOLOGY

3. METHODOLOGY

The research methodology followed in the study is presented under the following heads.

3.1. Locale of research.

3.2. Selection of respondents.

3.3. Selection of plant protection methods.

3.4. Selection and operationalisation of variables and their measurements.

3.5. Procedure employed in data collection.

3.6. Statistical tools employed.

3.7. Hypotheses set for the study.

3.1. Locale of research

The study was undertaken in two districts of Kerala viz., Thiruvananthapuram and Alappuzha with main emphasis on paddy and vegetables concentrating on the differential adoption of plant protection technology by farmers owing to the following reasons.

a) Paddy and vegetables are two important crops with food value to the people of Kerala.

b) These crops are subjected to intensive and extensive use of plant protection chemicals and

c) these two crops are grown extensively in the districts of Thiruvananthapuram and Alappuzha.

It is also important that the per hectare consumption of plant protection chemicals in different districts of Kerala ranged from the lowest value of 0.14 kg/ha of cropped area in Thiruvananthapuram district to the highest value of 1.11 kg/ha of cropped area in Alappuzha district. (Directorate of Economics and Statistics, 1990-91) A map showing the location of the study is furnished in FIG.2.

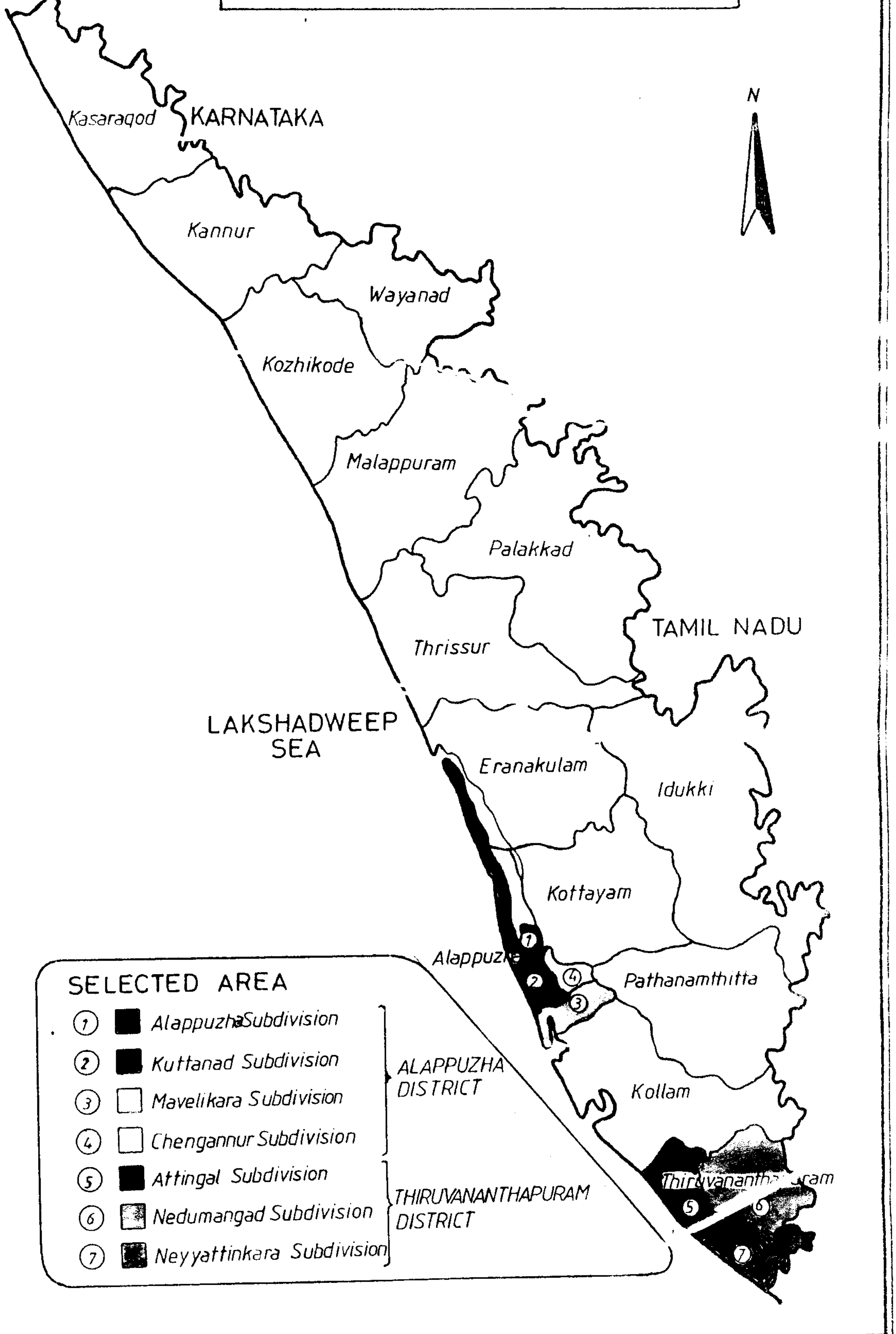
3.2. Selection of respondents

The respondent-farmers were selected from the study area based on stratified random sampling procedure.

3.2.1. Selection of Krishi Bhavans

There are three agricultural subdivisions in the district of Thiruvananthapuram and four in the district of Alappuzha. Stratified two stage sampling technique was adopted for the selection of respondents from these agricultural subdivisions. The subdivisions of both the districts constituted the strata. From each subdivision, two Krishi Bhavans each where both paddy and vegetables were

FIG. 2. MAP SHOWING LOCATION OF THE STUDY



cultivated extensively, were selected randomly which formed the first stage units. Altogether six Krishi Bhavans were selected from the three subdivisions in Thiruvananthapuram district and eight Krishi Bhavans from the four subdivisions of Alappuzha district.

3.2.2. Selection of respondents

The study was concerned with the differential adoption of plant protection technology by the farmers who cultivate both paddy and vegetables. In consultation with the Agricultural Officer of the selected Krishi Bhavan, a list of farmers who cultivate both paddy and vegetables was prepared separately for each Krishi Bhavan. From each selected Krishi Bhavan in Thiruvananthapuram district 20 farmers each were chosen randomly to constitute 120 farmers. In Alappuzha district, from each Krishi Bhavan, 15 farmers each were chosen randomly to constitute 120 farmers. Thus, altogether 240 farmers were selected for the study from both the districts which formed the second stage units. The selected agricultural subdivisions, Krishi Bhavans and number of respondents are presented in Table 1.

3.3. Selection of plant protection methods

In accordance with the objectives of the study,

Table 1. Selected Krishi Bhavans and number of farmers.

District	Subdivision	Krishi Bhavan	Number of farmers per Krishi Bhavan	Number of farmers per district
1. Thiruvanthapuram	1.Neyyattinkara	1.Kalliyoor	20	
		2.Venganoor	20	
	2.Nedumangadu	1.Anadu	20	
		2.Vembayam	20	120
	3.Attingal	1.Chempazhanthy	20	
		2.Pothencode	20	
2. Alappuzha	1.Chengannur	1.Thiruvanvandoor	15	
		2.Budhannur	15	
	2.Alappuzha	1.Punnapra	15	
		2.Pattanakadu	15	120
	3.Mavelikkara	1.Kumarapuram	15	
		2.Veeyapuram	15	
	4.Kuttanad	1.Chambakulam	15	
		2.Edathua	15	
			Grand total	240

based on review of literature, discussion with experienced field level functionaries and pilot study, six methods of plant protection technology were identified. These methods were selected based on the criteria that these are applicable to all the respondents if he/she decides to adopt. The methods were chemical, cultural, mechanical, biological, physical and integrated methods of plant protection. A list of these methods was prepared and subjected to judges' rating to determine the degree of importance of these methods for adoption by the farmers in rice and vegetable production. Altogether 40 judges were involved for this purpose. The letter sent to the judges is furnished in Appendix II. The degree of importance was quantified by assigning a score of 5 for the 'most important', 4 for 'more important', 3 for 'important' and 2 for 'less important' and 1 for 'not important' responses.

The total score for all the judges, obtained for each method was calculated and the methods having 80 per cent and above the degree of importance score of judges were considered as the most important methods of plant protection. All the six methods of plant protection fell within this category and were selected for the study.

3.3.1. Selection of pests

Based on the discussion with the officers of the State Department of Agriculture, scientists, farmers and pilot study, the major pests and diseases prevalent in paddy and the vegetable crops like bhindi, brinjal, cucurbits and cowpea were identified. They are presented in Table 2.

3.3.2. Selection and categorisation of practices related to plant protection methods.

Based on review of literature, discussions with scientists and progressive farmers, various practices with possible dimensions related to the adoption of plant protection methods were identified in accordance with the objectives of the study.Practices form the part and parcel of a plant protection method .

Practices of a plant protection method referred to the activities undertaking with possible dimensions related to the adoption of that plant protection method.

According to Somasundaram(1988) dimension of technology is the technological unit which besides forming the part and parcel of the whole technology, also affect the

Table 2 Pests and diseases selected for the study.

Sl. No.	Crops	Pests/diseases
A	Paddy	1. Stem borer 2. Gall midge 3. Rice bug 4. Leaf roller 5. Case worm 6. Blast 7. Leaf spot 8. Sheath rot 9. Bacterial leaf blight
B	Vegetables	
	1. Bhindi	1. Fruit and shoot borer 2. Jassids 3. Mildews
	2. Brinjal	1. Fruit and shoot borer 2. Mealy bugs and lace wings 3. Leaf spot
	3. Cucurbits	1. Fruit fly 2. Beetles 3. Lice, thrips and other sucking pests 4. Mildews
	4. Cowpea	1. Pea aphid 2. Pod borer 3. Leaf spot

impact of the technology acceptance based on the extent of its adoption.

Dimension of a plant protection practice referred to the component or specific unit of that plant protection practice under which various sub- practices related to the adoption of that particular plant protection practice were grouped together .

Sub-practices of a plant protection practice referred to the ultimate activities carrying out under specific units/dimensions related to the adoption of that particular plant protection practice.

The various practices identified for chemical method of plant protection were grouped under the following dimensions on the lines adopted by Krishnamoorthy(1988), Athimuthu(1990) and Govind (1992).

i) Name : This referred to the nomenclature of the inputs involved in the selected plant protection practices.

ii) Quantity : This referred to the amount of inputs involved in the selected plant protection practices.

iii) Number of applications : This referred to the number of times the input involved in the selected plant protection practices were to be used.

iv) Interval of application : This referred to the duration between two consecutive operations involving the inputs of the plant protection practices.

v) Method : This referred to the way in which or procedure by which the inputs involved in the selected plant protection practices were to be used.

vi) Precautions : This referred to the carefulness required for the operation involving the inputs of the selected plant protection practices.

For cultural, mechanical, biological, physical and integrated methods of plant protection also various plant protection practices were identified with possible dimensions. A list of identified practices and sub-practices under different dimensions related to adoption of each plant protection method was prepared and subjected to judges' rating to determine the degree of importance of each of these practices and sub-practices in plant protection. In total, 40 judges were involved for the purpose. The letter sent to judges is given in Appendix II. The degree of importance was quantified by assigning a score of 5 for 'the most important', 4 for 'more important', 3 for'important' and 2 for 'less important' and 1 for 'not important'.

The total score obtained for each of the practices and sub-practices under a practice for all the judges was calculated separately and the practices or sub-practices having 80 per cent and above the degree of importance score of judges were considered as the most important practices/sub-practices of plant protection. The practices selected under each method of plant protection are detailed below.

1. Chemical method : The practices selected under the chemical method of plant protection for both paddy and vegetables were 1) selection of chemical, 2) quantity of chemical to be used/acre, 3) quantity of chemical to be taken/pump load, 4) number and interval of application and 5) method of application and precautions.

2. Cultural method : The practices included under the cultural method of plant protection in paddy were 1) summer ploughing, 2) selection of variety, 3) monitoring for pests in nursery, 4) synchronised planting, 5) plant population/sq.m., 6) weeding operation, 7) monitoring for pests in main field, 8) water management and 9) application of nitrogenous fertilizers. The practices included under cultural method of plant protection in vegetables were

1) monitoring for pests in nursery, 2) synchronised planting, 3) plant population/sq.m., 4) weeding operation, 5) monitoring for pests in main field and 6) application of nitrogenous fertilizers.

3. Mechanical method : The practices included under the mechanical method of plant protection in paddy and vegetables were 1) collection and destruction of egg masses and other stages of pests and 2) collection and destruction of affected plant parts or plants by pests /diseases.

4. Biological method : Practices related to the conservation of natural enemies were included under this method.

5. Physical method : The practices related to pest surveillance using light traps were included under this method.

6. Integrated method : The practices related to the concept of integrating the above methods of plant protection were included under this method.

3.4. Selection and operationalisation of variables and their measurements

The variables were selected based on the objectives, review of literature and discussion with scientists in K.A.U. and experts in the field of plant protection . The procedures of operationalisation and quantification of these variables are as detailed below.

3.4.1. Independent variables

3.4.1.1. Family educational status

The family educational status was operationally defined as the extent of literacy attained by the family members of the respondent. The scale developed by Shivarudrappa(1988) and adopted by Sushama(1993) was slightly modified for the present study. The scoring procedure followed was.

Category	Score
Illiterate	0
Can read and write	1
Primary school	2
Middle school	3
High school	4
College and above	5

The family educational status of the respondents was determined by summing up the scores obtained by all the members of the family.

3.4.1.2. Farm size

Farm size referred to the number of cents of land cultivated by the respondent. The number of cents of land possessed by the respondents was taken as the index of farm size. The fraction in land size was converted into the next whole number.

3.4.1.3. Annual income

Annual income referred to the net income of the respondent and his family for a year, obtained from the main and subsidiary occupations. The scoring procedure followed by Selvakumar(1988), Venugopalan(1989) and Govind (1992) was adopted. One score was assigned to every thousand rupees of annual income.

3.4.1.4. Farming experience

Farming experience referred to the actual completed years of experience of the respondent in farming. The scale developed by Venugopalan(1989) was adopted. A score of one was given to every completed year of experience in farming.

3.4.1.5. Cosmopoliteness

Cosmopoliteness of the respondents was measured by the scale developed by Desai(1981). Here cosmopoliteness was measured in terms of the frequency of visit to nearby town, purpose of visit and membership in organisations outside the village. The scoring procedure was

1. **Frequency of visit to the nearby town**	**Score**
Never	0
Once in a month	1
Once in a fortnight	2
Once in a week	3
Two/more times a week	4

2. **Purpose of visit**	**Scores**
Entertainment	0
Other purpose	1
Personal/Professional	2
Agricultural	3

3. **Membership in organisation outside the village**	**Scores**
Non-member	0
Member	1

The cosmopoliteness score was obtained by summing up the total score obtained by an individual.

3.4.1.6. Economic motivation

Economic motivation referred to the extent to which a farmer is oriented towards achievement of the maximum profit from his farm. The scale developed by Thiagarajan(1981) and adopted by Selvanayagam(1986) was used to measure the variable with slight modification. All the four statements included in the scale were positive. Based on the responses for each statement, in terms of Agree/Disagree, scores of '1' and '0' were given respectively. The scores thus ranged from 0 to 4. The scores obtained for an individual were summed up to obtain the individual economic motivation score.

3.4.1.7. Crop Yield Index

Crop Yield Index in the present study referred to the ratio of the per acre yield of paddy and vegetables cultivated by the farmer to the average yield of these crops in the village, converted to percentage.

The scale developed by Samantha(1977) and adopted by Bhaskaran (1979) and Ramachandran(1992) was used with slight modifications for the study. For calculating the crop yield index for a farmer, the average yields of paddy and vegetables in the village were first determined separately. By dividing the yield/unit area of paddy on the particular farm by the average yield of paddy in the village and multiplying by 100, a percentage index was obtained. Similarly, a percentage index was obtained for the vegetable crops also. Here the yield levels of paddy and vegetables viz., bhindi, brinjal, cucurbits and cowpea in respect of each individual farm for the two years 1991-92 and 1992-93 were found.

The percentage index obtained for each crop was multiplied by the area devoted to the cultivation for the corresponding crops to obtain the products. By adding the products and dividing the sum of the products by the total area under the crops, the crop yield index for a particular farmer for one year was found. Similarly, the crop yield indices for the two years were calculated and the average was taken as the crop yield index for a particular farmer.

3.4.1.8. Contact with extension agency

Contact with extension agency was operationally defined as the degree to which an individual maintained contacts with extension agency. Somasundaram(1976) stated that the contact with extension agency may increase one's knowledge and motivate him for adoption of innovations. The scoring procedure adopted by Krishnanmoorthy(1988) was followed to measure this variable on two dimensions of the contact in terms of frequency and purpose of contact. The scoring procedure was as follows.

a) **Frequency of contact**	**Scores**
Never	1
Sometimes	2
Regularly	3

b) **Purpose of contact**	**Scores**
Non-agricultural	1
Agricultural	2

The total score obtained by an individual on both items was taken as his score for contact with extension agency.

3.4.1.9. Information source utilisation

Information source utilisation was operationally defined as the use of various sources of information by the respondent in order to get information on agricultural technology. Here the 'source', 'individual' and 'channels' were collectively termed as 'information sources', since for practical purposes, there is no clear demarcation that could be made between 'source' and 'channel'.

Various sources of information utilised by the farmers were identified based on discussion with experienced field level functionaries, scientists and progressive farmers and categorised under personal localite, personal cosmopolite and mass media sources. The procedure adopted by Ramachandran(1974), Athimuthu(1990) and Govind(1992) was followed with slight modification. The respondents were asked to indicate the frequency of their use on a three point continuum viz., 'Never','Sometimes' and 'Regularly' with scores of 1, 2 and 3 respectively. The sum of scores obtained for an individual was his information source utilisation score. The information source utilisation score ranged from 27 to 81 in the present study.

3.4.1.10. Scientific orientation

Scientific orientation referred to the degree to which the farmer was oriented to the use of scientific methods in decision making in farming.

Scientific orientation scale developed by Supe(1969) and adopted by Ramachandran(1992) was used in the present study. The responses were collected on a five point continuum for the four statements. Three statements were positive and one was negative. The responses were collected on a five-point continuum as shown below

Responses	Scores
Strongly agree	5
Agree	4
Undecided	3
Disagree	2
Strongly disagree	1

The scoring pattern was reversed for the negative statement. The total scores thus obtained by an individual was taken as his score for scientific orientation. The possible range of score in this scale was 5 to 20. Maximum score would reveal high scientific orientation and the minimum score, low scientific orientation.

3.4.1.11. Risk orientation

Risk orientation referred to the degree to which the farmer was oriented towards risk and uncertainty in adopting new ideas in farming. The scale was developed by Supe(1969) and adopted by Venugopalan(1989) and Govind(1992).

The responses were collected on a five point continuum from strongly agree to strongly disagree. There were six statements, of which four were positive and two negative. The scoring was done as follows.

Responses	Scores
Strongly agree	5
Agree	4
Undecided	3
Disagree	2
Strongly disagree	1

The scoring pattern was reversed for negative statements. The scores obtained for each statement were summed up to get individual farmer's risk orientation score.

3.4.1.12. Management orientation

Management orientation referred to the degree to which a farmer is oriented towards scientific farm management comprising planning, production and marketing of his farm enterprises. Chari and Nandapurkar(1987) were of the opinion that farmers as the managers of agriculture enterprise are expected to maximise the profits. The scale developed by Samantha(1977) and adopted by Ramachandran(1992) was used to measure management orientation of farmers. Here the statements were grouped under three categories viz., planning, production and marketing orientation with six statements each. In each group positive and negative statements were mixed.

A score of '1' was given for agreement and '0' for disagreement. The scoring pattern was reversed for negative statements. The total score obtained by an individual for all the statements was taken as his management orientation score.

3.4.2. Dependent variables

3.4.2.1. Knowledge

Knowledge was referred to the quantum of scientific information possessed on the subject 'plant protection technology' by the respondents. Various researchers have developed items which reflect the knowledge. Bloom et al.(1955) defined knowledge as those behaviour and test situation which emphasised the remembering either by recognition or recall of ideas, materials or phenomena.

Sankariah and Singh(1967) measured knowledge of farmers on improved methods of vegetable cultivation based on teacher-made test as suggested by Anastasi(1961). Nair(1969) measured knowledge level of farmers on recommended package of practices of rice using teacher made test with multiple choice questions. Meera(1981) computed the knowledge score of farm women about improved agricultural practices as the total number of items answered correctly by the respondents. Anantharaman(1991) also calculated the total knowledge score of farmers on scientific management in crop enterprise by adding the number of items answered correctly by each respondent. The procedure followed in the present study to measure the knowledge of the farmers about plant protection methods is described in the pages that follow.

3.4.2.1.1. Collection of items

The content of the knowledge test is composed of questions called items. A pool of items was prepared with respect to plant protection methods viz., chemical, cultural, mechanical, biological, physical and integrated methods of plant protection in consultation with the subject matter specialists, agricultural officers, extension workers and progressive farmers. Since the study aims at analysing the knowledge of farmers about various practices of plant protection, inorder to have a complete understanding about the farmers' knowledge, all the items included in adoption were taken for evaluating their knowledge (Appendix IV). A teacher made test was used to assess the knowledge of farmers about plant protection technology.

3.4.2.1.2. Method of scoring

All the items were framed in the objective form to be answered by the respondents as correct/incorrect. The respondents were given a score of '1' for answering the items correctly and '0' for answering the items incorrectly. The total knowledge score for each respondent was calculated by summing up the number of items correctly answered by him.

3.4.2.1.3. Categorisation of the respondents

The knowledge levels of the farmers of Thiruvananthapuram and Alappuzha districts were found for the categorisation of farmers into low and high knowledge level categories. First the mean knowledge score was calculated for the farmers of both the districts separately. Farmers having less than the mean knowledge score were grouped under low knowledge level category and farmers having equal to or more than the mean knowledge score were grouped under high knowledge level category and the percentages worked out for easy interpretation.

3.4.2.2. Attitude of farmers towards chemical method of plant protection

An attitude scale is one that assesses the degree of affect that individual may associate with some psychological object. A number of attitude scales to measure attitude have been evolved since Thurstone advanced his theory in 1929. Among the techniques available for constructing attitude scale the Likert's summated rating is quite well known. Latha(1990) developed an attitude scale following the Likert method for measuring the attitude towards bio-gas technology. An attitude scale was developed for the purpose of present study following Likert's summated rating technique,(Likert, 1932).

3.4.2.2.1. Collection of items.

The statements from all the possible sources reflecting the attitude of farmers towards chemical method of plant protection were collected to develop a universe of content. The statements were collected through review of literature, discussion with experts from Kerala Agricultural University and Department of Agriculture and some farmers. Thus a total of 70 statements were collected. Then these statements were edited based on the criteria described by Edwards(1957) and from the total statements 54 statements were selected. Care was taken to include both positive and negative statements.

These statements were given to 40 experts in the Kerala Agricultural University, and Department of Agriculture to test their relevancy to be included in the scale. Their responses were collected in a four point continuum of Very Much Relevant(VMR), Much Relevant(MR), Somewhat Relevant(SR) and Not Relevant(NR). The scores were given as 4,3,2 and 1 for VMR, MR, SR and NR respectively. The total score for each statement given by the experts was calculated. The statements were ranked in descending order of their scores. From these, 30 statements with highest scores were selected, (Appendix III-A.)and subjected to item analysis.

3.4.2.2.2. Item Analysis

The purpose of Item Analysis is to examine how well each statement discriminates between farmers with different attitudes. Procedure suggested by Edwards(1957) was followed. These statements were administered to 60 farmers cultivating both paddy and vegetables selected randomly from non-sample areas in the districts. The farmers were asked to respond to each statement in terms of their own agreement or disagreement on a five point continuum viz., Strongly Agree(SA), Agree(A), Undecided(UD), Disagree(DA) and Strongly Disagree(SDA). The various responses were assigned numerical weights such that the response of strongly agree had a score of 5, agree 4, undecided 3, disagree 2 and strongly disagree 1 for positive statements and reverse for the negative statements.The respondents were then arranged in descending order of the total scores. From these ,25 per cent of the subjects with the highest total score and 25 per cent of the subjects with the lowest total score were taken up for item analysis.The following formula was used for evaluating the responses as the high and low group.

$$t = \frac{XH - XL}{\sqrt{\dfrac{SH^2 + SL^2}{n_H \quad n_H}}}$$

where,

X_H - the mean score on a given statement for the high group

X_L - the mean score on a given statement for the low group

S_H^2 - the variance of the distribution of responses of the high group to the statement

S_L^2 - the variance of the distribution of responses of the low group to the statement

n_H - the number of subjects in the high group

n_L - the number of subjects in the low group

The value of 't' is a measure of the extent to which a given statement differentiates between the high and low groups .As an appropriate rule of thumb any value of 't' equal to or greater than 1.75 only was considered. Statements with 't' values were arranged in ascending order of magnitude and nine statements having the maximum 't' value were selected for the final scale of which five were positive and four were negative statements .The statements with their 't' values are furnished in Appendix III-B.

3.4.2.2.3. Reliability of the scale

Test-retest method was used to establish the reliability of the developed attitude scale. The scale was administered twice to 30 non sample farmers at 15 days interval. The two sets of scores were correlated and the correlation coefficient(r) was estimated. The correlation coefficient(0.82) was significant at 0.01 level and thus the scale was found reliable.

3.4.2.2.4. Validity of the scale

The attitude scale was checked for its content validity. This is a kind of validity obtained by assumption. The main criterion here is how well the contents of the scale represent the subject matter under study. This was ensured by perusing relevant literature, discussion with social scientists, extention workers in the field and progressive farmers for the collection and the selection of statements for the construction of the scale. Care was taken to include all the statements covering the universe of content, relating to the farmer's attitude towards chemical method of plant protection .

3.4.2.2.5. Administration of the attitude scale

The attitude scale developed was administered to the respondents at the time of data collection and their attitude towards chemical method of plant protection was measured on a five point continuum.

3.4.2.2.6. Method of scoring

The responses of farmers for the nine statements were obtained on a five point continuum of strongly agree to strongly disagree. The scores alloted were 5,4,3,2 and 1 in that order for positive items and the reverse for negative items. The attitude score of an individual was found out by summing up the scores for all statements of an individual.

3.4.2.2.7. Categorisation of the respondents

The mean attitude scores were worked out separately for the farmers of Thiruvananthapuram and Alappuzha districts. The farmers of both the districts were classified separately into the following categories and their percentages worked out for easy interpretation.

1. Unfavourable - Those possessing less than mean attitude score and expressed in percentage and

2. Favourable - Those possessing equal to or more than mean attitude score and expressed in percentage.

3.4.3. Adoption of plant protection technology by farmers

Adoption of plant protection technology referred to the practice of following recommended plant protection methods by farmers.

Various methods have been developed to measure the adoption behaviour by several researchers. Ernest(1973), Anantharaman(1977), and Chandrakandan(1982) measured the adoption of agricultural practices based on actual/recommended model. Selvakumar(1988) followed an indepth practice analysis by identifying seven sub-practices for studying the adoption of one major practice viz., control of white fly on cotton. Krishnamoorthy(1988), Athimuthu(1990) and Govind(1992) also identified various technological units for measuring adoption of agricultural innovations. Realising the merits of this procedure, in the present study, the adoption behaviour was measured with the help of a Plant Protection Adoption Index developed exclusively for the study.

3.4.3.1. Fixing weightage score

The identified practices and sub-practices under various dimensions related to each plant protection method were referred to 40 judges. They were requested to assign a score, ranging from 1-10 for each of the practices and subpractices of plant protection based on their importance in rice and vegetable production. The letter sent to judges is given in Appendix IV. The mean importance score was taken as the weightage for each of the practice and sub-practices The importance score arrived at are also given in Appendix IV.

3.4.3.2. Computing extent of adoption score

The next step in the procedure of developing Plant Protection Adoption Index was computing the extent of adoption. The extent of adoption of the selected plant protection methods was measured based on actual/recommended model for certain practices and also on adoption or non adoption for certain practices. First, for the actual/recommended model, the actual/recommended for each of the plant protection sub-practices coming under a practice of adoption of plant protection method was calculated(Appendix VI). It was then multiplied by the corresponding weight of that particular sub-practice to get the extent of adoption of that sub-practice. These extent of adoption of sub-practices were summed up for a particular practice and divided by the number of sub-practices for which the values were added. This value is then multiplied by the corresponding weight of the practice under which the sub- practices were included to get the extent of adoption of that particular practice of a plant protection method. Similiarly the extent of adoption of all the practices coming under a plant protection method for which this model was applicable were calculated and summed up to obtain the extent of adoption of the practices under a plant protection method. Similiarly the extent of adoption of all the methods were computed.

The adoption score for the practice, 'precautions to be undertaken while using the plant protection chemicals' under chemical method of plant protection was calculated for each respondent separately as detailed below. For this a score of '1' was given for adoption and '0' for non-adoption. The total score obtained by an individual for the five statements was taken as his adoption score for the same. This score was added to the adoption score obtained for chemical method of plant protection based on the actual/recommended model to arrive at the total adoption score for chemical method of plant protection for each individual. Similiarly, adoption score for integrated method of plant protection was found out by assigning a score of '1' for adoption and '0' for non-adoption. By summing up the scores obtained for all the statements by an individual, the total adoption score for this method was arrived at. For computing the overall adoption score of an individual, first the adoption scores for all the selected methods viz., chemical, cultural, mechanical, biological, physical and integrated methods of plant protection for each individual were calculated for the crops paddy and vegetables - bhindi, brinjal, cucurbits and cowpea separately. The Plant Protection Adoption Index for each individual was computed by the summation of the adoption scores obtained for all the methods for both the crops viz., paddy and vegetables for an individual. The mean adoption scores were worked out separately for the farmers of both the districts, Thiruvananthapuram and Alappuzha.

3.4.3.3. Categorisation of the respondents

The farmers having less than mean adoption score were grouped under 'low adoption category' and those having equal to or more than mean adoption score were grouped under 'high adoption category' for both the districts separately and percentages worked out for adoption of the different selected methods of plant protection and the overall adoption of plant protection methods. With regard to the adoption of chemical method of plant protection, the farmers were categorised into 'correct adopters', who adopt correctly and fully the recommended plant protection practices and also into'incorrect adopters' who were actually the 'lower' and 'excess adopters' of the chemical plant protection practices. The farmers whose actual adoption of plant protection practices were found less than the recommended level were grouped under, 'lower' adopters' and whose actual adoption of plant protection practices were found more than the recommended level were grouped under 'excess adopters' and percentages worked out for easy and correct interpretation.

3.4.4. Perception of farmers about the utility and practicability of plant protection methods.

Perception of farmers referred to the process by which the farmers get awareness about the impact of object or events or characteristics of pesticidal application or environmental aspects by means of sensory organs.

Rogers(1983) reported that the properties of a given idea act as a stimuli and their perception by an individual influences his behaviour. Perception of farmers about the utility and practicability of plant protection methods referred to the process by which the farmers become aware of the utility and practicability of objects, events or characteristics of plant protection methods by means of sensory operations. The perception influences the adoption behaviour of an individual.

3.4.4.1. Method of scoring

Farmer's perception about the utility of plant protection methods was measured on a three point continuum having scores 3,2 and 1 for 'Extremely useful', 'Useful' and 'Not useful' repectively. Similarly perception about practicability of plant protection methods was also collected on a three point continuum having scores 3, 2 and 1 for 'Extremely practicable','Practicable' and 'Not practicable' respectively. The total scores for both utility and practicability perceptions were calculated separately by summing up all the scores obtained by an individual respectively.

3.4.4.2. Categorisation of respondents

The perception level of the farmers of both the districts of Thiruvananthapuram and Alappuzha were calculated separately for utility as well as practicability perception. The mean utility perception score and the mean practicability score were calculated separately for the farmers of both the districts. The farmers having less than the mean perception score were grouped under 'low perception category' and the farmers having equal to or more than mean perception score were grouped under 'high perception category' separately for both utility and practicability perceptions of the farmers of the two districts. The percentage of farmers under each category was worked out for easy interpretation.

3.4.5. Perception of farmers about indigenous practices of plant protection being practised by them

A list of indigenous practices of plant protection being practised by the farmers for paddy and vegetables namely bhindi, brinjal, cucurbits and cowpea was prepared and referred to 40 judges. The letter sent to judges is furnished in Appendix V. They were asked to rate the effectiveness and scientific rationality for each practice separately on a 4 point continuum having scores 4,3,2 and 1 for 'Highly effective','Moderately effective','Least effective' and 'Not at all effective' and also for 'Highly rational','Moderately rational','Least rational' and 'Not at all rational'. The pooled mean scores were calculated for effectiveness and scientific rationality of practices separately and ranked for meaningful interpretation.

3.4.6. Perception of farmers about the impact of pesticides on environmental aspects

Bohlen and Beal(1960) postulated that an individual's response or action is the result of perception of a stimulus which implies the behaviour as motivated by the stimulus. Here impact of pesticides on environmental aspects as perceived by the farmers of Thiruvananthapuram and Alappuzha districts was studied. Based on review of literature, discussion with specialists in K.A.U. and progressive farmers ten areas covering all aspects of environmental impact and pollution by pesticides were identified. Statements were prepared based on these and the responses of the farmers were obtained on a three point continuum of 'Very correct', 'Correct' and 'Not at all correct'. A score of '3' was given to 'Very correct', '2' to 'Correct' and '1' to 'Not at all correct' for positive statements. The scoring pattern was reversed for the negative statements.

The mean perception score for each statement for the entire respondents was calculated. The farmers were categorised into low and high perception categories based on their mean scores. Those,obtained scores less than the the mean score were grouped under low perception category and those, obtained a score equal to or more than the mean score were grouped under high perception category for easy interpretation.

3.4.7. Constraints experienced by farmers in the adoption of plant protection technology

Constraints become a major theme for transfer of technology research. Pandya and Trivedi(1988) defined constraints as those items or difficulties or problems faced by individuals in the adoption of technology. Based on the discussion with farmers, scientists, extension workers, review of relevant literature and experience of the researcher, various constraints were identified and enlisted. The farmers were asked to indicate whether they were experiencing these constraints or not in the adoption of plant protection technology. The frequency of responses for each of the constraints was found separately and the percentages were calculated and ranked to facilitate easy inference.

3.4.8. Suggestions to overcome the constraints in the adoption of plant protection technology given by the farmers and experts.

The farmers were asked to suggest solutions for the constraints experienced by them in the adoption of plant protection technology. Based on discussion with forty experts in the field of plant protection, the solutions suggested by them to solve the constraints put forward by the farmers in the adoption of plant protection technology were also enlisted. The frequency responses for each of the suggestions given by both the farmers and experts were obtained separately, percentages calculated and ranked to facilitate easy inference.

3.5. Procedure employed in data collection

3.5.1. Construction of Interview Schedule

Based on discussions with farmers, scientists and extension workers and review of literature the researcher acquired sufficient knowledge in the area. Then an interview schedule was prepared in confirmity with the objectives of the study. The interview schedule was pretested in a pilot study before finalisation. Adequate caution was exercised to make the schedule unambiguous, clear, complete, comprehensive and understandable. The copy of the finalised schedule is presented in Appendix I.

3.5.2. Method of Data Collection

The data were collected using a pretested and well structured interview schedule for the purpose of study. The schedule consisted of three parts. Part I dealt with the collection of information on various independent variables under study. Part II dealt with the attitude of farmers towards chemical method of plant protection, farmers' knowledge about,and adoption of plant protection technology and also their perception about the utility and practicability of plant protection methods. Part III-A dealt with the collection of information on the indigenous practices of plant protection followed by farmers and perception of farmers about the impact of pesticides on environmental aspects. While part III-B was meant to collect data on the constraints experienced by farmers along with the suggestions to overcome the constraints in the adoption of plant protection technology.

The final interview schedule prepared was administered to the respondent farmers in the selected area in Thiruvananthapuram and Alappuzha districts. The data collection was carried out during July 1993 to January 1994.

3.6. Statistical tools employed

The data collected from the respondents were scored, tabulated and analysed using suitable statistical methods. The statistical analysis was done using computer facilities available at the College of Agriculture, Vellayani.

The following statistical methods were used in this study based on the nature of the data and relevant information required.

3.6.1. Mean

The mean scores for all the variables were worked out to make suitable comparisons wherever necessary.

3.6.2. Percentage analysis

The percentage analysis was done to make simple comparisons wherever necessary.

3.6.3. Simple correlation analysis

Simple correlation analysis was done to study the relationship between each of the independent variables and dependent variables.

3.6.4. Independent 't' test

Independent 't' test was used to find out the test of significance between mean scores, wherever necessary.

3.6.5. Multiple Regression Analysis

The test was carried out to determine the combined contribution of the independent variables considered for the variations in the dependent variables. The test was also carried out to find the variables which have contributed significantly for the changes in the dependent variables.

The square of the multiple correlation coefficient(R) ie the coefficient of determination (R2) was worked out which represented the proportion of the total variation explained by the independent variables in the regression equation taken together. The partial regression coefficient or partial 'b' were obtained for the variables included in the regression equation. The following prediction equation was used in the present study to determine the multiple regression.

$$Y = a + b1\ x1 + b2\ x2 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots bn\ xn$$

where a = constant

b1 = the coefficient which appears in the equation which represents the amount of change in Y that can be associated with unit increase in 'x1' with the remaining independent variables held fixed. This is referred to as partial regression coefficient or partial 'b'.

x1, x2,........xn = the independent variables.

Y = the dependent variable.

A correction was made to bring the measurements of the independent variables to a single unit. The correction was effected by standardising each partial 'b' value using the standard deviation of the respective variable. A standard 'b' called the beta weight of the partial coefficient was computed by the following formula.

$$\text{Beta weight} = \frac{\text{S.D of independent variable}}{\text{S.D of dependent variable}} \times \text{partial 'b'}$$

The absolute values of these beta weights indicated the relative importance of the independent variables in the regression equation.

3.7. Hypotheses set for the study

In the light of postulated relationship of variables as per the theoretical orientation of the study, based on the objectives and assumptions, relevant hypotheses were formulated and are as follows.

1. There would be no significant difference between the farmers of the two districts with respect to their characteristics(independent variables).

2. There would be no significant difference between the farmers of the two districts with respect to the dependent variables.

3. There would be no significant relationship between the independent and dependent variables selected for the study.

4. There would be no significant contribution of the independent variables in the variation of the dependent variables selected for the study.

5. There would be no significant relationship among the dependent variables selected for the study.

RESULTS AND DISCUSSION

4. RESULTS AND DISCUSSION

Keeping in view of the objectives of the study, the results of the study are presented and discussed under the following sub heads.

4.1. Analysis of the characteristics of farmers.

4.2. Analysis of the dependent variables of the study.

4.2.1. Knowledge of farmers about plant protection methods.

4.2.2. Attitude of farmers towards chemical method of plant protection.

4.2.3. Adoption of plant protection methods by farmers.

4.2.4. Utility perception of farmers about plant protection methods.

4.2.5. Practicability perception of farmers about plant protection methods.

4.2.6. Comparison of the dependent variables of the study.

4.3. Relationship between the independent and dependent variables of the study.

4.4. Indigenous practices of plant protection followed by farmers.

4.5. Perception of farmers about the impact of pesticides on environmental aspects.

4.6. Constraints experienced by farmers in the adoption of plant protection technology.

4.7. Suggestions to overcome the constraints in the adoption of plant protection technology as perceived by farmers and experts in the field of plant protection.

4.8. Empirical model of the study.

4.1. Analysis of the characteristics(independent variables) of the farmers

A comparison of mean scores, and 't' values testing the significance of difference between mean scores for the selected characteristics of farmers of the two districts, Thiruvananthapuram and Alappuzha is presented in Table 3.

It is interesting to see from Table 3 that there was significant difference between the farmers of Thiruvananthapuram and Alappuzha districts with respect to their mean scores of annual income, farming experience, crop yield index, information source utilisation, scientific orientation, risk orientition and management orientation.

The same table also shows that there existed no

Table 3. The characteristics of farmers of Thiruvananthapuram(TVM) and Alappuzha(ALPA) districts.

Sl. No.	Characteristics	TVM(n=120) Mean score	ALPA(n=120) Mean score	't' value
1.	Family educational status	11.48	11.48	0
2.	Farm size	328.33	330.46	0.07NS
3.	Annual income	17.33	25.86	5.21**
4.	Farming experience	10.96	12.79	2.15*
5.	Cosmopoliteness	6.03	5.93	0.64NS
6.	Economic Motivation	3.19	3.18	0.19NS
7.	Crop yield index	84.74	90.55	5.29**
8.	Contact with extension agency	30.74	33.26	0.79NS
9.	Information source utilisation	65.88	63.42	2.00*
10.	Scientific orientation	15.92	16.78	4.94**
11.	Risk orientation	25.10	25.63	2.05*
12.	Management orientation	13.95	12.59	5.89**

** Significant at 1% level

* Significant at 5% level

NS Not significant

significant difference between the two groups of farmers in their mean scores for their family educational status, farm size, cosmopoliteness, economic motivation and contact with extension agency.

It may be inferred from the above results that the farmers of Thiruvanthapuram and Alappuzha districts differed significantly with reference to their seven characteristics viz., annual income, **farming experience** crop yield index, information source utilisation, scientific orientation, risk orientation and management orientation, while they were not significantly different with respect to their family educational status, farm size, cosomopoliteness, economic motivation and contact with extension agency. Based on the mean scores it may be stated that the farmers of Alappuzha district who had more annual income, **farming** experience and more crop yield index possessed high scientific orientation and high risk orientation .

In order to acheive brevity, the significant characteristics alone were taken for discussion.

The farmers of Alappuzha district were found to have significantly higher annual income than the farmers of

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Thiruvananthapuram district. It was also noticed from the same table that the farmers of Alappuzha district also registered higher crop yield index. They were also characterised by more farming experience which might have helped them to achieve higher yields and earn more income. Better economic security enabled them to develop higher risk taking capacity. This coupled with better orientation towards scientific technology would have made tangible contribution to better yields and income.

The characteristic, namely information source utilisation also registered significant difference among the farmers of the two districts. The farmers of Thiruvananthapuram district utilised more information sources compared to the farmers of Alappuzha district. This might be due to the fact that the farmers of Thiruvananthapuram district had utilised the information sources to a greater extent since they might have got better opportunity and facilities to utilise the sources of information properly. Better utilisation of information sources might have also helped the farmers of Thiruvananthapuram district to improve their managerial ability. They registered significantly higher orientation

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towards management when compared to the farmers of Alappuzha district.

Based on the above discussion the hypotheses that there would be no significant difference between the farmers of Thiruvananthapuram and Alappuzha districts with regard to their characteristics (independent variables) were rejected in the case of annual income, farming experience, crop yield index, information source utilisation, scientific orientation, risk orientation and management orientation while the same were accepted in the case of family educational status, farm size, cosmopoliteness, economic motivation and contact with extension agency.

4.2. Analysis of the dependent variables of the study

4.2.1. Knowledge of farmers about plant protection methods

The data relating to mean scores, percentage analysis and 't' values testing the significance of difference between the mean scores for knowledge of farmers of Thiruvananthapuram and Alappuzha districts about plant protection methods are given in Table 4.

It is quite clear from Table 4 that with regard to

Table 4. Knowledge of farmers of Thiruvananthapuram and Alappuzha districts about plant protection methods.

Sl. No.	Plant protection methods	TVM (n=120) Category		Mean score	ALPA (n=120) Category		Mean score	't' value
		Low (%)	High (%)		Low (%)	High (%)		
1.	Chemical	65	35	56.91	73	27	49.85	2.96**
2.	Cultural	72	28	11.00	68	32	12.28	2.31*
3.	Mechanical	77	23	2.24	79	21	2.18	0.45NS
4.	Biological	—	—	—	—	—	—	—
5.	Physical	—	—	—	—	—	—	—
6.	Integrated (I.P.M.)		—	—	—	—	—	—

** Significant at 1% level

* Significant at 5% level

NS Not significant

chemical method of plant protection 35.00 per cent of farmers of Thiruvananthapuram district and 27.00 per cent of farmers of Alappuzha district were having high knowledge level. With regard to cultural method of plant protection, 28.00 per cent and 32.00 per cent of farmers possessed high knowledge level in Thiruvananthapuram and Alappuzha districts respectively. With regard to mechanical method of plant protection, 23.00 per cent and 21.00 per cent of farmers were having high level of knowledge in Thiruvananthapuram and Alappuzha districts respectively.

The same Table 4 and FIG. 3 project the results on the comparison of mean scores for knowledge about plant protection methods with regard to the farmers of Thiruvananthapuram and Alappuzha districts.

The farmers of the two districts, differed significantly in the mean scores for their knowledge about the chemical method of plant protection. The farmers of Thiruvananthapuram district possessed significantly higher level of knowledge than the farmers of Alappuzha district. The farmers of Thiruvananthapuram district were found, utilising the information sources more than the farmers of

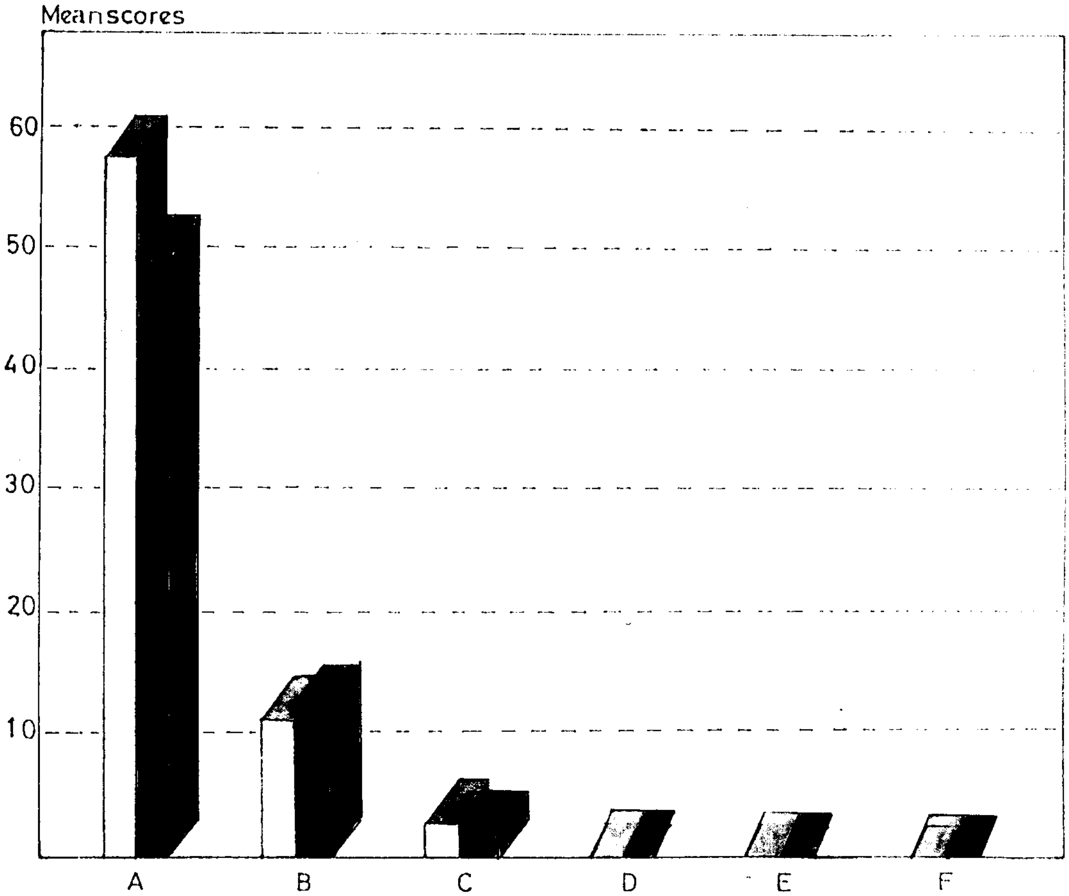

FIG. 3. KNOWLEDGE OF FARMERS ABOUT PLANT PROTECTION METHODS

A Chemical method
B Cultural method
C Mechanical method
D Biological method
E Physical method
F Integrated method

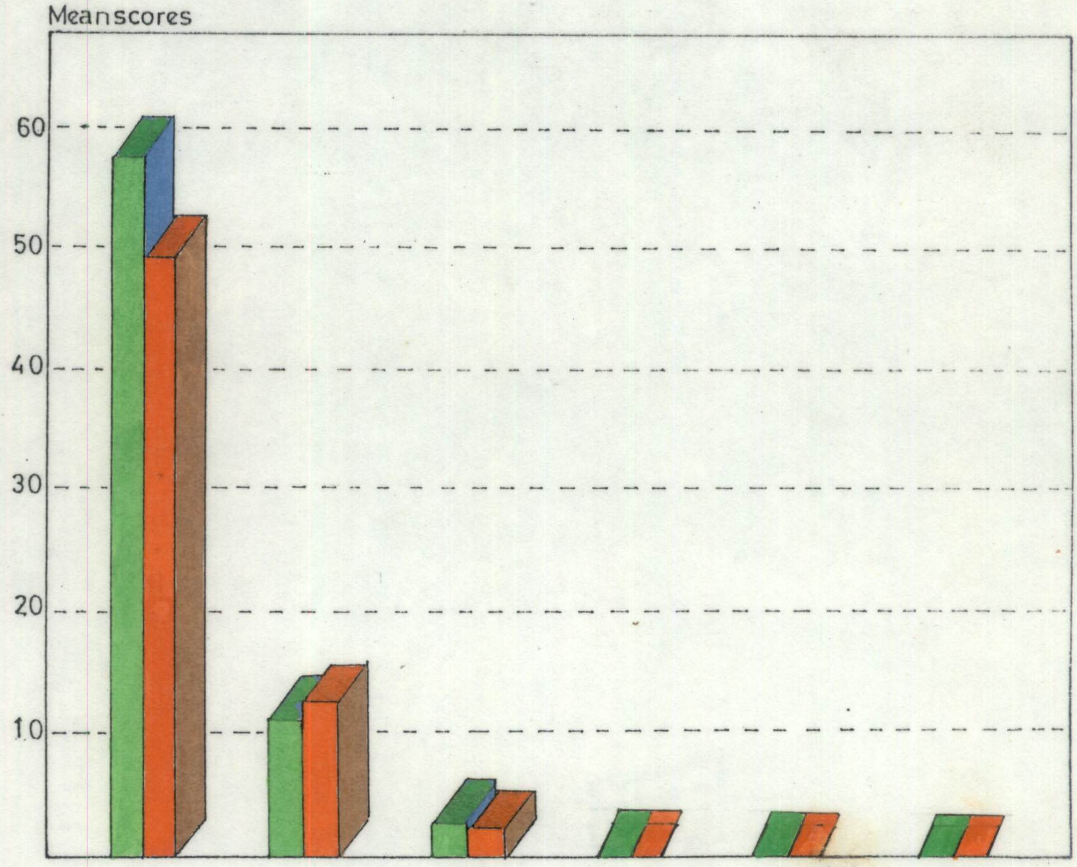

FIG. 3. KNOWLEDGE OF FARMERS ABOUT PLANT PROTECTION METHODS

A Chemical method
B Cultural method
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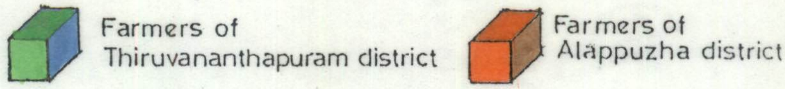


Alappuzha district and this nature might have helped them to acquire more knowledge about chemical method of plant protection than the farmers of Alappuzha district.

The farmers of Alappuzha district possessed significantly higher level of knowledge about cultural method of plant protection than the farmers of Thiruvananthapuram district. The farmers of Alappuzha district had significantly greater experience in farming and this would have helped them to realise the importance of cultural method of plant protection for pests and diseases in paddy and vegetables and hence they might have tried to attain more knowledge about this important method of plant protection. This findings is in line with the findings reported by Jeyakrishnan(1984) and Jnanadevan(1993).

It is also observed from the same table that there existed no significant difference in the mean scores for the knowledge about mechanical method of plant protection among the two groups of farmers. It may be due to the fact that the farmers of both the districts possessed almost equal level of knowledge in this regard. The farmers of both the districts obtained zero scores for their knowledge about biological, physical and integrated methods of plant protection inferring that they were ignorant about these methods of plant protection. This might be due to the fact that the farmers were not exposed to these plant protection methods and hence were not convinced about the importance, utility and practicability of these methods in plant protection.

In order to assess the practicewise knowledge about each method of plant protection, for the farmers, further analysis was done as detailed below.

4.2.1.1. Knowledge about chemical method of plant protection

The data relating to mean scores, percentage analysis and 't' values testing the significance of difference between the mean scores for knowledge of farmers of Thiruvananthapuram and Alappuzha districts, about chemical method of plant protection are furnished in Table 5

It is vivid from Table 5 that the majority of the farmers of both the districts belonged to high knowledge level category for the practice, 'selection of the

Table 5. Knowledge of farmers of Thiruvananthapuram and Alappuzha districts about chemical method of plant protection.

Sl. No.	Practices	TVM (n=120) Category Low (%)	High (%)	Mean score	ALPA (n=120) Category Low (%)	High (%)	Mean score	't' value
A	Paddy							
I	Pests							
1	Selection of the chemical	40	60	3.02	42	58	2.93	0.50 NS
2	Quantity of chemical/acre	48	52	2.99	54	46	2.28	3.87**
3	Quantity of chemical/pump load	68	32	2.10	72	28	1.70	3.31**
4	Number and interval of application	54	46	2.11	56	44	1.52	4.73**
5	Method of application	40	60	2.98	42	58	2.90	0.59 NS
ii	Diseases							
1	Selection of the chemical	49	51	2.37	51	49	2.22	1.00 NS
2	Quantity of chemical/acre	55	45	1.99	58	42	1.64	2.99**
3	Quantity of chemical/pump load	70	30	1.96	73	27	1.60	3.08**
4	Number and interval of application	57	43	1.81	70	30	1.50	3.16**
5	Method of application	51	49	2.00	55	45	1.90	0.93 NS

Table 5.(Contd....)

B	Vegetables							
I	Pests							
1	Selection of the chemical	57	43	5.09	60	40	4.80	1.09^{NS}
2	Quantity of chemical/acre	64	36	3.10	67	33	2.59	3.19**
3	Quantity of chemical/pump load	70	30	3.46	72	28	2.88	3.38**
4	Number and interval of application	69	31	3.55	71	29	2.60	5.56**
5	Method of of application	59	41	4.00	63	37	3.80	1.39^{NS}
II	Diseases							
1	Selection of the chemical	58	42	2.38	60	40	2.30	0.59^{NS}
2	Quantity of chemical/acre	67	33	2.20	69	31	1.73	4.18**
3	Quantity of chemical/pump load	70	30	2.14	73	27	1.90	2.37*
4	Number and interval of application	69	31	2.00	72	28	1.68	3.10**
5	Method of application	60	40	2.00	62	38	2.10	0.91^{NS}
C	Precautions taken while using pesticides	57	43	3.66	66	34	3.18	3.13**

* * Significant at 1% level

* Significant at 5% level

NS Not significant

chemical' for pests and diseases in paddy and vegetables. With regard to the practice, 'quantity of chemical to be taken/pump load percentage of farmers belonged to high knowledge level category was the minimum for both the districts. With regard to the practice 'precautions to be taken while using pesticides' 43.00 per cent of the farmers of Thiruvananthapuram district and 34.00 per cent of the farmers of Alappuzha district posessed higher knowledge level.

It could also be observed from the same table that the farmers of the two districts, Thiruvananthapuram and Alappuzha were found to be significantly different in the mean scores, with regard to their knowledge about the practices,'quantity of chemical to be used/acre','quantity of chemical to be taken/pump load' and 'number and interval of application' of the chemical for pests and diseases in paddy. Significant difference was also noticed in the mean scores with regard to their knowledge about the practices, 'quantity of chemicals to be used/acre', 'quantity of chemical to be taken/pump load'and 'number and interval of application' of the chemicals for pests and diseases in vegetables. Further it is also seen from the same table that there existed no significant difference between the farmers of the two districts, in the mean scores with regard to their knowledge about the practices,'selection of the chemical', and 'method of application' of the chemical for pests and diseases in paddy as well as in vegetables. In the case of the practice 'precautions to be taken while using pesticides',significant difference was noticed in the mean knowledge scores of the farmers of Thiruvananthapuram and Alappuzha districts.

It may be concluded that the farmers of Thiruvananthapuram district possessed significantly higher knowledge about the practices, 'quantity of chemical to be used/acre','quantity of chemical to be taken/pump load' and 'number and interval of application' of the chemical than the farmers of Alappuzha district, for pests and diseases in paddy. The same table also shows that the farmers of Thiruvananthapuram district had higher knowledge about the practices 'quantity of chemical to be used/acre','quantity of chemical to be taken/pump load'and 'number and interval of application', of the chemical, for pests and diseases in vegetables. It was also noticed that they had higher knowledge with regard to the practice 'precautions to be taken while using pesticides' than the farmers of Alappuzha district. It has to be pointed out in this context,that the farmers of Thiruvananthapuram district had the nature of utilising information sources significantly higher than the farmers of Alappuzha district. This might have enabled them to acquire more knowledge about certain practices than the farmers of Alappuzha district.

4.2.1.2. Knowledge about cultural method of plant protection.

4.2.1.2.1. Knowledge about cultural method of plant protection in paddy.

The data relating to mean scores, percentage analysis and 't' values, testing the significance of difference between the mean scores for knowledge of farmers of Thiruvananthapuram and Alappuzha districts,about cultural method of plant protection in paddy are furnished in Table 6.

A critical glance at Table 6 reveals that among nine practices of cultural method of plant protection in paddy, more than half of the farmers belonged to high knowledge level category for all the practices except for

Table 6. Knowledge of farmers of Thiruvananthapuram and Alappuzha districts about cultural method of plant protection in paddy.

Sl. No.	Practices	TVM (n=120) Category Low (%)	TVM (n=120) Category High (%)	TVM (n=120) Mean score	ALPA (n=120) Category Low (%)	ALPA (n=120) Category High (%)	ALPA (n=120) Mean score	't' value
1	Summer ploughing	32	68	0.68	69	31	0.31	12.18**
2	Selection of variety	31	69	0.69	15	85	0.85	4.41**
3	Monitoring for pests in nursery	24	76	0.76	14	86	0.86	2.71**
4	Synchronised planting	28	72	0.72	14	86	0.86	4.22**
5	Plant population/sq.m.	38	62	0.62	23	77	0.77	4.11**
6	Weeding operation	31	69	0.69	14	86	0.86	4.69**
7	Monitoring for pests in main field.	24	76	0.76	14	86	0.86	3.08**
8	Water management	48	52	1.35	65	35	0.95	6.18**
9	Application of nitrogenous fertilizers	65	35	0.95	54	46	1.11	3.08**

** Significant at 1 % level

'water management' and 'application of nitrogenous fertilizers' with regard to the farmers of Thiruvananthapuram district and except for the practices 'summer ploughing', 'water management' and 'application of nitrogenous fertilizers' with regard to the farmers of Alappuzha district. The majority of the farmers of Thiruvananthapuram district belonged to high knowledge level category, for the practices 'monitoring for pests in nursery and in main field' (86.00 per cent each).In the case of the farmers of Alappuzha district, the majority of the farmers belonged to high knowledge level category for the practices 'monitoring for pests in nursery','synchronised planting' and 'monitoring for pests in main field' (86.00 per cent each).

A further look into the same table reveals that the farmers of both the districts differed significantly in the mean scores with regard to their knowledge about all the nine practices under cultural method of plant protection in paddy. It was also clear that the farmers of Alappuzha district had significantly higher knowledge about seven cultural practices namely 'selection of variety','monitoring for pests in nursery', 'synchronised planting', 'plant population/sq.m.', 'weeding operation','monitoring for pests in main field', and 'application of nitrogenous fertilizers'. When compared to the farmers of Thiruvananthapuram district, the farmers of Alappuzha district had more farming experience as had been pointed out earlier. This might have helped them to gain more knowledge about these practices which were found to be effective in the control of pests and diseases in paddy to achieve better crop yields and income from their farms.

It was also noticed from the same table that the farmers of Alappuzha district possessed lesser knowledge about 'summer ploughing', and 'water management' in paddy fields than the farmers of Thiruvananthapuram district. This might be due to the fact that the waterlogged nature and poor drainage facilities observed in Alappuzha district might have prevented them to acquire more knowledge about these practices which were less applicable and practicable in their fields.

4.2.1.2.2. Knowledge about cultural method of plant protection in vegetables.

The data relating to mean scores, percentage analysis and 't' values testing the significance of difference between the mean scores for knowledge of farmers of Thiruvananthapuram and Alappuzha districts about cultural method of plant protection in vegetables are furnished in Table 7.

It is evident from Table 7 that more than half of the farmers belonged to high knowledge level category for all the practices of cultural method of plant protection in vegetables , except for the practices 'synchronised planting','plant population/sq.m.' and 'application of nitrogenous fertilizers' with regard to the farmers of Thiruvananthapuram district and except for 'application of nitrogenous fertilizers' with regard to the farmers of Alappuzha district. The majority of the farmers belonged to high knowledge level category for the practice, 'monitoring for pests in main field' among the farmers of both the districts, Thiruvananthapuram and Alappuzha(78.00 per cent and 92.00 per cent respectively).

Table 7 also clearly shows that the two groups of farmers differed significantly with respect to their mean knowledge scores for all the six practices under cultural method of plant protection. It may be inferred that there

Table 7. Knowledge of farmers of Thiruvananthapuram and Alappuzha districts about cultural method of plant protection in vegetables.

Sl. No.	Practices	TVM (n=120) Category Low (%)	High (%)	Mean score	ALPA (n=120) Category Low (%)	High (%)	Mean score	't' value
1.	Monitoring for pests in nursery	28	72	0.72	11	89	0.89	3.63**
2.	Synchronised planting	61	39	0.39	39	61	0.61	5.98**
3.	Plant population/sq.m.	59	41	0.41	31	69	0.69	5.96**
4.	Weeding operation	24	76	0.76	18	82	0.82	3.00**
5.	Monitoring for pests in main field	22	78	0.78	8	92	0.92	3.02**
6.	Application of nitrogenous fertilizers	72	28	0.72	64	36	0.92	4.70**

** Significant at 1% level

NS Not significant

existed significant difference in the mean knowledge scores between the two groups of farmers with regard to all the six cultural practices of plant protection. The farmers of Alappuzha district were found to be higher adopters of these cultural practices. The same reason of more farming experience might have helped them to realise from their own experience, the importance and effectiveness of these practices in the control of pests and diseases in vegetables and this might have provoked them to acquire more knowledge about these cultural practices in the field of plant protection.

4.2.1.3. Knowledge about mechanical method of plant protection

The data relating to mean scores, percentage analysis and 't' values testing the significance of difference between the mean scores for knowledge of farmers of Thiruvananthapuram and Alappuzha districts about mechanical method of plant protection in paddy and vegetables are furnished in Table 8.

It may be observed from Table 8 that less than half of the farmers belonged to high knowledge level

Table 8. Knowledge of farmers of Thiruvananthapuram and Alappuzha districts about mechanical method of plant protection.

Sl. No.	Practices	TVM (n=120) Category Low (%)	High (%)	Mean score	ALPA (n=120) Category Low (%)	High (%)	Mean score	't' value
A	Paddy							
1.	Collection and destruction of egg masses and other stages of pest	77	23	0.23	79	21	0.21	0.91^{NS}
2.	Collection and destruction of affected plant parts or plants	52	48	0.48	55	45	0.45	0.79^{NS}
B	Vegetables							
1	Collection and destruction of egg masses and other stages of pest	24	76	0.76	24	76	0.76	0.47^{NS}
2	Collection and destruction of affected plant parts or plants	23	77	0.77	24	76	0.76	0.18^{NS}

NS Not significant

category for the mechanical practices of plant protection in paddy in both the districts, Thiruvananthapuram and Alappuzha. It was also noticed that a little more than three-fourth of farmers belonged to high knowledge level category for the mechanical practices 'collection and destruction of egg masses and other stages of pests' and 'collection and destruction of affected plant parts or plants' in vegetables in both the districts Thiruvananthapuram and Alappuzha. The farmers of both the districts might have perceived the utitity and practicability of mechanical method of plant protection more in vegetables and hence might have tried to acquire more knowledge about these practices in vegetables than in paddy. But a similiar trend was noticed in the distribution of the farmers of the two districts for their practicewise knowledge about this method of plant protection.

The same table also clearly shows that there existed no significant difference between the farmers of Thiruvananthapuram and Alappuzha districts with regard to their mean knowledge scores for the practices under mechanical method of plant protection in paddy and vegetables. It may be inferred that farmers of both the districts possessed almost equal level of knowledge about the practices under mechanical method of plant protection. This might be due to the fact that the farmers of both the districts might had sought and acquired knowledge about the mechanical practices more or less equally, since they had perceived the utility and practicability of these practices more or less same in both the crops which is mentioned else where.

4.2.2. Attitude of farmers towards chemical method of plant protection.

The data relating to mean scores, percentage analysis and 't' values testing the significance of difference between the mean scores for attitude of farmers of Thiruvananthapuram and Alappuzha districts towards chemical method of plant protection are furnished in Table 9

A perusal of Table 9 reveals that more than 50.00 per cent of farmers of Thiruvananthapuram and Alappuzha districts had favourable attitude towards chemical method of plant protection.

A comparison of mean scores for the attitude of

Table 9. Attitude of farmers of Thiruvananthapuram and Alappuzha districts towards chemical method of plant protection.

Sl. No.	Category	Distribution of farmers				't' value
		TVM (n=120)		ALPA (n=120)		
		Mean score	(%)	Mean score	(%)	
1.	Favourable (Mean and above)		53		58	
		32.40		34.33		2.00*
2.	Unfavourable (Less than mean)		47		42	

* Significant at 5% level

the farmers of Thiruvananthapuram and Alappuzha districts can be made from the same Table 9 and FIG 4.

It can be seen that there was significant difference between the farmers of Thiruvananthapuram and Alappuzha districts with regard to their mean scores for attitude towards chemical method of plant protection(the mean scores being 32.40 and 34.33, respectively).

According to attitude formation theories, one tries to maintain consistency and congruency of balance in one's attitude.This attitude towards a stimulus is explained by his/her expectations, knowledge, perception and first hand experience with stimulus. Here the farmers of Alappuzha district were found to have significantly higher attitude score than the farmers of Thiruvananthapuram district. The results of the preponderant 'KAP' (Knowledge, Attitude and Practice) studies on diffusion of agricultural innovations (Rogers, 1983) and the myriad experiments on cognitive, affective and connative components in explaining the cause-effect relationship between attitude and behaviour could be cited here.

It is also relevant to this context that the

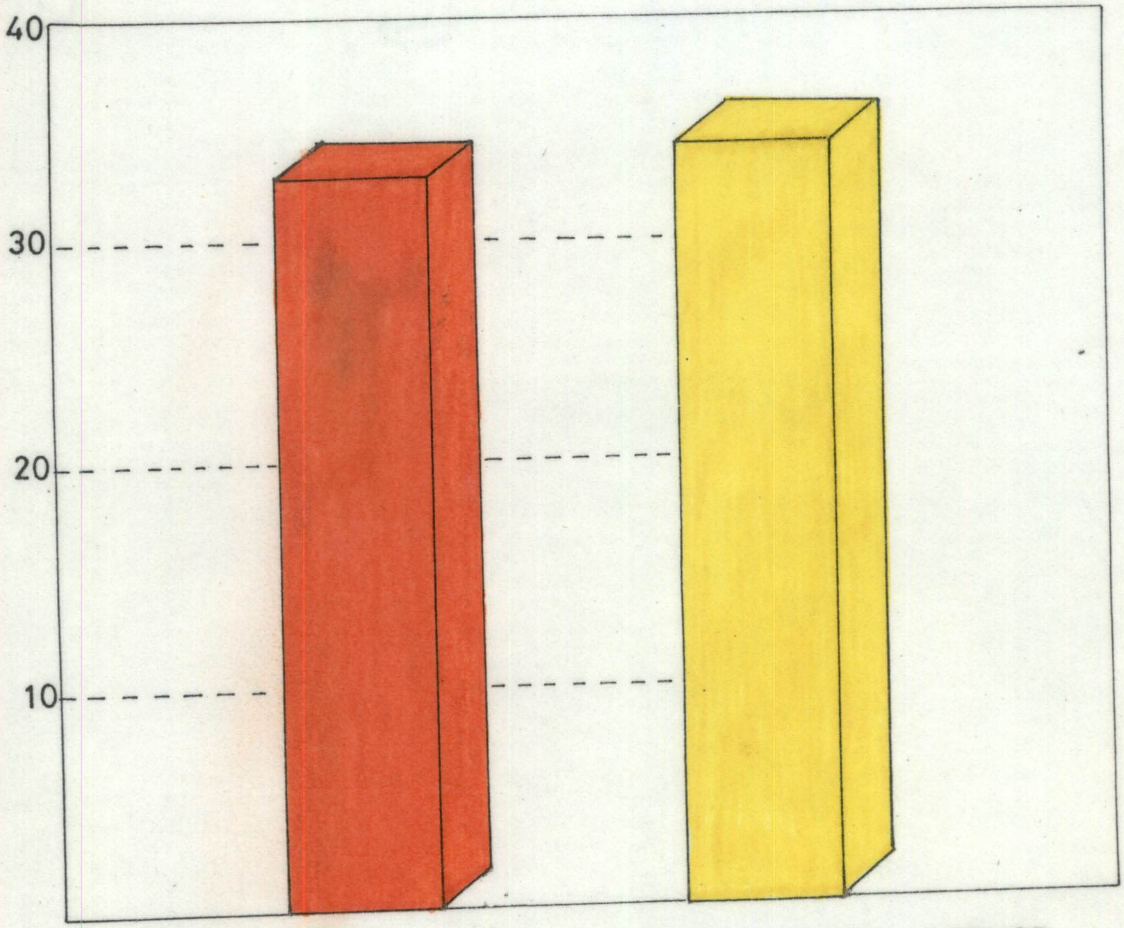
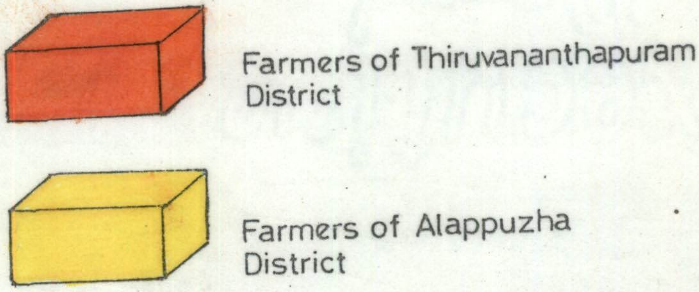


FIG. 4. ATTITUDE OF FARMERS TOWARDS CHEMICAL METHOD OF PLANT PROTECTION



farmers of Alappuzha district had significantly higher level of adoption of chemical method of plant protection which is mentioned elsewhere. The above results do support the already available evidence on this regard.

In view of the above, the hypothesis that there would be no significant difference among the farmers of Thiruvananthapuram and Alappuzha districts with respect to their attitude towards chemical method of plant protection was rejected.

4.2.3. Adoption of plant protection methods by farmers

The data relating to mean scores, percentage analysis and 't' values testing the significance of difference between mean scores for adoption of plant protection methods by farmers presented in Table 10.

It is evident from Table 10 that only 28.00 per cent of the farmers of Thiruvananthapuram district and 21.00 per cent of the farmers of Alappuzha district correctly adopted the chemical method of plant protection. With regard to cultural method of plant protection 32.00 per cent of the farmers of Thiruvananthapuram district and 40.00 per cent of the farmers of Alappuzha district belonged

Table 10. Adoption of plant protection methods by farmers of Thiruvananthapuram and Alappuzha districts.

Sl. No.	Plant protection methods	TVM (n=120) Category Low (%)	High (%)	Mean score	ALPA (n=120) Category Low (%)	High (%)	Mean score	't' value
1.	Chemical	28(correct) (30)		3286.65	21(correct) (8)		4061.93	2.28*
2.	Cultural	68	32	596.99	60	40	694.84	3.09**
3.	Mechanical	74	26	95.67	76	24	99.83	0.60NS
4.	Biological	—	—	—	—	—	—	—
5.	Physical	—	—	—	—	—	—	—
6.	Integrated(I.P.M.)	—	—	—	—	—	—	—

Figures in parantheses indicate percentage of non-adopters.

** Significant at 1% level

* Significant at 5% level

NS Not significant

to the high adoption category. While with regard to mechanical method of plant protection, 26.00 per cent of the farmers of Thiruvananthapuram district and 24.00 per cent of the farmers of Alappuzha district belonged to high adoption category.

It was also noticed from the same table that none of the farmers of Thiruvananthapuram and Alappuzha districts were adopting biological, physical and integrated methods of plant protection. This might be due to the fact that the farmers of both the districts did not possess any knowledge about these methods of plant protection which were mentioned before.

The Table 10 and FIG.5 clearly show a comparison of mean scores for the adoption of plant protection methods by farmers of Thiruvananthapuram and Alappuzha districts. It is evident from the same table that there existed significant difference in the mean adoption scores among both the groups of farmers, with respect to chemical and cultural methods of plant protection(the mean scores being 3286.50 and 4061.93, respectively for the adoption of chemical method of plant protection and 596.99 and 694.84, respectively for the adoption of cultural method of plant protection).

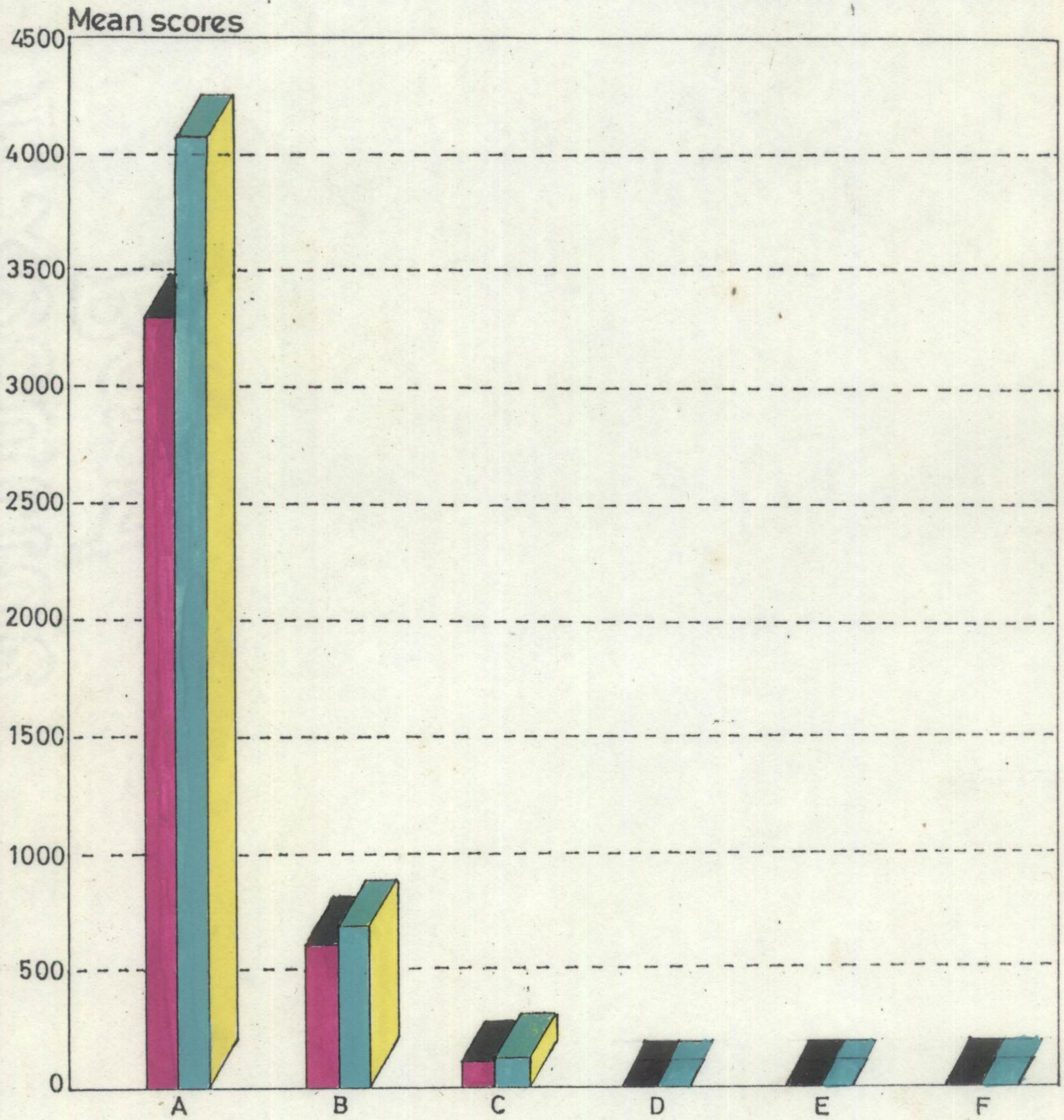


FIG. 5. ADOPTION OF PLANT PROTECTION METHODS BY FARMERS

A. Chemical method
B. Cultural method
C. Mechanical method
D. Biological method
E. Physical method
F. Integrated method

The farmers of Alappuzha district were found higher adopters of chemical and cultural methods of plant protection when compared to the farmers of Thiruvananthapuram district. The farmers of Alappuzha district were more scientific oriented and also risk oriented. They got greater farming experience and higher annual income(Table 2). From their own experience, coupled with the above characteristics they might have felt the utility and practicability of these practices more. All these reasons might have made the farmers of Alappuzha district higher adopters than the farmers of Thiruvananthapuram district.

It was also noticed that there was no significant difference between the two groups of farmers in their mean scores for adoption of mechanical method of plant protection. It may be inferred that the farmers of both the districts were more or less similiar adopters of this method It might be due to the fact that they had more or less same level of knowledge about this method and have perceived the utility and practicability of this method more or less equally which is mentioned elsewhere.

It was also noticed from the same table that the farmers of both the districts obtained zero scores for the adoption of biological, physical and integrated methods of plant protection. It may be inferred that they were non-adopters of these methods. It might be due to the fact that none of them possessed enough knowledge about these methods and probably they were not convinced about the utility and practicability of these methods.

Further analysis, made to assess the practice-wise adoption of each method of plant protection followed by the farmers of the districts of Thiruvananthapuram and Alappuzha is detailed as below.

4.2.3.1. Adoption of chemical method of plant protection by farmers.

The data relating to mean scores, percentage analysis and 't' values testing the significance of difference between mean scores for adoption of chemical method of plant protection by the farmers of Thiruvananthapuram and Alappuzha districts are given in Table 11.

The results in Table 11 clearly shows that majority of the farmers adopted the practice 'selection of

Table 11. Adoption of chemical method of plant protection by farmers of Thiruvananthapuram and Alappuzha districts.

Sl. No.	Practices	TVM (n=120) Adopters Correct	Incorrect Lower	Incorrect Excess	Incorrect Total	Mean score	ALPA (n=120) Adopters Correct	Incorrect Lower	Incorrect Excess	Incorrect Total	Mean score	't' value
A	Paddy											
I	Pests											
1	Selection of the chemical	64 (30)	—	—	6	136.15	65 (8)	—	—	27	160	2.59**
2	Quantity of chemical/acre	42	20	8	28	191.47	33	11	48	59	439.21	11.91**
3	Quantity of chemical/pump load	31	31	8	39	146.10	29	13	50	63	234.00	7.29**
4	Number and interval of application	42	20	8	28	186.70	36	7	49	56	304.64	8.51**
5	Method of application	63	—	—	7	147.90	64	—	—	28	160.13	1.94^{NS}
ii	Diseases											
1	Selection of the chemical	48 (40)	—	—	12	97.35	60 (11)	—	—	29	114.16	2.52**
2	Quantity of chemical/acre	38	12	10	22	155.76	31	12	46	58	300.66	9.72**
3	Quantity of chemical/pump load	26	25	9	34	148.27	29	12	48	60	231.60	6.82**
4	Number and interval of application	38	14	8	22	116.82	34	9	46	55	172.04	6.28**
5	Method of application	47	—	—	13	130.80	58	—	—	31	142.22	1.94^{NS}

Table 11 (Cont...)

B Vegetables

I	Pests										
1	Selection of the chemical	50 (35)	—	—	15	181.90	44 (38)	—	—	18	178.95	0.65^{NS}
2	Quantity of Chemical/acre	39	20	9	29	298.05	35	7	20	27	290.12	1.11^{NS}
3	Quantity of chemical/pump load	33	20	12	32	286.77	30	7	25	32	282.90	1.02^{NS}
4	Number and interval of application	34	21	10	31	216.08	31	7	24	31	216.34	1.47^{NS}
5	Method of of application	47	—	—	18	230.20	43	—	—	19	229.60	1.12^{NS}
II	Diseases										
1	Selection of the chemical	48 (40)	—	—	12	80.50	46 (38)	—	—	16	80.15	1.32^{NS}
2	Quantity of chemical/acre	34	19	7	26	160.20	32	6	24	30	156.20	1.60^{NS}
3	Quantity of chemical/pump load	29	20	10	31	144.80	26	8	25	33	140.12	1.52^{NS}
4	Number and interval of application	31	19	10	29	108.40	31	7	24	31	107.77	0.87^{NS}
5	Method of application	45	—	—	15	119.10	44	—	—	18	118.03	0.76^{NS}
C	Precautions taken while using pesticides	38	—	—	22	3.33	29	—	—	33	3.09	2.41^{*}

Figures in parantheses indicate percentage of non-adopters.

** Significant at 1% level
* Significant at 5% level
NS Not significant

chemical' for the pests and diseases in paddy and vegetables, correctly in both the districts. The same table also reveals that the lowest percentage of farmers of the two districts adopted correctly the practice 'quantity of chemical used/pump load' for the chemical control of pests and diseases in paddy and vegetables. It was also noticed from the same table that 38.00 per cent of farmers of Thiruvananthapuram district and 29.00 per cent of farmers of Alappuzha district adopted correctly the practice 'precautions to be taken while using pesticides'.

It is also evident from Table 11 that the farmers of the two districts showed significant difference in the mean scores for the adoption of all the practices except for the practice 'method of application' with respect to the chemical method of plant protection for the pests and diseases in paddy cultivation.

The farmers of Alappuzha district were significantly higher adopters of all the practices except 'method of application'. Similiarly there was significant difference in the mean scores of adoption of the practice 'precautions to be taken while using pesticides'(the mean scores being 3.33 and 3.09, respectively for the farmers of

Thiruvananthapuram and Alappuzha districts). Here, the farmers of Thiruvananthapuram district showed higher adoption of this practice than those of Alappuzha district. The highest difference was noticed among the two groups of farmers, for adoption of the practice 'quantity of chemical used/acre' for pests and diseases in paddy cultivation.

In Alappuzha district, farmers mostly cultivated high yielding varieties and their application of nitrogenous fertilizers was found to be significantly higher which were mentioned earlier. The farmers of Alappuzha district had higher annual income which enabled them to purchase and use more fertilizers and plant protection chemicals in their fields. Application of nitrogenous fertilizers if become excess makes the plant more succulent and susceptible to pest and disease attack. Moreover some high yielding varieties are susceptible to certain pests and diseases. These might be the reasons for the farmers of Alappuzha district to use more quantity of chemical/acre. That was why the highest difference was noticed among the two groups of farmers with respect to adoption of the practice 'quantity of chemical used/acre' for the selected pests and diseases in paddy crop. Further, it is relevant to this context that the farmers of Alappuzha district possessed significantly lesser knowledge about 'quantity of chemical to be used/acre','quantity of chemical/pump load' and 'number and interval of application of the chemical' for pests and diseases in paddy cultivation which was mentioned before. Due to ignorance about these practices also, they might have adopted these practices and applied more quantity of chemical and their adoption rate went up.

The farmers of Thiruvananthapuram district were found to be significantly higher adopters of the practice 'precautions to be taken while using pesticides'. It was found that they possessed higher knowledge about ' the precautions to be taken while using pesticides 'than the farmers of Alappuzha district and hence they also might have perceived the utility and practicability of these practices more than the farmers of Alappuzha district and found as higher adopters.

There was no significant difference between the farmers of Thiruvananthapuram and Alappuzha districts with respect to their adoption of the five practices under chemical method of plant protection for pests and diseases in vegetable cultivation. It may be inferred that both the groups of farmers had similiar levels of adoption in the case of the above practices in vegetable cultivation. In vegetables, incidence of pests and diseases was found almost similiar and both the two groups of farmers were equally cautious about the pest and disease attack in vegetables and gave much importance to plant protection practices with utmost interest . Hence their adoption of these practices was high and almost equal resulting in the non-significant difference in the mean adoption score of these five practices in vegetable cultivation among the two groups of farmers.

The mean score obtained for the practice 'precautions to be undertaken while using pesticides' was significantly lower for the farmers of Alappuzha district inferring that the farmers of Alappuzha district were lesser adopters of the practice than the farmers of Thiruvananthapuram district. This might be due to the fact that the farmers of Alappuzha district possessed significantly lesser knowledge about the practice than the farmers of Thiruvananthapuram district which was mentioned before.

4.2.3.2. Adoption of cultural method of plant protection

4.2.3.2.1. Adoption of cultural method of plant protection in paddy.

The data relating to mean scores, percentage analysis and 't' values testing the significance of difference between the mean scores for adoption of cultural method of plant protection in paddy by farmers of Thiruvananthapuram and Alappuzha districts are furnished in Table 12.

It is evident from Table 12 that among nine cultural practices more than half of the farmers of Thiruvananthapuram district belonged to high adoption category for four practices viz., 'monitoring for pests in nursery','weeding operation','monitoring for pests in main field' and 'water management'. While with regard to the farmers of Alappuzha district, more than half of the farmers belonged to high adoption category for six practices, viz.,'selection of variety','monitoring for pests in nursery','synchronised planting', 'plant population/sq.m.', 'weeding operation'and 'monitoring for pests in main field'.

The results of Table 12 distinctly project that

Table 12. Adoption of cultural method of plant protection in paddy by farmers of Thiruvananthapuram and Alappuzha districts

Sl. No.	Practices	TVM (n=120) Category Low (%)	High (%)	Mean score	ALPA (n=120) Category Low (%)	High (%)	Mean score	't' value
1	Summer ploughing	55	45	12.22	74	26	8.86	4.86**
2	Selection of variety	70	30	10.00	40	60	15.00	6.00**
3	Monitoring for pests in nursery	50	50	55.35	38	62	70.25	4.78**
4	Sychronised planting	58	42	35.78	32	68	47.50	4.56**
5	Plant population/sq.m.	60	40	24.10	40	60	31.20	4.03**
6	Weeding operation	50	50	26.11	38	62	31.78	3.66**
7	Monitoring for pests in main field.	42	58	67.55	32	68	76.63	3.02**
8	Water management	49	51	30.90	74	26	20.47	7.75**
9	Application of nitrogenous fertilizers	71	29	43.43	62	38	57.88	5.93**

** Significant at 1% level

the two groups of farmers were significantly different in their mean scores for the adoption of all the nine practices under cultural method of plant protection. Out of the nine practices of cultural method, the farmers of Alappuzha district were found to be significantly higher adopters of seven practices namely 'selection of variety', monitoring for pests in nursery', 'synchronised planting','plant population/sq.m.','weeding operation','monitoring for pests in main field' and 'application of nitrogenous fertilizers' than the farmers of Thiruvananthapuram district.

The farmers of Alappuzha district cultivated paddy extensively and they synchronised planting and other cultivation practices with their fellow farmers and many farmers followed group farming for paddy cultivation. They were very careful in maximising their returns from paddy cultivation, by selecting high yielding varieties, adopting correct plant population/sq.m.,adopting regular weeding operations and monitoring pests in the nursery and main field. Hence they were found to be higher adopters of these practices when compared to the farmers of Thiruvananthapuram district. Adoption of all these practices helped the farmers of Alappuzha to attain more returns from their fields.

Increased returns and higher income obtained provoked them to adopt these practices more in their fields.

The farmers of Thiruvananthapuram district showed higher adoption for the practice 'summer ploughing' and 'water management'. The waterlogged nature and poor drainage facilities of the fields in many parts of Alappuzha district would have prevented the farmers to dewater their fields and adopt summer ploughing and proper water management practices. In this context it must also be noted that this fact was pointed out as one of the important constraints as mentioned by the farmers of Alappuzha district, elsewhere.

4.2.3.2.2. Adoption of cultural method of plant protection in vegetables

The data relating to mean scores, percentage analysis and 't' values testing the significance of difference between the mean scores for adoption of cultural method of plant protection in paddy by farmers of Thiruvananthapuram and Alappuzha districts are furnished in Table 13.

It is evident from Table 13 that among six practices of cultural method of plant protection in

Table 13. Adoption of cultural method of plant protection in vegetables by farmers of Thiruvananthapuram and Alappuzha districts.

Sl. No.	Practices	TVM (n=120) Category Low (%)	TVM (n=120) Category High (%)	TVM Mean score	ALPA (n=120) Category Low (%)	ALPA (n=120) Category High (%)	ALPA Mean score	't' value
1	Monitoring for pests in nursery	35	65	71.87	34	66	78.80	2.07*
2	Synchronised planting	70	30	49.28	40	60	58.03	2.34*
3	Plant population/sq.m.	60	40	24.90	58	42	32.50	3.85**
4	Weeding operation	48	52	31.49	32	68	35.17	2.24*
5	Monitoring for pests in main field	35	65	79.25	37	63	89.53	2.76**
6	Application of nitrogenous fertilizers	74	26	34.76	67	33	41.25	3.31**

** Significant at 1% level

* Significant at 5% level

vegetables more than half of the farmers of Thiruvananthapuram district belonged to high adoption category for three practices viz.,'monitoring for pests in nursery', 'weeding operation' and 'monitoring for pests in main field'. While in the case of the farmers of Alappuzha district, more than half of the farmers belonged to high adoption category for four practices,viz.,'monitoring for pests in nursery','synchronised planting','weeding operation' and 'monitoring for pests in main field'.

It is clear from Table 13 that the two groups of farmers differed significantly with respect to their mean scores for adoption of all the six practices under cultural method of plant protection. The farmers of Alappuzha district were comparatively higher adopters of these cultural practices than the farmers of Thiruvananthapuram district. This might be due to the fact that the farmers of Alappuzha district possessed significantly higher knowledge about these practices as mentioned earlier. Hence, they might have realised the utility and practicability of these practices in the control of pests and diseases in vegetables resulting in higher adoption of these practices.

4.2.3.3. Adoption of mechanical method of plant protection

The data relating to mean scores, percentage analysis and 't' values testing the significance of difference between the mean scores for adoption of mechanical method of plant protection in paddy by farmers of Thiruvananthapuram and Alappuzha districts are furnished in Table 14.

It may be observed from Table 14 that less than one-fourth of the farmers of both the districts belonged to high adoption category for the mechanical practices of plant protection in paddy cultivation. While in the case of vegetable cultivation, it was found that 40.00 per cent of the farmers of Thiruvananthapuram district and 34.00 per cent of the farmers of Alappuzha district belonged to high adoption category for the practice 'collection and destruction of egg masses and other stages of pests' and 36.00 per cent of the farmers of Thiruvananthapuram district and 38.00 per cent of the farmers of Alappuzha district belonged to high adoption category for the practice 'collection and destruction of affected plant parts or plants'.

The results presented in Table 14 also clearly

Table 14. Adoption of mechanical method of plant protection by farmers of Thiruvananthapuram and Alappuzha districts.

Sl. No.	Practices	TVM (n=120) Category Low (%)	TVM (n=120) Category High (%)	TVM (n=120) Mean score	ALPA (n=120) Category Low (%)	ALPA (n=120) Category High (%)	ALPA (n=120) Mean score	't' value
A	Paddy							
1	Collection and destruction of egg masses and other stages of pests.	80	20	12.95	84	16	11.48	1.15^{NS}
2	Collection and destruction of affectted plant parts or plants	77	23	16.74	76	24	20.92	1.08^{NS}
B	Vegetables							
1	Collection and destruction of egg masses and other stages of pests	60	40	35.35	66	34	31.50	1.77^{NS}
2	Collection and destruction of affectted plant parts or plant	64	36	30.63	62	38	35.93	1.80^{NS}

NS Not siginificant

shows that there existed no significant difference between the farmers of Thiruvananthapuram and Alappuzha districts with respect to their mean scores for adoption of the practices of mechanical method of plant protection either in paddy or vegetables. It may be inferred that both the groups of farmers were more or less similiar adopters in the case of practices under mechanical method of plant protection. This might be due to the fact that the farmers of both the districts possessed more or less equal level of knowledge about mechanical practices of plant protection which was mentioned earlier. The same level of knowledge might have made them to perceive the utility and practicability of these practices also in a similiar manner, in plant protection, resulting in non significant difference in their adoption levels.

4.2.4. Utility perception of farmers about plant protection methods.

The data relating to utility perception, percentage analysis and 't' values testing the significance of difference between mean scores for utility perception of farmers of Thiruvananthapuram and Alappuzha districts are furnished in Table 15.

Table 15. Utility perception of farmers of Thiruvananthapuram and Alappuzha districts about plant protection methods.

Sl. No.	Plant protection methods	TVM (n=120) Category Low (%)	High (%)	Mean score	ALPA (n=120) Category Low (%)	High (%)	Mean score	't' value
1.	Chemical	65	35	20.58	68	32	23.47	3.30**
2.	Cultural	72	28	19.48	66	34	32.84	8.93**
3.	Mechanical	78	22	7.19	82	18	7.07	0.23NS
4.	Biological	—	—	—	—	—	—	—
5.	Physical	—	—	—	—	—	—	—
6.	Integrated(I.P.M.)	—	—	—	—	—	—	—

** Significant at 1% level

NS Not significant

The results of percentage analysis in Table 15 shows that 35.00 per cent of the farmers of Thiruvananthapuram district and 32.00 per cent of the farmers of Alappuzha district belonged to high perception category for their perception about the utility of the chemical method of plant protection recommended for the pests and diseases in paddy and vegetables. With regard to cultural method of plant protection, 28.00 per cent of the farmers of Thiruvananthapuram district and 34.00 per cent of the farmers of Alappuzha district belonged to high perception category for their perception about the utility of cultural method of plant protection. While,with regard to mechanical method of plant protection, 22.00 per cent of the farmers of Thiruvananthapuram district and 18.00 per cent of the farmers of the Alappuzha district belonged to high perception category for their perception about the utility of mechanical method of plant protection.

With regard to biological, physical and integrated methods of plant protection none of the farmers of the two districts perceived the utility of these methods in plant protection.

The same Table 15 and FIG. 6 clearly illustrate

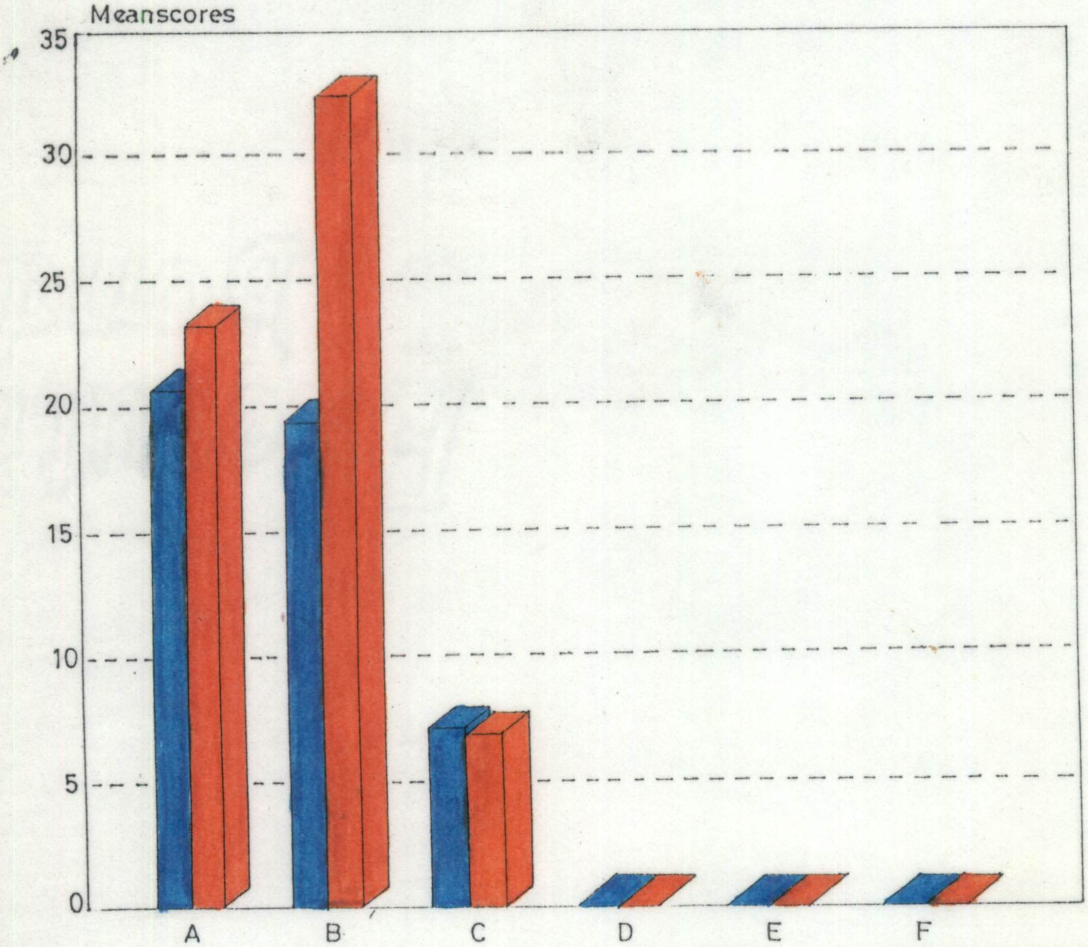
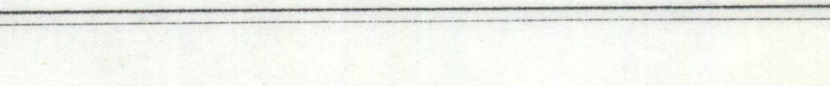


FIG. 6. UTILITY PERCEPTION OF FARMERS ABOUT PLANT PROTECTION METHODS

A. Chemical method
B. Cultural method
C. Mechanical method
D. Biological method
E. Physical method
G. Integrated method



the comparison of mean scores for the utility perception of farmers of Thiruvananthapuram and Alappuzha districts,about plant protection methods.With regard to utility perception, there existed significant difference in the mean scores with respect to chemical and cultural methods of plant protection among the farmers of Thiruvananthapuram and Alappuzha districts(the mean scores being 20.58 and 23.47, respectively for chemical method and 19.48 and 32.84, respectively for cultural method of plant protection for the farmers of Thiruvananthapuram and Alappuzha districts). The farmers of Alappuzha district perceived the utility of chemical and cultural methods of plant protection higher than the farmers of Thiruvananthapuram district. The farmers of Alappuzha district were more scientific and risk oriented. They got greater farming experience and higher income than the farmers of Thiruvananthapuram district. Their own experience in farming coupled with the other characteristics might have made them to think and perceive the utility of these methods higher than the farmers of Thiruvananthapuram district.

There was no significant difference among the two groups of farmers in their mean scores for perception about the utility of mechanical method of plant protection. It may be due to the fact that both the two groups of farmers perceived the utility of mechanical method of plant protection in almost equal manner. The reason already explained for the adoption of mechanical method of plant protection might hold good here also.

The farmers of both the districts obtained zero scores for their perception about utility of biological, physical and integrated methods of plant protection inferring that the farmers did not perceive the utility of these methods. This might be due to the fact that the farmers of the two districts did not possess any knowledge about these methods and also not convinced about the importance and utility of these methods in the field of plant protection.

4.2.4.1. Utility perception of farmers about chemical method of plant protection

The data relating to mean scores, percentage analysis and 't' values testing the significance of difference between the mean scores for utility perception of farmers about chemical method of plant protection are presented in Table 16.

Table 16. Utility perception of farmers about chemical method of plant protection in Thiruvananthapuram and Alappuzha districts.

Sl. No.	Practices	TVM (n=120) Category Low (%)	High (%)	Mean score	ALPA (n=120) Category Low (%)	High (%)	Mean score	't' value
A.	Paddy							
1	Selection of the chemical	39	61	2.10	31	69	2.23	1.42^{NS}
2	Quantity of chemical/acre	45	55	2.18	48	52	2.79	5.73^{**}
3	Quantity of chemical/pump load	64	36	1.80	66	34	1.90	1.13^{NS}
4	Number and interval of application	52	48	1.81	55	45	2.35	5.91^{**}
5	Method of application	41	59	2.10	33	67	2.22	1.24^{NS}
B.	Vegetables							
1	Selection of the the chemical	46	54	1.78	37	63	1.83	0.71^{NS}
2	Quantity of chemical/acre	57	43	1.68	58	42	2.63	8.53^{**}
3	Quantity of chemical/pump load	65	35	1.90	62	38	2.02	1.25^{NS}
4	Number and interval of application	56	44	1.86	61	39	2.42	5.39^{**}
5	Method of of application	51	49	1.66	42	58	1.56	1.30^{NS}
C.	Precautions to be taken while using pesticides	50	50	1.71	65	35	1.52	2.74^{**}

** Significant at 1% level

NS Not significant

Table 16 clearly projects that majority of the farmers belonged to high perception category for the practice 'selection of the chemical' under chemical method of plant protection' in both the districts. Minimum number of farmers belonged to high perception category for the practice 'quantity of chemical to be taken/pump load for both paddy and vegetables in both the districts.

It was also noticed from the same table that 50.00 per cent of the farmers of Thiruvananthapuram district and 35.00 per cent of the farmers of Alappuzha district belonged to high perception category for perception about the utility of the practice 'precautions to be taken while using pesticides.

The same Table 16 also illustrates that the farmers of the two districts differed significantly in the mean scores, with respect to their utility perception about the two practices under chemical method of plant protection in paddy and vegetables. They were 'quantity of chemical to be used/acre' and 'number and interval of application' of the chemical. There was no significant difference among the two groups of farmers in their mean scores about the practices 'selection of chemicals', 'quantity of chemicals to be taken/pump load' and 'method of application'.The farmers of Alappuzha district had perceived higher utility about the two practices in chemical method of plant protection viz.,'the quantity of chemical to be used/acre' and 'number and interval of application' of the chemical. It was also noticed by the researcher,during the survey, that pest and disease incidence was more in Alappuzha district than Thiruvananthapuram district. Hence the farmers of Alappuzha district might have felt that it would be very useful for them if they apply more quantity of chemical/ acre and increase the number and interval of application of the chemical, they could achieve effective pests and disease control in their fields and was due to the lack of proper knowledge.

In the case of the practice 'precautions to be taken while using pesticides', significant difference was noticed in the mean utility perception scores of the two groups of farmers. The farmers of Thiruvananthapuram district possessed higher knowledge about this practice and this might be the reason that they perceived the utility of this practice more than the farmers of Alappuzha district.

4.2.4.2. Utility perception of farmers about cultural method of plant protection.

4.2.4.2.1 Utility perception of farmers about cultural method of plant protection in paddy.

The data relating to mean scores, percentage analysis and 't' values testing the significance of difference between mean scores for perception about utility of cultural method of plant protection in paddy are given in Table 17.

The results furnished in Table 17 illustrates that among nine practices of cultural method of plant protection, for four practices namely, 'monitoring for pests in nursery', 'weeding opertation','monitoring for pests in mainfield' and 'water management' more than half of the farmers of Thiruvananthapuram district belonged to high perception category. With regard to the farmers of Alappuzha district, more than half of the farmers belonged to high perception category for 'selection of variety', 'monitoring for pests in nursery','synchronized planting','plant popolation/sq.m.', 'weeding operation' and 'monitoring for pests in main field'.

Table 17. Utility perception of farmers of Thiruvananthapuram and Alappuzha districts about cultural method of plant protection in paddy.

Sl. No.	Practices	TVM (n=120) Category Low (%)	TVM (n=120) Category High (%)	TVM (n=120) Mean score	ALPA (n=120) Category Low (%)	ALPA (n=120) Category High (%)	ALPA (n=120) Mean score	't' value
1	Summer ploughing	53	47	1.80	72	28	1.53	5.20**
2	Selection of variety	67	33	1.30	35	65	2.44	9.77**
3	Monitoring for pests in nursery	47	53	1.30	37	63	2.43	8.01**
4	Synchronised planting	54	46	1.13	31	69	2.16	8.00**
5	Plant population/sqm.	60	40	1.40	37	63	2.39	8.87**
6	Weeding operation	47	53	1.30	36	64	2.32	8.86**
7	Monitoring for pests in main field.	35	65	1.26	31	69	2.58	10.48**
8	Water management	49	51	2.30	70	30	1.98	3.02**
9	Application of nitrogenous fertilizers	70	30	1.39	61	39	2.33	9.18**

** Significant at 1% level

The same Table 17 also shows that the two groups of farmers differed significantly with respect to their mean utility perception scores, for all the nine practices under cultural method of plant protection, the farmers of Alappuzha district perceived seven practices as having higher utility, than the farmers of Thiruvananthapuram district. They were 'selection of variety','monitoring for pests in nursery','synchronised planting', 'plant population/sq.m.', 'weeding operation', 'monitoring for pests in main field', and 'application of nitrogenous fertilizers'.

The farmers of Alappuzha district also possessed more knowledge about the above practices as mentioned before. Higher knowledge coupled with their greater farming experience might have prompted the farmers of Alappuzha district to feel and perceive their utility higher in the control of pests and diseases in paddy. Due to poor drainage facilities and water logged nature of many parts of Alappuzha district, the farmer's utility perception about the practices, 'summer ploughing' and 'water management' in paddy fields was significantly lower when compared to the farmers of Thiruvananthapuram district.

4.2.4.2.2. Utility perception of farmers about cultural method of plant protection in vegetables.

The data relating to mean scores, percentage analysis and 't' values testing the significance of difference between the mean scores for the utility perception of farmers about cultural method of plant protection in vegetables are given in Table 18

The data furnished in Tabe 18 clearly show that more than half of the farmers of Thiruvananthapuram district belonged to high utility perception category for the practices 'monitoring for pests in nursery', 'weeding operation' and 'monitoring for pests in mainfield' for vegetables. With regard to the farmers of Alappuzha district more than half of the farmers belonged to high perception category for the practices 'monitoring for pests in nursery', 'synchronised planting', 'weeding operation' and 'monitoring for pests in mainfield' in vegetable cultivation. In Alappuzha district, the farmer's utility perception about the practices, 'summer ploughing' and 'water management' in paddy fields was significantly lower when compared to the farmers of Thiruvananthapuram district.

Table 18. Utility perception of farmers of Thiruvananthapuram and Alappuzha districts about cultural method of plant protection in vegetables.

Sl. No.	Practices	TVM (n=120)			ALPA (n=120)			't' value
		Category		Mean score	Category		Mean score	
		Low (%)	High (%)		Low (%)	High (%)		
1.	Monitoring for pests in nursery	35	65	1.15	34	66	2.05	9.49**
2.	Synchronised planting	68	32	0.88	40	60	2.09	11.57**
3.	Plant population/sq.m.	60	40	0.90	52	48	2.03	11.30**
4.	Weeding operation	47	53	1.22	31	69	2.28	9.44**
5.	Monitoring for pests in main field	35	65	1.20	34	66	2.23	10.58**
6.	Application of nitrogenous fertilizers	72	28	0.96	66	34	2.00	10.71**

** Significant at 1% level

The same Table 18 also clearly indicates that the two groups of farmers differed significantly with respect to their mean utility scores for all the six practices under cultural method of plant protection in vegetables. The farmers of Alappuzha perceived higher the utility of all the six cultural practices, than the farmers of Thiruvananthapuram district. The farmers of Alappuzha district possessed higher knowledge about all these cultural practices and hence they were convinced about the importance and utility of these cultural practices more.

4.2.4.3. Utility perception of farmers about mechanical method of plant protection

The data relating to mean scores, percentage analysis and 't' values, testing the significance of difference between the farmers of Thiruvananthapuram and Alappuzha districts are presented in Table 19.

The results furnished in Table 19 reveals that less than one-fourth of the farmers belonged to high perception category for mechanical practices of plant protection in paddy, in both Thiruvananthapuram and Alappuzha districts. With regard to mechanical practices of

Table 19. Utility perception of farmers of Thiruvananthapuram and Alappuzha districts about mechanical method of plant protection.

Sl. No.	Practices	TVM (n=120) Category Low (%)	High (%)	Mean score	ALPA (n=120) Category Low (%)	High (%)	Mean score	't' value
A	Paddy							
1	Collection and destruction of egg masses and other stages of pest	28	22	1.57	82	18	1.40	1.59^{NS}
2	Collection and destruction of affected plant parts or plants	75	23	1.85	70	24	1.64	1.44^{NS}
B	Vegetables							
1	Collection and destruction of egg masses and other stages of pest	57	43	2.00	61	39	2.14	1.39^{NS}
2	Collection and destruction of affected plant parts or plants	62	38	1.77	59	41	1.89	1.02^{NS}

NS Not significant

plant protection in vegetables also less than half of the farmers of both the districts belonged to high perception category.

The results presented in Table 19 also showed that there existed no significant difference between the farmers of Thiruvananthapuram and Alappuzha districts with respect to their mean scores for utility perception about mechanical method of plant protection either in paddy or in vegetables. It may be inferred that the two groups of farmers possessed no significant difference in their perception about mechanical method of plant protection. It was also noticed by the researcher,during the survey that the farmers of both the districts were more interested in chemical and cultural methods of plant protection and less interested in mechanical method of plant protection which they found practically difficult to adopt. Both the groups of farmers possessed knowledge about these practices more or less equally and perceived the utility of these practices also more or less equally.

4.2.5. Practicability perception of farmers about plant protection methods.

The data relating to mean scores, percentage analysis and 't' values, testing the significance of difference between the mean scores for practicability perception of farmers of Thiruvananthapuram and Alappuzha districts about plant protection methods are presented in Table 20.

It is evident from the results furnished in Table 20 that 32.00 per cent of farmers of Thiruvananthapuram district and 27.00 per cent of farmers of Alappuzha district belonged to high perception category for practicability perception about chemical method of plant protection. With regard to cultural method of plant protection 28.00 percent of the farmers of Thiruvananthapuram district and 21.00 per cent of farmers of Alappuzha district belonged to high perception category.

It was also noticed from the same table that 20.00 per cent of farmers of Thiruvananthapuram district and 16.00 per cent of farmers of Alappuzha district belonged to high perception category for mechanical method of plant protection.

It is evident from Table 20 and FIG.7 that there existed significant difference in the mean scores with

Table 20. Practicability perception of farmers of Thiruvananthapuram and Alappuzha districts about plant protection methods.

Sl. No.	Plant protection methods	TVM (n=120)			ALPA (n=120)			't' value
		Category		Mean score	Category		Mean score	
		Low (%)	High (%)		Low (%)	High (%)		
1.	Chemical	68	32	19.76	73	27	21.50	2.05*
2.	Cultural	72	28	18.12	74	21	31.33	9.64**
3.	Mechanical	80	21	6.04	84	16	6.50	0.96NS
4.	Biological	—	—	—	—	—	—	—
5.	Physical	—	—	—	—	—	—	—
6.	Integrated(I.P.M.)	—	—	—	—	—	—	—

** Significant at 1% level

* Significant at 5% level

NS Not significant

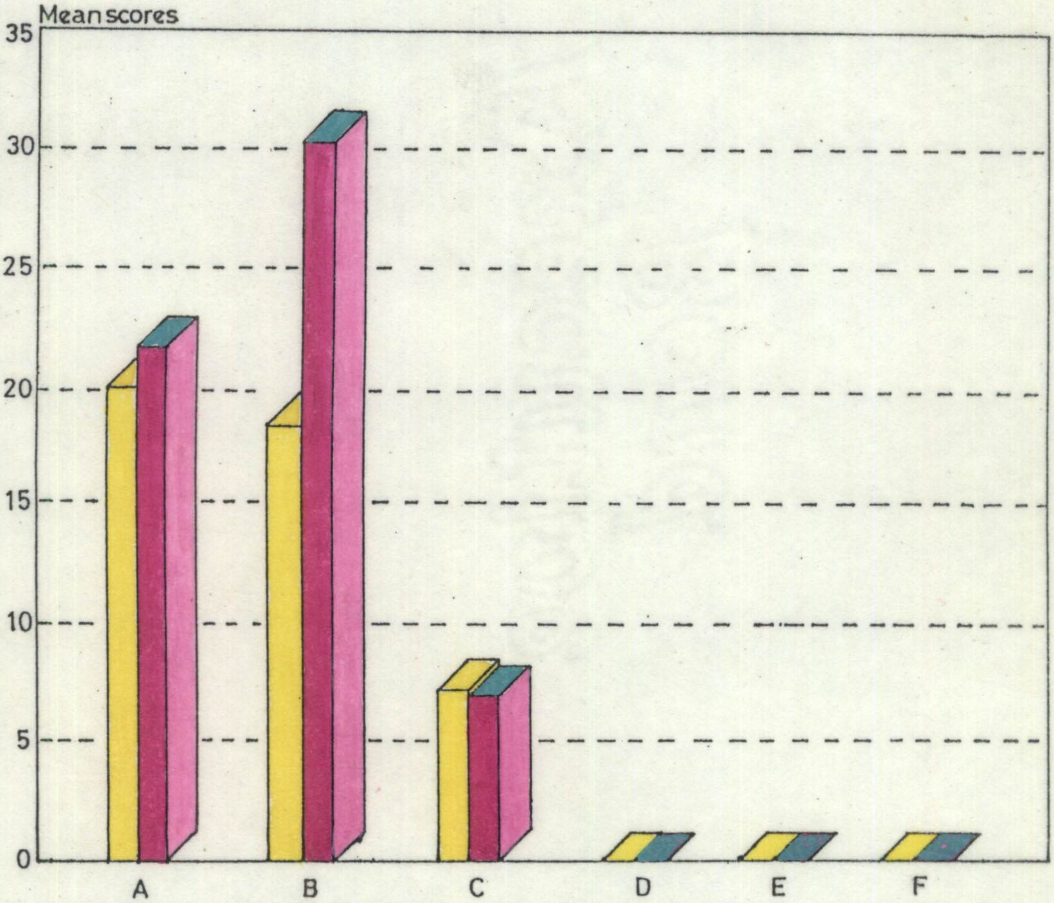


FIG. 7. PRACTICABILITY PERCEPTION OF FARMERS ABOUT PLANT PROTECTION METHODS

respect to practicability perception about chemical and cultural methods of plant protection among the farmers of Thiruvananthapuram and Alappuzha districts (the mean scores being 19.76 and 21.50, respectively for chemical method and 18.12 and 31.33, respectively for cultural method of plant protection among the farmers of Thiruvananthapuram and Alappuzha districts). It may be concluded that the farmers of Alappuzha district perceived the practicability of both the chemical and cultural methods of plant protection more than the farmers of Thiruvananthapuram district. There was no significant difference among the two groups of farmers in their mean scores for mechanical method of plant protection. Both the groups of farmers perceived more or less equally the practicability of mechanical method of plant protection. The farmers of the two districts obtained zero scores for biological, physical and integrated methods of plant protection inferring that they had not perceived the practicability of these methods. The farmers of both the districts did not possess any knowledge about these methods of plant protection and hence not perceived about the utility of these methods in the field of plant protection (which was mentioned before) resulting in non-perception about the practicability of these methods of plant protection.

Further analysis was made to assess the practice-wise practicability perception of each method of plant protection by the farmers of the two districts.

4.2.5.1. Practicability perception of farmers about chemical method of plant protection

The data relating to practicability perception, percentage analysis and 't' values, testing the significance of difference between the mean scores for practicability perception of farmers of Thiruvananthapuram and Alappuzha districts about chemical method of plant protection are presented in Table 21.

The results furnished in Table 21 clearly illustrates that the majority of farmers belonged to high perception category for the practice 'selection of the chemical', in both the districts. It was also found from the same table that the lowest number of farmers in the high perception category was for the practice 'quantity of chemical to be taken/pump load'.

The same Table 21 also shows that the farmers of

Table 21. Practicability perception of farmers of Thiruvananthapuram and Alappuzha districts, about chemical method of plant protection

Sl. No.	Practices	TVM (n=120) Category Low (%)	TVM Category High (%)	TVM Mean score	ALPA (n=120) Category Low (%)	ALPA Category High (%)	ALPA Mean score	't' value
A	Paddy							
1	Selection of the chemical	41	59	2.03	35	65	2.10	0.87 NS
2	Quantity of chemical/acre	48	52	2.16	50	50	2.40	2.39*
3	Quantity of chemical/pump load	69	31	1.50	70	30	1.60	1.37 NS
4	Number and interval of application	55	45	1.80	58	42	2.02	2.70**
5	Method of application	44	56	2.10	39	61	2.15	0.60 NS
B	Vegetables							
1	Selection of the chemical	50	50	1.75	41	59	1.81	0.90 NS
2	Quantity of chemical/acre	61	39	1.65	60	40	2.24	6.62**
3	Quantity of chemical/pump load	68	32	1.79	65	35	1.88	1.03 NS
4	Number and interval of application	60	40	1.80	64	36	2.34	6.23**
5	Method of of application	55	45	1.65	46	54	1.74	1.40 NS
C	Precautions to be taken while using pesticides	53	47	1.53	69	31	1.22	5.19**

** Significant at 1% level
* Significant at 5% level
NS Not significant

the two districts, Thiruvananthapuram and Alappuzha significantly in the mean scores with respect to the practicability perception about the two practices under chemical method of plant protection in paddy and vegetables. They were 'quantity of chemical to be used/acre' and 'number and interval of application' of the chemicals. There was no significant difference among the two groups of farmers with regard to their perception about the practices 'selection of the chemicals','quantity of chemical to be taken/pump load' and 'method of application'. The farmers of Alappuzha had perceived higher utility about the two practices in chemical method of plant protection viz.,'quantity of chemical to be used/acre' and 'number and interval of application' of the chemical. It was also noticed by the researcher,during the survey that pest and disease incidence was more in Alappuzha district than in Thiruvananthapuram district. Hence the farmers of Thiruvananthapuram district might have felt that it would be very useful for them if they apply more quantity of chemical/acre and increase the number and interval of application of the chemical to ensure effective pest and disease control in their fields. These might be the reasons for the farmers of Alappuzha district to perceive significantly higher about the practicability of the two the two districts, Thiruvananthapuram and Alappuzha differed significantly in the mean scores with respect to their practicability perception about the two practices under chemical method of plant protection in paddy and vegetables. They were 'quantity of chemical to be used/acre' and 'number and interval of application' of the chemicals. There was no significant difference among the two groups of farmers with regard to their perception about the practices 'selection of the chemicals','quantity of chemical to be taken/pump load' and 'method of application'. The farmers of Alappuzha had perceived higher utility about the two practices in chemical method of plant protection viz.,'quantity of chemical to be used/acre' and 'number and interval of application' of the chemical. It was also noticed by the researcher,during the survey that pest and disease incidence was more in Alappuzha district than in Thiruvananthapuram district. Hence the farmers of Thiruvananthapuram district might have felt that it would be very useful for them if they apply more quantity of chemical/acre and increase the number and interval of application of the chemical to ensure effective pest and disease control in their fields. These might be the reasons for the farmers of Alappuzha district to perceive significantly higher about the practicability of the two practices 'quantity of chemical / acre' and 'number and interval of application of the chemical', than the farmers of Thiruvananthapuram district. More over the farmers of Alappuzha district, had higher annual income than the farmers of Thiruvananthapuram district.Their higher income also might have helped them to perceive the practicability of adopting these practices more than the farmers of the other district. In the case of the practice 'precautions to be taken while using pesticides',significant difference was noticed in the mean practicability perception scores between the two groups of farmers.The farmers of Thiruvananthapuram district perceived the practicability of these practices more since they had perceived the utility of these practices more than the farmers of Alappuzha district .

4.2.5.2. Practicability perception of farmers about cultural method of plant protection.

4.2.5.2.1. Practicability perception of farmers about cultural method of plant protection in paddy.

The data relating to mean scores, percentage analysis 't' values testing the significance of difference between mean scores for practicability perception of farmers of Thiruvananthapuram and Alappuzha districts about cultural method of plant protection in paddy are furnished in Table 22.

It is clearly evident from Table 22 that with regard to the farmers of Thiruvananthapuram district more than half of the farmers belonged to high perception category for the practices 'monitoring for pests in nursery', 'weeding operation', 'monitoring for pests in main field' and 'water management'. It was also noticed that with regard to the farmers of Alappuzha district, more than half of the farmers belonged to high perception category for the practices 'selection of variety' 'monitoring for pests in nursery', 'synchronised planting','plant population/sq.m.', 'weeding operation'and 'monitoring for pests in main field'.

Table 22 also shows that the farmers of Thiruvananthapuram and Alappuzha districts differed significantly in the mean scores of practicability perception about all the nine practices under cultural method of plant protection in paddy. Out of the nine cultural practices of plant protection in paddy, seven practices, 'selection of variety', 'monitoring pests in nursery', 'synchronised planting','plant population/sq.m.',

Table 22. Practicability perception of farmers of Thiruvananthapuram and Alappuzha districts, about cultural method of plant protection in paddy.

Sl. No.	Practices	TVM (n=120)			ALPA (n=120)			't' value
		Category		Mean score	Category		Mean score	
		Low (%)	High (%)		Low (%)	High (%)		
1	Summer ploughing	54	46	1.96	74	26	1.63	2.89**
2	Selection of variety	70	30	1.20	40	60	2.24	10.32**
3	Monitoring for pests in nursery	49	51	1.20	37	63	2.33	10.17**
4	Synchronised planting	58	42	1.02	32	68	1.86	9.05**
5	Plant population/sq.m.	60	40	1.20	38	62	2.29	10.81**
6	Weeding operation	49	51	1.20	38	62	2.4	9.87**
7	Monitoring for pests in main field.	50	50	1.16	32	68	2.48	9.10**
8	Water management	49	51	2.15	74	26	1.80	3.25**
9	Application of nitrogenous fertilizers	71	29	1.29	61	39	2.25	10.25**

** Significant at 1 % level

'weeding operation', 'monitoring for pests in main field'and 'application of nitrogenous fertilizers' had been perceived significantly higher for practicability by the farmers of Alappuzha district. It is very much relevant in this context that the farmers of Alappuzha district possessed significantly higher knowledge about these practices and moreover thay had perceived the utility and practicability of these practices significantly more when compared with the farmers of Thiruvananthapuram district. The farmers of Alappuzha district perceived the practicability of 'summer ploughing' and 'water management' significantly lesser than the farmers of Thiruvananthapuram district. This might be due to the fact that most of the fields in Alappuzha district had poor drainage facilities and suffered from water logging problems. Hence they perceived the utility and practicability of these two practices significantly lesser than the farmers of Thiruvananthapuram district.

4.2.5.2.2. Practicability perception of farmers about cultural method of plant protection in vegetables.

The data relating to mean scores, percentage analysis and 't' values testing the significance of difference between mean scores for practicability perception of farmers of Thiruvananthapuram and Alappuzha districts about cultural method of plant protection in vegetables are furnished in Table 23.

It may be observed from Table 23 that among six practices, more than half of the farmers of Thiruvananthapuram district belonged to high perception category for the practices 'monitoring for pests in nursery', 'weeding operation' and 'monitoring for pests in main field'. It was also noticed from the same table that with regard to the farmers of Alappuzha district, more than half of the farmers belonged to high adoption category for the practices 'monitoring for pests in nursery','synchronised planting', 'weeding operation' and 'monitoring for pests in mainfield'.

Table 23 also clearly shows that the two groups of farmers differed significantly with respect to their mean practicability perception scores for all the six practices under cultural method of plant protection. It may be inferred that the farmers of Alappuzha district perceived significantly higher about the practicability of all these practices in plant protection than the farmers of

Table 23. Practicability perception of farmers of Thiruvananthapuram and Alappuzha districts, about cultural method of plant protection in vegetables.

Sl. No.	Practices	TVM (n=120) Category Low (%)	TVM Category High (%)	TVM Mean score	ALPA (n=120) Category Low (%)	ALPA Category High (%)	ALPA Mean score	't' value
1.	Monitoring for pests in nursery	35	65	1.05	34	66	1.95	10.58**
2.	Synchronised planting	70	30	0.78	40	60	1.99	13.16**
3.	Plant population/sq.m.	60	40	0.80	55	45	1.90	13.84**
4.	Weeding operation	48	52	1.12	32	68	2.18	11.05**
5.	Monitoring for pests in main field	35	65	1.10	37	63	2.13	10.35**
6.	Application of nitrogenous fertilizers	73	27	0.89	66	34	1.90	13.74**

** Significant at 1% level

Thiruvananthapuram district. It may be due to the fact that they possessed higher knowledge about these cultural practices which might have acquired from their own longer experience in farming.

4.2.5.3. Practicability perception of farmers about mechanical method of plant protection.

The data relating to mean scores, percentage analysis and 't' values , testing the significance of difference between mean scores for practicability perception of farmers of Thiruvananthapuram and Alappuzha districts about mechanical method of plant protection are given in Table 24.

Table 24 clearly projects that less than 50.00 per cent of the farmers of both districts belonged to high perception category for the mechanical practices of plant protection in paddy and vegetables.

It is also observed from Table 24 that there existed no significant difference between the farmers of Thiruvananthapuram and Alappuzha districts with regard to their practicability perception about the practices of mechanical method of plant protection in paddy and

Table 24. Practicability perception of farmers of Thiruvananthapuram and Alappuzha districts about mechanical method of plant protection.

Sl. No.	Practices	TVM (n=120) Category Low (%)	High (%)	Mean score	ALPA (n=120) Category Low (%)	High (%)	Mean score	't' value
A	Paddy							
1	Collection and destruction of egg masses and other stages of pests	80	20	1.25	84	16	1.34	0.78^{NS}
2	Collection and destruction of affected plant parts or plants.	78	22	1.23	72	28	1.30	0.62^{NS}
B	Vegetables							
1	Collection and destruction of egg masses and other stages of pests.	60	40	1.86	62	38	1.98	1.06^{NS}
2	Collection and destruction of affected plant parts or plants.	62	38	1.70	62	38	1.88	1.68^{NS}

NS Not significant

vegetables. It may be inferred that the farmers of both districts perceived the practicability of mechanical method of plant protection more or less equally. The farmers of both the districts possessed more or less equal level of knowledge and perceived the utility of this method in plant protection more or less equally resulting in non significant difference in their perception about practicability of mechanical method of plant protection in paddy and vegetables.

4.2.6. Comparison of the dependent variables of the study.

The data relating to mean scores, percentage analysis on distribution of farmers for the dependent variables and 't' values testing the significance of difference between the mean scores for the dependent variables of the study are given in Table 25.

It is implicit from Table 25 that 34.00 per cent of the farmers of Thiruvananthapuram district and 30.00 per cent of the farmers of Alappuzha district belonged to high knowledge level category. It was also clear that more than 50.00 per cent of the farmers of both the districts had favourable attitude towards chemical method of plant

Table 25. Comparison of dependent variables of the study.

Sl. No.	Practices	TVM (n=120) Category Low (%)	High (%)	Mean score	ALPA (n=120) Category Low (%)	High (%)	Mean score	't' value
1.	Knowledge	66	34	70.15	70	30	64.31	2.18*
2.	Attitude	47 (UF)	53 (F)	32.40	42 (UF)	58 (F)	34.33	2.00*
3.	Adoption	61	39	3979.31	37	63	4856.60	4.40**
4.	Utility perception	67	33	47.25	65	35	63.38	5.55**
5.	Practicability perception	67	33	43.92	66	34	59.33	5.32**

** Significant at 1% level

* Significant at 5% level

F Favourable

UF Unfavourable

protection. With regard to adoption of plant protection methods 39.00 per cent of the farmers of Thiruvananthapuram district and 63.00 per cent of farmers of Alappuzha district belonged to high adoption category. It is also noticeable that with regard to utility and practicability perceptions the distribution of farmers in the high perception categories were more or less same in both the districts. The farmers in the high knowledge level category was less in Alappuzha district (30.00 per cent) and at the same time those belonged to high adoption category was more (63.00 per cent).It is heartening to note that the 63.00 per cent of farmers belonged to high adoption category due to excess adoption of chemical method of plant protection which was mentioned earlier. Lack of proper knowledge of the farmers of Alappuzha district,about scientific method of chemical plant protection paved way to excess adoption of these chemicals,threatening man and his environment .

It is also implicit from Table 25 that the difference in the mean scores was significant between the farmers of Thiruvananthapuram and Alappuzha districts with respect to all the dependent variables namely knowledge, attitude, adoption, utility perception and practicability perception. The farmers of Alappuzha district were found to be higher adopters of plant protection methods than the farmers of Thiruvananthapuram district. The possible reasons might be that these farmers were found to possess more favourable attitude towards chemical method of plant protection and also they had perceived the utility and practicability of plant protection methods significantly, better than the farmers of Thiruvananthapuram district. More over the farmers of Alappuzha district had higher annual income and this enabled them to purchase plant protection chemicals and also adopt plant protection methods more than the farmers of Thiruvananthapuram district. It could be further seen from the same table that the farmers of Thiruvananthapuram district scored significantly higher knowledge score than the farmers of Alappuzha district indicating their better level of knowledge about plant protecton methods when compared to the farmers of Alappuzha district. This might be due to the fact that the farmers of Thiruvananthapuram district might have got better facilities and opportunities to utilise information sources which could have enriched their knowledge. The farmers of Alappuzha district were found to be higher adopters of plant protection methods. It is relevant to point out in this context , that most of the farmers of Alappuzha district were found as excess adopters of chemical method of plant protection. It might be due to the fact that the farmers of Alappuzha district possessed lesser knowledge and due to lack of proper knowledge they might have utilised more quantities of chemicals and thus their adoption rate went up. More over it was also noticed that the occurrence of pests and diseases was more in Alappuzha district.

From the above discussions the hypotheses that there would be no significant difference between the farmers of the two districts with respect to the dependent variables were rejected in the case of knowledge, attitude, adoption, utility perception, and practicability perception.

4.3. Relationship between the independent and dependent variables

4.3.1. Correlation between independent and dependent variables with respect to the farmers of Thiruvananthapuram district.

The results of correlation analysis between the independent variables and the five dependent variables namely knowledge(Y1), attitude(Y2), adoption(Y3), utility perception(Y4) and practicability perception(Y5) with respect to the farmers of Thiruvananthapuram district are furnished in Table 26.

It is clear from Table 26 that out of the 12 independent variables, seven variables namely economic motivation, crop yield index, contact with extention agency, information source utilisation, scientific orientation, risk orientation and management orientation indicated positive and significant relationship with dependent variables namely knowledge(Y1), adoption(Y3), utility perception(Y4) and practicability perception(Y5). With regard to the dependent variable attitude(Y2), only farm size and farming experience were found to have significant relationship.

4.3.2. Correlation between independent and dependent variables with respect to the farmers of Alappuzha district.

The results of correlation analysis between the independent variables and the five dependent variables namely knowledge(Y1), attitude(Y2), adoption(Y3), utility perception(Y4) and practicability perception(Y5) with

Table 26. Correlation between independent and dependent variables with respect to the farmers of Thiruvananthapuram district. n=120

Sl. No.	Independent variable	Correlation coefficient(r) Dependent variable				
		Y1	Y2	Y3	Y4	Y5
1	Family educational status	0.0088^{NS}	0.0660^{NS}	0.0088^{NS}	0.0623^{NS}	0.0469^{NS}
2	Farm size	0.0027^{NS}	0.2723**	0.0055^{NS}	0.1045^{NS}	0.1219^{NS}
3	Annual income	0.0295^{NS}	0.1247^{NS}	0.0339^{NS}	0.1053^{NS}	0.1186^{NS}
4	Farming experience	0.0785^{NS}	0.2019*	0.0177^{NS}	0.0540^{NS}	0.0683^{NS}
5.	Cosmopoliteness	0.0796^{NS}	0.0105^{NS}	0.1015^{NS}	0.1112^{NS}	0.0886^{NS}
6.	Economic motivation	0.7804**	0.03460^{NS}	0.5227**	0.7799**	0.7713**
7	Crop yield index	0.7351**	0.0430^{NS}	0.5515**	0.9375**	0.9167**
8	Contact with extension agency	0.4473**	0.0702^{NS}	0.4021**	0.4371**	0.4215**
9	Information source utilisation	0.3980**	0.1298^{NS}	0.3712**	0.3874**	0.3947**
10	Scientific orientation	0.8545**	0.0886^{NS}	0.6262**	0.8507**	0.8435**
11	Risk orientaion	0.4907**	0.1363^{NS}	0.3704**	0.5299**	0.5372**
12	Management orientation	0.3470**	0.0723^{NS}	0.1959*	0.3552**	0.3771**

** Significant at 1% level
* Significant at 5% level
NS Not significant
Y1 Knowledge
Y2 Attitude
Y3 Adoption
Y4 Utility perception
Y5 Practicability perception

respect to the farmers of Alappuzha district are furnished in Table 27.

It is implicit from Table 27 that out of twelve independent variables, nine variables namely farm size, annual income, economic motivation, crop yield index, contact with extension agency, information source utilisation. scientific orientation, risk orientation and management orientation showed positive and significant relationship with all the five dependent variables namely knowledge (Y1), attitude(Y2),adoption(Y3), utility perception(Y4) and practicability perception(Y5).

It may be seen from Table 26 and Table 27 that the correlation values of seven independent variables namely economic motivation, crop yield index, contact with extension agency, information source utilisation, scientific orientation, risk orientation and management orientation had significant and positive relationship with the dependent variables knowledge(Y1), adoption(Y3), utility perception(Y4) and practicability perception(Y5) among the farmers of Thiruvananthapuram and Alappuzha. Farm size and farming experience were positively and significantly related to dependent variable attitude(Y2) among the farmers

Table 27. Correlation between independent and dependent variables with respect to the farmers of Alappuzha district. n=120

Sl. No.	Independent variables	Correlation coefficient(r) Dependent variables Y1	Y2	Y3	Y4	Y5
1	Family educational status	0.0157NS	0.0424NS	0.0361NS	0.0906NS	0.0964NS
2	Farm size	0.2052*	0.2496**	0.2738**	0.1810*	0.1958*
3	Annual income	0.4856**	0.5294**	0.5274**	0.4166**	0.4013**
4	Farming experience	0.0111NS	0.0306NS	0.0155NS	0.0431NS	0.0727NS
5.	Cosmopoliteness	0.0019NS	0.0914NS	0.0352NS	0.0070NS	0.0199NS
6.	Economic motivation	0.7741**	0.8539**	0.8191**	0.7823**	0.7548**
7	Crop yield index	0.8736**	0.8450**	0.8886**	0.7283**	0.6890**
8	Contact with extension agency	0.6785**	0.7515**	0.7721**	0.7012**	0.6736**
9	Information source utilisation	0.6864**	0.7746**	0.7385**	0.6981**	0.6904**
10	Scientific orientation	0.9115**	0.9740**	0.9478**	0.8777**	0.8256**
11	Risk orientation	0.3932**	0.4236**	0.4305**	0.4190**	0.3978**
12	Management orientation	0.8671**	0.9098**	0.9153**	0.8634**	0.8215**

** Significant at 1% level
* Significant at 5% level
NS Not significant
Y1 Knowledge
Y2 Attitude
Y3 Adoption
Y4 Utility perception
Y5 Practicability perception

of Thiruvananthapuram district (Table 26). The correlation values portrayed in Table 27 reveals that nine independent variables namely farm size, annual income, economic motivation, crop yield index, contact with extension agency, information source utilisation, scientific orientation, risk orientation and management orientation showed positive and significant relationship with all the five dependent variables with regard to farmers of Alappuzha district.

Farm size showed positive and significant relationship with knowledge, attitude, adoption, utility perception and practicability perception of farmers of Alappuzha district. Large farm size would have made the farmers to search for more information and acquire more knowledge about plant protection methods to practise in their farms extensively to augment the production. Cultivation on large farms gives more income to the farmers and better monetary benefits in turn help the farmers to develop a favourable attitude. These might be the reasons for the positive and significant relationship of farm size with knowledge and attitude of farmers.

Farm size also had positive and significant relationship with adoption among the farmers of Alappuzha district. It may be attributed to the reason that it is quite obvious that farmers with large size holding would have greater income and hence it would have helped them for higher adoption. This finding is in line with the findings of Gogoi and Gogoi(1989), Vijayan(1989) and Athimuthu(1990). Farm size showed positive and significant association with the utility and practicability perception. Farm size has an important role in deciding the adoption of a practice by a farmer which is actually a reflection of his perception about the utility and practicability of that particular practice.

Annual income was also found to have positive and significant association with knowledge among the farmers of Alappuzha district. Farmers with higher annual income will have a position to afford to get more detailed information through various avenues of information and which would have paved way for realisation of the worthiness of the technology. This finding is in line with the findings of Patil(1985), Chenniappan(1987) and Venkatapirabu(1988). Annual income had positive and significant relationship with attitude among the farmers of Alappuzha district. Farmers who possessed more income will have a positive affect towards practising an innovation. This finding is in line with the findings of Sushama(1979), Viju(1985), Kunchu (1989) and Latha(1990). Annual income was found to have positive and significant relationship with adoption among the farmers of Alappuzha district. Annual income has an important role in making available the required amount of money essential for the adoption of various farming operations. Annual income influences various farming and related activities of farmer. This argument draws the support of the findings made by Aziz(1988), Athimuthu(1990) and Govind(1992). Annual income also showed positive and significant association with the utility and practicability perceptions.Annual income has an important role in deciding adoption behaviour of an individual which is vested upon the fact that how he perceives the utility and practicability of an idea. This finding is in line with the findings of Sudha(1987) and Latha(1990).

Economic motivation was found to have significant and positive relationship with knowledge of farmers of Thiruvananthapuram and Alappuzha districts. Economic motivation directs a farmer towards profit augmentation and helps him to make more money out of his farming and other related activities. Those farmers who had high economic motivation showed a tendency to know more about the practices which would help to protect their crops and earn more. This finding is in confirmity with the findings of Janakiramraju (1978), Jeyakrishnan(1984) and Singh and Ray(1985).

Economic motivation had positive and significant relationship with attitude among the farmers of Thiruvananthapuram and Alappuzha districts. A farmer seeking more monetory benefits is likely to invest more money for production inputs. Once money is invested wisely and high yields are obtained the farmer is likely to develop a positive attitude and this might be the reason for positive association of economic motivation with attitude. This finding is in line with the findings of Jayavelu(1980) and Jnanadevan(1993).

Economic motivation was found to have significant and positive relationship with adoption among the farmers of Thiruvananthapuram and Alappuzha districts. The significant relationship might be due to the fact that a farmer who invests more money in farming is likely to achieve an increase in yield when he adopts a practice. Economic motivation is one of the important motives which moulds the behaviour of individual and hence it is quite possible that farmers high in this value aspect exhibit a desired behavioural pattern. This result is in confirmity with the findings of Balan(1987) and Sajeevchandran(1989).

Economic motivation also had positive and significant relationship with utility and practicability perception among the farmers of Thiruvananthapuram and Alappuzha districts. When high yields are obtained by putting into practice a method the farmer is likely to get convinced and perceive more about the utility and practicability of that method. This might be the reason for the positive association of economic motivation with utility and practicability perceptions.

Crop yield index had positive and significant relationship with knowledge, attitude, adoption, utility perception and practicability perception with regard to the farmers of both the districts. It showed the strong influence of crop yield index on the dependent variables knowledge, attitude, adoption, utility perception and practicability perceptions. When the knowledge of the farmer about a particular technology was high it could be, able to develop a favourable attitude towards that technology resulting in higher adoption due to higher perception about the utility and practicability of that particular technology. The yield potential plays a significant role in making the farmers accept and adopt a new variety. It is evident that the farmers would be ready to adopt a technology when they are convinced about its role in increased yields. When the crop yields are higher farmers go for continued use of the technology in the coming seasons so as to stabilise the high crop yields they obtained earlier. The crop yield index had a strong and positive relationship with adoption. This finding is in line with the findings of Samantha(1977), Ramalingagowda(1978), Bhaskaran(1979), Syamala(1988) and Ramachandran(1992). Crop yield index definitely had an influence on the farmer's behaviour.

Contact with extension agency and information source utilisation were found to have positive and significant relationship with knowledge, attitude, adoption and utility and practicability perceptions among the farmers of Thiruvananthapuram and Alappuzha districts. The greater the contact with extension agency and the more the information sources utilised farmers acquired more knowldege which would have helped them to develop a favourable attitude towards a technology. This might have helped them to perceive more about the utility and practicability of these agricultural practices, so as to adopt these practices more in their farms for increasing the returns and earnings from their farms. This finding is in confirmity with the findings of Anandarao(1988), Syamala(1988) and Govind(1992).

Scientific orientation, risk orientation and management orientation also had positive and significant relationship with knowledge, attitude, adoption and utility and practicability perceptions of farmers of both the districts. Scientific orientation helps farmers to attain excellence in cultivation. Farmers with more scientific orientation have a tendency to know more about new ideas and methods of scientific agriculture. Sometimes the farmer has to take risks in performing certain farming operations. In such cases he has to effectively manage his farming operations in such a manner to protect his crops from crop loss so as to increase production. The nature of being more scientifically oriented and possessing more capacity to take risks helped the farmers to know and understand the practices very clearly for effective management of the farm.

This led to the development of a favourable attitude towards scientific technology and higher perception about the utility and practicability of the technology resulting in better adoption. This finding is in agreement with the findings of Kamarudeen(1981), Anithakumari(1989) and Jnanadevan(1993).

In view of the above discussion, with regard to the farmers of Thiruvananthapuram district the hypotheses set for the study that there would be no significant relationship between the independent variables and dependent variables Y1,Y3,Y4 and Y5 were rejected in the case of economic motivation, crop yield index, contact with extension agency, information source utilisation, scientific orientation, risk orientation and management orientation and accepted in the case of family educational status, farm size,annual income,farming experience and cosmopoliteness. And also the hypotheses set for the study that there would be no significant relationship between the independent variables and Y2 were rejected in the case of farm size and farming experience,. and the same was accepted in the case of the other ten independent variables.

With regard to the farmers of Alappuzha

districts the hypotheses set for the study that there would be no significant relationship between the independent variables and dependent variables Y1,Y2,Y3,Y4 and Y5 were rejected in the case of nine independent variables namely farm size, annual income, economic motivation,crop yield index, contact with extension agency, information source utilisation, scientific orientation, risk orientation and management orientation while the same were accepted in the case family educational status, farming experience and cosmopoliteness.

4.3.3 Multiple regression analysis of the independent variables with dependent variables with respect to the farmers of Thiruvananthapuram district.

The results of multiple regression analysis of the independent variables and the dependent variables with respect to the farmers of Thiruvananthapuram district are furnished in Table 28. For all the five dependent variables namely knowledge(Y1), attitude(Y2), adoption(Y3), utility perception(Y4) and practicability perception(Y5) the 'F' values obtained were found to be significant, indicating that the selected independent variables put together contributed significantly to the variations in the five

Table 28 Multiple regression analysis of the independent variables with dependent variables with respect to the farmers of Thiruvananthapuram District (n = 120)

Sl. No.	Independent variables	Y1 B weights	Y1 't' value	Y2 B weights	Y2 't' value	Y3 B weights	Y3 't' value	Y4 B weights	Y4 't' value	Y5 B weights	Y5 't' value
1	Family educational status	-0.0527	-0.319	0.0886	1.203	-1.6255	-0.091	0.0004	0.010	-0.0103	-0.213
2	Farm size	-0.0174	-1.505	-0.0068	-1.330	-1.1117	-0.892	0.0014	0.432	-0.0005	-0.148
3	Annual income	0.4011	1.507	0.0481	0.405	25.5972	0.889	-0.0879	-1.194	-0.0460	-0.588
4	Farming experience	-0.1198	-0.8290	0.1250	1.940	-3.3017	-0.211	0.0174	0.435	0.0076	0.178
5	Cosmopoliteness	0.4301	-0.586	0.3073	0.940	4.5934	0.436	0.0585	0.289	-0.0683	-0.317
6	Economic motivation	0.0986	0.032	0.6081	0.448	448.986	1.365	2.7884	3.320**	2.5880	2.90**
7	Crop yield index	0.3879	1.450	0.1393	1.168	1.9305	0.067	0.9693	13.128**	0.8367	10.563**
8	Contact with extension agency	0.2007	0.757	-0.0481	-0.407	32.7817	1.144	0.0048	0.065	-0.0529	-0.680
9	Information source utilisation	0.0090	0.084	0.0553	1.162	7.4459	0.645	0.0025	0.086	0.0106	0.339
10	Scientific orientation	10.7593	3.439	0.7935	1.023	646.459	3.439	0.9875	2.057	1.1336	2.222*
11	Risk orientation	-0.1765	-0.379	0.2937	1.415	-4.0191	-0.080	0.1278	0.004	0.1314	0.962
12	Management orientation	0.0718	0.135	-0.2230	-1.426	-63.859	-1.632	0.1926	1.311	0.2981	1.910
		R^2 = 0.7489** F = 24.3266**		R^2 = 0.2509** F = 2.7303**		R^2 = 0.4675** F = 7.1073**		R^2 = 0.9037** F = 76.541**		R^2 = 0.8741** F = 56.622**	

** Significant at 1% level *Significant at 5% level R^2 Coefficient of determination dependent variables. The coefficient of determination worked out were 0.7489, 0.2509, 0.4675, 0.9037 and 0.8741 for Y1, Y2, Y3, Y4 and Y5 respectively. This revealed that about 75 per cent of the variations in knowledge 25 per cent of the variations in attitude, 47 per cent of the variations in adoption , 90 per cent of the variations in utility perception and 87 per cent of the variations in practicability perception were explained by the independent variables selected for the study.

The β weights computed, showed that scientific orientation was found significantly contributing to the variations in knowledge(Y1). In the case of adoption(Y3) the β weights showed that scientific orientation was found significant in contributing to the variations in adoption. With regard to utility perception(Y4), the β weights computed showed that economic motivation, crop yield index and scientific orientation were significant in contributing to variations in utility perception. While in the case of practicability perception(Y5), the β weights computed showed that economic motivation, crop yield index and scientific orientation were found significant in contributing to the variations in practicability perception.

The results of multiple regression analysis with respect to the farmers of Thiruvananthapuram district indicated that scientific orientation was found to be an important variable in explaining the variations in knowledge and adoption. Economic motivation, crop yield index and scientific orientation were found to be important variables in explaining the variations in utility perception and practicability perception.

In the light of the above discussion the hypotheses set for the study that there would be no significant contribution of the independent variables to the variations in the knowledge and adoption were rejected in the case of scientific orientation and the same were accepted in the case of other eleven variables. The hypotheses that there would be no significant contribution of the independent variables to the variations in the dependent variable attitude were accepted. While the hypotheses set for the study that there would be no significant contribution of the independent variables to the variations in the dependent variables, utility perception and practicability perception were rejected in the case of independent variables economic motivation, crop yield index and scientific orientation and the same were accepted in the case of the other nine independent variables.

4.3.4. Multiple regression analysis of the independent variables with the dependent variables with respect to the farmers of Alappuzha district.

The results of multiple regression analysis of the independent variables with respect to the farmers of Alappuzha district are presented in Table 29.

It is observed from the above Table that the 'F' values obtained for all the five dependent variables namely knowledge(Y1), attitude(Y2), adoption(Y3), utility perception(Y4) and practicability perception(Y5), were found significant, indicating that the selected independent variables put together contributed significantly to the variations in the five dependent variables. The coefficients of determination worked out were 0.8736, 0.9539, 0.9353, 0.7987 and 0.7170 for Y1, Y2, Y3, Y4 and Y5 respectively. This revealed that about 87 per cent of the variations in knowledge, 95 per cent of the variations in attitude, 94 per cent of the variations in adoption, 80 per cent of the variations in utility perception and 72 per cent of the

Table 29 Multiple regression analysis of the independent variables with dependent variables with respect to the farmers of Alappuzha District (n=120)

Sl. No.	Independent variables	Y1		Y2		Y3		Y4		Y5	
		B weights	't' value	B weights	't' value	B weights	't' value	B weights	't' value	B weights	't' value
1	Family educational status	0.0814	0.814	0.0161	0.888	2.5439	0.572	0.0848	1.522	0.0688	1.133
2	Farm size	-0.0030	-1.04	-0.0005	-1.066	0.0982	0.321	-0.0009	-0.587	0.0003	0.161
3	Annual income	0.0153	0.345	0.0068	0.829	1.1425	0.571	-0.0191	-0.762	-0.0208	-0.760
4	Farming experience	0.0198	-0.314	-0.0069	0.598	-0.9922	-0.354	-0.0227	-0.646	-0.0428	-1.117
5	Cosmopoliteness	-0.0546	-0.124	0.0621	0.776	-5.8557	0.599	0.3391	1.383	0.1969	0.736
6	Economic motivation	-0.6731	-0.456	-0.1255	-0.467	25.2133	0.384	-0.3846	-0.467	0.2402	0.268
7	Crop yield index	0.4387	4.684**	0.0096	0.565	27.2844	6.550**	-0.0298	-0.571	0.0045	0.079
8	Contact with extension agency	-0.2772	-1.251	-0.0361	-0.896	14.1012	1.430	-0.1144	-0.926	-0.1212	-0.900
9	Information source utilisation	0.0133	-0.140	0.0157	0.950	-2.0053	-0.497	0.0281	0.556	0.0656	1.188
10	Scientific orientation	5.06662	3.258**	3.1265	11.059**	236.441	3.419**	3.225	3.718**	1.7260	1.327
11	Risk orientation	-0.3223	-0.830	0.0125	0.177	10.1767	0.589	0.2748	1.269	0.2848	1.206
12	Management orientation	1.2887	-1.366	-0.3163	-1.344	59.766	1.502	0.9570	1.820	1.150	2.006*
		R^2=0.8736 F =56.3722**		R^2 0.9539 F = 168.6101**		R^2 =0.9353 F =117.8912**		R^2=0.7987 F =32.3597**		R^2 =0.7170 F =20.6617**	

** Significant at 1% level * Significant at 5% level R^2 Coefficient of determination variations in practicability perception were explained by the idependent variables selected for the study. The β weights computed showed that with regard to knowledge(Y1), crop yield index, and scientific orientation contributed significantly to knowledge. In the case of attitude(Y2), the β weights computed showed that only scientific orientation contributed significantly to the variations in attitude. With regard to adoption(Y3), crop yield index and scientific orientation were significant in contributing to the variations in adoption. In the case of utility perception(Y4) also, the β weights computed showed that only scientific orientation was found significant in contributing to the variations in utility perception and in the case of practicability perception (Y5), the β weights computed showed that only management orientation contributed significantly to the variations in practicability perception.

The results of multiple regression analysis with respect to the farmers of Alappuzha district indicated that crop yield index and scientific orientation were found to be important variables in explaining the variations in knowledge. Scientific orientation was found to be an important variable in explaining the variations in attitude. It was also found that crop yield index and scientific orientation were important variables in explaining the variations in adoption. Scientific orientation was found to be an important variable in explaining the variations in utility perception while management orientation was found to be an important variable in explaining the variations in practicability perception.

In the light of the above discussion the hypotheses set for the study that there would be no significant contribution of the independent variables io the variations in the dependent variables, knowledge and adoption were rejected in the case of the independent variables crop yield index and scientific orientation and the same were accepted in the case of all the other ten indepedent variables. The hypotheses,that there would be no significant contribution of the independent variables in the variations in the dependent variable, attitude were rejected in the case of the independent variable, scientific orientation and the same were accepted in the case of the all the other eleven independent variables. Similarly the hypotheses that there would be no significant contribution of the independent variables to the variations in the utility perception were rejected in the case the independent variable scientific orientation and the same were accepted in the case of all the other eleven independent variables. The hypotheses that there would be no significant contribution of the independent variables to the variations in the practicability perception were rejected in the case of the independent variable management orientation and the same were accepted in the case of all the other eleven independent variables.

4.3.5. Inter correlation among the dependent variables.

The inter correlation analysis was made among the dependent variables Y1, Y2, Y3, Y4 and Y5 and the results are presented in Table 30.

It is revealed from the results furnished in Table 30 that with respect to the farmers of Thiruvananthapuram district, knowledge(Y1) had positive and significant relationship with attitude(Y2), adoption(Y3), utility perception(Y4) and practicability perception(Y5). Attitude(Y2) had positive and significant relationship with all the other four dependent variables. It was also noticed

Table 30. Inter correlation among the dependent variables.

	Thiruvananthapuram (n=120)					Alappuzha (n=120)				
	Y1	Y2	Y3	Y4	Y5	Y1	Y2	Y3	Y4	Y5
Y1	—	0.8430**	0.5222**	0.7017**	0.6974**	—	0.8879**	0.8858**	0.8109**	0.7839**
Y2	0.8430**	—	0.1080NS	0.658**	0.0909NS	0.8879**	—	0.9210**	0.8705**	0.8128**
Y3	0.5222**	0.1080NS	—	0.5606**	0.5598**	0.8858**	0.9210**	—	0.8386**	0.7985**
Y4	0.7017**	0.658**	0.5606**	—	0.9773**	0.8109**	0.8705**	0.8386**	—	0.9078**
Y5	0.6974**	0.0909NS	0.5598**	0.9773**	—	0.7839**	0.8128**	0.7985**	0.9078**	—

** Significant at 1% level

NS Not significant

that adoption(Y3) had positive and significant relationship with utility perception(Y4) and practicability perception(Y5), while utility perception (Y4) had positive and singnificant relationship with practicability perception (Y5).

With regard to the farmers of Alappuzha district it was observed that knowledge(Y1) had positive and significant relationship with attitude(Y2), adoption(Y3), utility perception(Y4) and practicability perception(Y5). Attitude(Y2) had positive and significant relationship with adoption(Y3), utility perception(Y4) and practicability perception(Y5). It was also noticed that adoption(Y3) had positive and significant relationship with utility perception(Y4) and practicability perception(Y5) and utility perception(Y4) had positive and significant relationship with practicability perception(Y5).

The foregoing results succintly point out the close relationship among the dependent variables selected for the study. According to Bloom et al.(1955) behaviour is a matrix where the three components namely the cognitive, affective and connative are found to be inextricably interlinked. They identified the three components as distinguishable , yet interrelated components of behaviour. The paradign of human behaviour could be cited in this context to substantiate the above findings.

In the present study, the dependent variables, knowledge, attitude and adoption are construed to represent the cognitive, affective and connative dimensions of the behaviour of the farmers respectively. Their utility perception and practicability were considered as the reflectors of the performance of plant protection methods as perceived by farmers and are the indicators of adoption, the connative component. In view of the above, the close relationship observed among these five dependent variables in the study is in accordance with the paradign of human behaviour cited above.

In the view of the foregoing discussion, the hypotheses that there would be no significant relationship between dependent variables were rejected in the case of Y1 and Y2, Y1 and Y3, Y1 and Y4, Y1 and Y5, Y2 and Y4, Y3 and Y4, Y3 and Y5 and Y4 and Y5 were rejected and the same hypotheses were accepted in the case Y2 and Y3, Y2 and Y5 with regard to the farmers of Thiruvananthapuram district. As far as the farmers of Alappuzha district were concerned,

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the hypothesis that there would be no significant relationship between the dependent variables were rejected in the case of Y1 and Y2,Y1 and Y3,Y1 and Y4, Y1 and Y5, Y2 and Y3, Y2 and Y4, Y2 and Y5, Y3 and Y4, Y3 and Y5 and Y4 and Y5 .

4.4. Indigenous practices of plant protection methods followed by farmers.

The results presented in Table 31 reveal the effectiveness and scientific rationality rated by judges for the indigenous practices of plant protection followed by the farmers of Thiruvananthapuram and Alappuzha districts for paddy and vegetable cultivation. With regard to paddy cultivation, the practice ' controlled application of nutrients for reducing pest and disease attack' registered the highest score for effectiveness(mean score 3.6), followed by the practices 'draining water and preparing land one month prior to actual cultivation to allow all the weeds to germinate and flooding the field after two weeks for destroying all the germinated weeds for weed control'(mean score 3.3) and 'using tolerant local varieties' (mean score 3.0). Similarly for scientific rationality the 'controlled application of nutrients for reducing pest and

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Table 31. Effectiveness and scientific rationality of the indigenous practices of plant protection methods being practiced by farmers.

Sl. No.	Practices	Mean scores	
		Effectiveness	Scientific rationality
A	Paddy		
1	Application of extract of drumstick plant's bark, chilli and azafoetida, diluted to ten times for controlling rice bug.	2.58	2.00
2	Tying waste plastic threads/tapes across fields to keep away the birds during earhead stage.	2.80	2.50
3	Keeping wooden pegs/pedicel of coconut leaves at places in fields to help the birds to rest upon and pick up pests.	2.51	2.80
4	Draining water and preparing land one month prior to actual cultivation to allow all weeds to germinate. Flood the field after two weeks for destroying all the germinated weeds for weed control.	3.30	3.10
5	Using tolerant local varieties.	3.00	3.20
6	Controlled application of ferilizers for reducing pest and disease attack.	3.60	3.40
7	Organic farming for reducing pest and disease occurrence.	2.55	3.00

Table 31.(Contd....)

B	Vegetables		
1	Application of wood ash @25g/plant to reduce the attack of mealy bugs, aphids etc.	1.60	2.20
2	Application of lime @ 100g/pit to control yellowing or damping off.	1.10	1.20
3	Controlled application of chemical ferilizers to reduce pest and disease attack.	3.10	3.60
4	Organic farming to reduce pest and disease occurrence.	2.80	3.20
5	Use of *thulasikeni* in pandals to trap and kill fruit flies (ie. a mixture of crushed 'thulsi' leaves, jaggery and little quantity of furadan or malathion in coconut shells).	3.30	3.70
6	Use of maggot traps in vegetable gardens (ie. Palayanthodan banana + furadan in coconut shells).	3.20	3.60

disease attack' registered highest score(3.4) followed by the practice 'using tolerant local varieties'(mean score 3.2) and 'draining water and preparing land one month prior to actual cultivation to allow all the weeds to germinate and flooding the field after two weeks for destroying all the germinated weeds for weed control'(mean score 3.1). With regard to vegetable cultivation, the practice 'use of *thulsikeni* in *pandals* to trap and kill fruit flies' was most effective and scientifically rational (mean scores 3.3 and 3.7 respectively), followed by the practice 'use of banana traps in vegetable gardens'(mean scores 3.2 and 3.6 respectively), and 'controlled application of nutrients to reduce pest and disease attack'(mean scores 3.1 and 3.5 respectively).

Now a days more attention is being given to the farmers indigenous/local practices in the control of pests and diseases in crops, in different parts of the world. The practice 'controlled application of nutrients for reducing pest and disease attack' was judged as most effective and scientifically rational . Modern science has proved that if fertilizers and manures are applied in more quantities, the plant will absorb these nutrients in excess quantities and become more succulent. When the plants become more succulent they will be susceptible to more pest and disease attack. Hence controlled application of these nutrients to plants plays an important role in the control of pests and disease occurrence in plants. The practice of 'using tolerant local varieties' will reduce the pests and disease incidence and hence it is more effective and scientifically rational. Similarly, preparation of land one month prior to actual cultivation allows all weeds to germinate. While flooding the fields after two weeks, all the germinated weeds get destroyed and this practice was also registered as effective and scientifically rational. Weed control plays an important role in plant protection since they usually act as alternate hosts for pests and diseases. With regard to vegetable cultivation the practice, 'use of *thulsikeni* in *pandals* to trap and kill fruit flies' was the most effective and scientifically rational practice. A mixture of crushed *thulsi* leaves, jaggery and little quantity of furadan or malathion taken in coconut shells and hanged in vegetable gardens was found very effective in attracting fruit flies and once the flies get attracted they are killed by the chemical in the mixture.

Since the pesticides are used in very little quantities it will not cause any problem of residual toxicity which is a major problem as far as the use of pesticides especially in vegetables is concerned. Moreover the excess amount of money required for the pesticides can also be saved. Similarly the practice of using banana traps in vegetable gardens was also found very effective and scientifically rational for pests and diseases due to the same benefits mentioned earlier.

Almost all the indigenous practices of plant protection were found effective and scientifically rational to control pests and diseases in paddy as well as in vegetables. Comprehending the science underlying indigenous practices would help us to understand the concepts and practices depicting the elements of sustainability to integrate with the modern information system for efficient resource managenment. Traditional wisdom is time tested, and understanding dimension of technology of clientele helps in ascertaining the degree and direction of change through formal research. The knowledge of indigenous practices can be of use to the scientists in developing new hypotheses for research resulting in extending the existing knowledge about the indigenous practices adopted by farmers.

4.5. Perception of farmers about the impact of pesticides on environmental aspects.

The results indicating the perception of the farmers about the impact of pesticides on environmental aspects are furnished in Table 32.

A critical glance on the table reveals that the farmers' perception about the impact of pesticides on environmental aspects was very low and most of the farmers belonged to low perception category for their perception about the selected aspects of impact of pesticides on environment.

It may be inferred from the results that the farmers were very poor in understanding the impact or the detrimental effects of pesticides on man, animals, birds, fish and their eco-system. Lack of knowledge about the impact of pesticides on environment and mismanagement of these pesticides create a lot of problems in the eco-system leaving residues in various components of environments. The residues are detected in the soil, water, plants and animals including human beings.

Table 32. Perception of farmers about the impact of pesticides on environmental aspects. n=240

Sl. No.	Statement	Perception category Low (%)	High (%)	Mean score
1	Plant protection chemicals destroy soil fertility.	56	44	1.98
2	Unscientific application of pesticides pollutes the atmosphere.	66	34	1.35
3	Unscientific application of certain pesticides become harmful to fish.	57	43	1.78
4	Certain pesticides get accumulated in human beings at toxic level through fish and flesh when consumed.	68	32	1.25
5	Unscientific application of pesticides does not cause pest resurgence.	69	31	1.26
6	Unscientific application of pesticides kill natural enemies.	70	30	1.92
7	Pesticides get accumulated in milk and milk products.	74	26	1.23
8	Pesticides residues in water become harmful to birds, animals and human beings.	62	38	1.88
9	Scientific methods of plant protection is not safe	60	40	1.99
10	Integrated pest management is most effective in controlling pests and diseases in crops.	56	44	1.52
11	Unscientific use of plant protection chemicals destroys soil biota.	55	45	1.97

In our country pesticide residues detected in market samples is very high and it is in fact said that Indians have the distinction of having the highest pesticide residue in their food(Vijayalaxmi and Babu 1991). There are several studies, in India and other developig countries indicating the presence of pesticide residues in quantities more than the tolerant limit in vegetables, cereals, pulses, milk and milk products, meat, fish, eggs, animal feed etc.

The foregoing discussion throws light on the fact that the improved technology adopted in agriculture along with the modernisation, no doubt, contributed to the improvement in productivity, but also has brought in, certain dangerous ill effects into the society, which could be to some extent attributed to the excessive use of pesticides, fertilizers etc. Time is not far off when the vast majority of our population will definitely realise these hazards. No doubt, pesticides have succeeded in achieving the prime objective of preventing diseases of crops and reducing the losses caused by the destruction of crops but they have been causing hazards in many forms such as destruction of beneficial insects, high pest resistance, secondary pest outbreak, high residues and toxicity hazards. There is an urgent need to achieve effective pest control and curb possible adverse effect on the environment and for that the concept of 'Integrated Pest Management'(IPM) technique should be made more popular. This could be encouraged through popularising biological pest control, diverting more researches in to this area and through governmental policies such as identifying the most poisonous pesticides and putting a ban and also restricting the use of pesticides in a sustainable way. Pesticides such as DDT and BHC have already been banned in other developed countries, for example in United States of America. Another important aspect would be to educate the farmers through extension services in the form of training to safeguard man and environment from the hazards of these chemicals.

4.6. Constraints encountered by the farmers in the adoption of plant protection technology.

In accordance with the objectives, the constraints experienced by the farmers of Thiruvananthapuram and Alappuzha districts were studied and the results in this regard are presented in Table 33.

Table 33. Constraints experienced by the farmers in the adoption plant protection technology.

Sl. No.	Constraints	TVM(n=120)		APLA (n=120)	
		Per cent	Rank	Per cent	Rank
1	Pest and disease problems	47	4	55	3
2	Lack of adequate irrigation facility	36	8	31	11
3	Lack of proper drainage facility	20	11	68	1
4	High labour cost and shortage of labour in peak seasons	47	4	45	5
5	Untimely supply and high cost of inputs	67	1	55	3
6	Weed problem	36	8	38	8
7	Lack of technical guidance	40	6	48	6
8	Difficulty in the selection of alternate chemicals	55	3	45	5
9	Lack of knowledge	45	5	48	4
10	Difficulty in finding the dosage of chemical.	60	2	62	2
11	Poor supervision and management	32	10	40	7
12	Limited finance	40	6	35	9
13	Increased cost of cultivation due to plant protection methods	39	7	42	6
14	High risk involved	32	10	31	11
15	Difficulty to implement mechanical method.	34	9	33	10

A cursory look at the results presented in Table 33 reveals that with regard to the farmers of Thiruvananthapuram district the constraint,'untimely supply and high cost of inputs 'ranked first followed by 'difficulty in finding the dosage of chemicals' and 'difficulty in the selection of alternate chemicals'. The constraints namely pest and disease problem , high labour cost and shortage of labour in peak seasons registered the fourth rank followed by 'lack of knowledge' in the fifth position .The constraint 'lack of proper drainage facilities' obtained the lowest rank.

With regard to the farmers of Alappuzha district the constraint 'lack of proper drainage facilities' was the most serios constraint followed by 'difficulty in finding the dosage of chemicals', 'pest and disease problems' and the 'untimely supply and high cost of inputs' registered the third rank and 'lack of knowledge' secured the fourth position. Both the constraints 'high labour cost and shortage of labour in peak seasons' and 'difficulty in the selection of alternate chemicals' were equally ranked in the fifth place. The constraint 'high risk involved' was assigned the lowest rank by the farmers.

As it is evident from Table 33 that high cost of inputs and lack of availability in time was found to be the most serious constraint among the farmers of Thiruvananthapuram district and the third major constraint among the farmers of Alappuzha district. This may be due to the rising price of fungicides, chemicals, seeds and fertilizers coupled with their non availability in time. This finding is in confirmity with the studies of Prasannan(1987) and Govind(1992).

Lack of proper drainage facilities was experienced as the first and the most important constraint by the farmers of Alappuzha district. This was due to the water-logged nature and poor drainage system prevalent in many parts of Alappuzha district. Improper drainage was found to hinder indirectly the correct timing of various plant protection operations especially,the practice of synchronous planting. Only those farmers with sufficient drainage facilities would be able to dewater their land for land preparation and undertake other timely plant protection operations. This situation also resulted in improper water management at various crop growth stages. Regulation of water levels was found to be effective in pest control as a cultural method for certain pests. Due to all these reasons, the constraint, the ' lack of proper drainage facilities' was ranked as the farmers'first serious constraint. This finding is in confirmity with the findings of Venkatapirabu(1988) and Govind(1992).

'Difficulty in finding the dosage of chemical' was ranked as the second major constraint by the farmers of both the districts. Most of the farmers were not in a position to find out the dosage of chemicals required for their farms because they widely considered it as a complex technology, involving many calculations. 'Difficulty in the selection of alternate chemicals' was ranked as the third important constraint by the farmers of Thiruvananthapuram district and as the fifth by the farmers of Alappuzha district. Majority of the farmers found very difficult to choose alternate chemicals in the absence of a chemical. These findings are in confirmity with the findings of Govind(1992). Farmers of Thiruvananthapuram district experienced 'pest and disease problem', 'high labour cost and shortage of labour in peak seasons' as the fourth major constraint. While the farmers of Alappuzha district felt 'pest and disease problem' as their third major constraint and 'high labour cost and shortage of labour in peak season' as their fifth major constraint. Pest and disease incidence was more in Alappuzha district and hence the farmers there, had perceived it as one of the serious and major constraints.'High labour cost and shortage of labour in peak season' was considered as a major problem and due to this the farmers of both the districts were always put in difficulty in taking up timely plant protection practices, synchronised cultivation ,weeding operations pesticidal and fertilizer applications.

Lack of knowledge was felt as the fifth serious constraint by the farmers of Thiruvananthapuram district while it was felt as the fourth major constraint by the farmers of Alappuzha district. Due to lack of knowledge the farmers had to depend on extension agencies for many activities related to plant protection and hence they would have considered it as a major problem. This had also been reported by Anantharaman et al. (1986) and Govind (1992).

4.7. Suggestions to overcome the constraints in the adoption of plant protection technology given by the farmers and the experts in the field of plant protection.

The suggestions given by the farmers and the experts to overcome the constraints experienced in the adoption of plant protection technology is given in Tables 34 and 35, respectively.

4.7.1. Suggestions given by the farmers

A cursory glance on the results presented in Table 34 revealed the following.

The most important suggestion was 'to develop simple and more compatible plant protection technologies'. It was also noticed from the same table that 'ensure adequate drainage facilties','develop low cost technologies for the control of pests and diseases' and 'impart adequate training to farmers to enhance knowledge' were important suggestions which need urgent attention by the planners, researchers and administrators.

Table 34. Suggestions to overcome the constraints in the adoption of plant protection technology given by the farmers. n=240

Sl. No.	Suggestions	Percentage	Rank
1	Develop pest and disease tolerant varities.	52	7
2	Ensure proper irrigation facilities	54	8
3	Ensure adequate drainage facilities	69	2
4	Develop low cost technologies for the control of pests and diseases.	64	3
5	Ensure adequate and timely supply of inputs	58	5
6	Ensure adequate supply of credit facilities.	55	6
7	Develop simple and more compatible plant protection technologies.	78	1
8	Impart adequate training to farmers to enhance knowledge.	60	4
9	Avail more extension support.	58	5

Table 35. Suggestions to overcome the constraints in the adoption of plant protection technology given by the experts in the field of plant protection

n=40

Sl. No.	Suggestions	Percentage	Rank
1	Assure proper drainage facilities	72	5
2	Assure proper irrigation facilities	69	6
3	Impart adequate training to farmers on IPM practices.	82	1
4	Impart adequate training to extension personnel on IPM practices.	80	3
5	Develop multiple resistant varieties.	61	7
6	Promote coordination and functional linkages among multiple agencies involved in plant protection	80	3
7	Give more extension support	81	2
8	Ensure timely and need based application of pesticides.	76	6
9	Promote public awareness about the impact of pesticides on environmental aspects.	76	4

4.7.2. Suggestions given by the experts

The solutions suggested by the experts, inorder to solve the constraints experienced by the farmers in the field of plant protection also need urgent attention by the planners, researchers and administrators.

A bird's eye view of the results presented in Table 35 showing the suggestions given by the experts revealed the following.

The most important suggestion was to 'impart adequate training to the farmers on integrated pest management practices'. 'Give more extension support', 'impart adequate training to extension workers on integrated pest management practices', 'promote public awareness about impact of pesticides on environmental aspects' and 'assure proper drainage facilities' were also important suggestions given by the experts in the field of plant protection.

4.8.The empirical model of the study is presented in FIG. 8 .

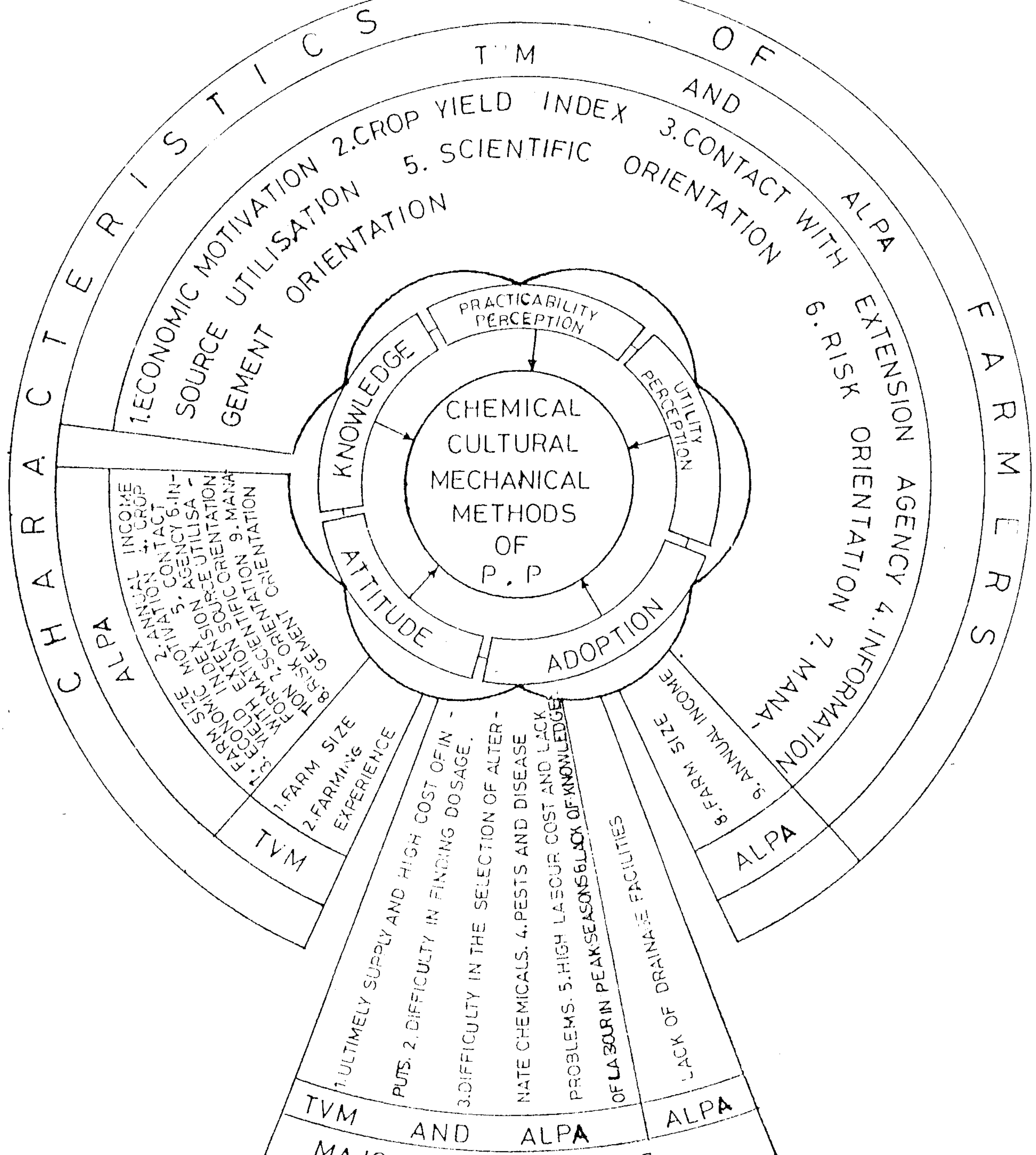

FIG. 8. EMPIRICAL MODEL OF THE STUDY

SUMMARY

5. SUMMARY

Introduction of high yielding varieties of crops and adoption of improved management practices for boosting up production of food grains have resulted in serious pest and disease problems warranting extensive and intensive use of plant protection chemicals. A number of limitations and adverse side effects such as pest resistance to pesticides, pesticide residues, health hazards, environmental pollution and ecological imbalance have been identified recently. Many studies are available reporting the extent to which human ecosystem is contaminated with pesticides. It is high time to think about stimulating awareness and its essentiality in the spread of knowledge in intensive and ecologically sustainable agriculture.

In this context it would be useful to study the components of plant protection technology and their differential adoption in important crops like paddy and vegetables by the farmers and to explain the variations in cognitive, affective and connative components of behaviour of farmers in the use of plant protection technology with a selected set of variables. The major constraints in the adoption of plant protection methods by farmers along with their suggestions to overcome the same have also to be studied to suggest a strategic model to popularise the effective use of plant protection technology. Considering the above facts the present research study was taken up with the following specific objectives.

5.1. Objectives of the study

1. To study the characteristics of farmers of Thiruvananthapuram and Alappuzha districts.
2. To study the level of knowledge of farmers about plant protection methods.
3. To study the attitude of farmers towards chemical method of plant protection.
4. To analyse the extent of adoption of plant protection methods by the farmers.
5. To determine the utility and practicability perception of farmers about the plant protection methods.
6. To find out the relationship of the characteristics of farmers with knowledge, attitude, adoption, utility and practicability perception about plant protection methods.
7. To study the indigenous practices of plant protection followed by farmers.

8. To analyse the perception of farmers about the impact of pesticides on environmental aspects.

9. To identify the constraints encountered by the farmers in the adoption of plant protection methods.

10. To draw the suggestions of farmers and experts in the field of plant protection to overcome the constraints in the adoption of plant protection technology, experienced by farmers.

11. To suggest a stategic model for popularising effective plant protection technology.

5.2. Methodolgy

The study was undertaken in two districts of Kerala namely Thiruvananthapuram and Alappuzha with main emphasis on paddy and vegetables since paddy and vegetables are the two important crops with food value to the people of Kerala and since these crops are subjected to intensive and extensive use of plant protection chemicals. These crops are grown extensively in these two districts and moreover the per hectare consumption of pesticides ranged from the lowest value of 0.14kg/ha of cropped area in Thiruvananthapuram district to the highest value of 1.11kg/ha of cropped area in Alappuzha district. A sample of 120 farmers each from the two districts was selected and the total sample size for the study was 240.

The dependent variables of the study were, farmer's knowledge, attitude , adoption, utility perception and practicability perception. These dependent variables were quantified using measurement devices developed for the study. Twelve independent variables were selected for the study and they were family educational status, farm size, annual income, farming experience, cosmopoliteness, economic motivation, crop yield index, contact with extension agency, information source utilization, scientific orientation, risk orientation and management orientation. These independent variables were quantified with the help of available scientific procedures. The relationship between the independent and dependent variables was also studied. Indigenous methods of plant protection being followed by farmers and their perceived impact of pesticides on environmental aspects were also studied. Various constraints experienced by the farmers in the adoption of plant protection methods were enlisted. The suggestions to overcome these constraints were also collected from the farmers as well as from experts in the field of plant protection.

The data were collected using a pretested and well structured interview schedule prepared for the purpose of the study, and data collection was carried out during July 1993 to January 1994. The statistical methods used were mean, percentage analysis, simple correlation analysis, independent 't' test, and multiple regression analysis.

5.3. Findings

The salient findings of the study are summarised and presented in the following pages.

5.3.1. The characteristics of the farmers

The farmers of Thiruvananthapuram and Alappuzha districts differed significantly with reference to their characteristics namely annual income, farming experience, crop yield index, information source utilisation, scientific orientation, risk orientation and management orientation, while they were not significantly different with respect to their family educational status, farm size, cosmopoliteness, economic motivation and contact with extension agency. The farmers of Alappuzha district had significantly more annual income, farming experience, more crop yield index higher scientific orientation and higher risk orientation. The farmers of Thiruvananthapuram district obtained significantly higher mean scores for utilization of information sources and management orientation.

5.3.2. Knowledge of farmers about plant protection methods

There was significant difference between the farmers of Thiruvananthapuram and Alappuzha districts with regard to their knowledge about plant protection methods. With regard to chemical method of plant protection 35.00 per cent of the farmers of Thiruvananthapuram district and 27.00 per cent of the farmers of Alappuzha district belonged to high knowledge level category. With regard to cultural method of plant protection 28.00 per cent of the farmers of Thiruvananthapuram and 32.00 per cent of the farmers of Alappuzha district belonged to high knowledge level category. With regard to mechanical method of plant protection less than one fourth of the farmers belonged to high knowledge level category in both the districts. The farmers of Thiruvananthapuram district possessed significantly higher knowledge about the chemical method of plant protection than the farmers of Alappuzha district. while the farmers of Alappuzha district possessed significantly higher knowledge about cultural method of plant protection than the farmers of Thiruvananthapuram district. There was no significant difference in the knowledge level of the two groups of farmers about mechanical method of plant protection. The farmers of both the districts were ignorant about biological, physical and integrated methods of plant protection.

5.3.2.1. Practicewise knowledge about chemical method of plant protection.

The majority of the farmers of both the districts belonged to high knowledge level category for the practice, 'selection of the chemical' for pests and diseases in paddy and vegetables, while the lowest number of farmers of both the districts belonged to high knowledge level category for the practice 'quantity of chemical to be taken/pump load'. The farmers of Thiruvananthapuram district possessed significantly more knowledge about the practices viz., 'quantity of chemical to be used/acre' and 'number and interval of application' of the chemical, than the farmers of Alappuzha district for pests and diseases in paddy and also about 'quantity of chemical to be taken/pump load' in addition to the above two practices for pests and diseases in vegetables. They also possessed more knowledge about the practice 'precautions to be undertaken while using pesticides' than the farmers of Alappuzha district.

5.3.2.2. Practicewise knowledge about cultural method of plant protection.

The farmers of Alappuzha district possessed significanly more knowledge about the seven cultural plant protection practices in paddy namely 'selection of variety','monitoring for pests in nursery','synchronised planting','plant population/sq.m.', 'weeding operation', 'monitoring for pests in main field', and 'application of nitrogenous fertilizers' and lesser knowledge about the two practices namely 'summer ploughing' and 'water management' when compared to the farmers of Thiruvananthapuram district. The farmers of Alappuzha district belonging to high knowledge level category were more for the seven practices than the farmers of Thiruvananthapuram district. The farmers of Alappuzha district possessed significantly more knowledge about the six cultural practices for plant protection in vegetables than the farmers of Thiruvananthapuram district.

The farmers belonging to high knowledge level category for the cultural practices in vegetables were more in Alappuzha district than in Thiruvananthapuram district.

5.3.2.3. Practicewise knowledge about mechanical method of plant protection.

There was no significant difference between the farmers of Thiruvananthapuram and Alappuzha districts with respect to their knowledge about mechanical practices of plant protection in paddy and vegetables. A similiar trend was noticed in their level of knowledge about mechanical method of plant protection among the farmers of the two districts.

5.3.3. Attitude of farmers towards chemical method of plant protection.

There existed significant difference between the farmers of Thiruvananthapuram and Alappuzha districts with regard to their attitude towards chemical method of plant protection and 53.00 per cent of the farmers of Thiruvananthapuram district and 58.00 per cent of the farmers of Alappuzha district had favourable attitude towards chemical method of plant protection . The farmers of

Alappuzha district were more favourable than the farmers of Thiruvananthapuram district in their attitude towards chemical method of plant protection.

5.3.4. Adoption of plant protection methods

The farmers of Alappuzha district were higher adopters of plant protecion methods when compared to the farmers of Thiruvanathapuram district. It was found that only 28.00 per cent of the farmers of Thiruvananthapuram district and 21.00 per cent of the farmers of Alappuzha district were the correct adopters of chemical method of plant protection . The farmers of Alappuzha district were significantly higher adopters of chemical and cultural methods of plant protection. With regard to the adoption of cultural method of plant protection 32.00 per cent of the farmers of Thiruvananthapuram district and 40.00 per cent of the farmers of Alappuzha district belonged to high adoption category. With regard to mechanical method of plant protection about one-fourth of the farmers of both the district belonged to high adoption category. There existed no significant difference in the adoption of mechanical method of plant protection between the farmers of the two districts. The farmers of both the districts were found to be non-adopters of biological, physical and integrated methods of plant protection.

5.3.4.1. Practicewise adoption of chemical method of plant protection.

The farmers of Alappuzha district were significantly higher adopters of all the practices of chemical method of plant protection except the practice 'method of application' of the chemical for the pests and diseases in paddy. The majority of the farmers correctly adopted the practice 'selection of the chemical' for pest and disease control in paddy as well as in vegetables in both Thiruvananthapuram and Alappuzha districts .Majority of the farmers of both the districts incorrectly adopted the practice 'quantity of chemical taken/pump load' for the pest and disease control in paddy and vegetables. There found no significant difference between the farmers of Thiruvananthapuram and Alappuzha districts with respect to their adoption of the five practices under chemical method of plant protection for pests and diseases, in vegetable cultivation. The farmers of Thiruvananthapuram district were found to be significantly higher adopters of the practice 'precautions to be taken while using pesticides' than the farmers of Alappuzha district.

5.3.4.2. Practicewise adoption of the cultural method of plant protection.

Out of the nine practices of cultural method, the farmers of Alappuzha district were found to be significantly higher adopters of seven practices namely 'selection of variety', 'monitoring for pests in nursery', 'sychronised planting', 'plant population/sq.m.', 'weeding operations','monitoring for pests in mainfield', and 'application of nitrogenous fertilizers'. The farmers of Alappuzha district were higher adopters of the above practices when compared to those of Thiruvananthapuram district.The farmers of Thiruvananthapuram district were higher adopters of the two practices viz.,'summer ploughing' and'water management'.

The farmers of Alappuzha district were found to be higher adopters of all the six practices of cultural method of plant protection, namely 'monitoring for pests in nursery', 'synchronized planting','plant population/sq.m'.,'weeding operations' 'monitoring for pests in mainfield' and 'application of nitrogenous fertilizers'than those in Thiruvananthapuram district.

5.3.4.3. Practicewise adoption of the mechanical method of plant protection.

There existed no significant difference between the farmers of Thiruvananthapuram and Alappuzha districts with respect to both the practices under mechanical method of plant protection namely 'collection and destruction of egg masses and other stages of pests' and 'collection and destruction of affected plant parts or plants by pests/diseases 'in paddy and vegetables. A similar trend in the extent of adoption was noticed among the farmers of both the districts with regard to their adoption of mechanical practices of plant protection in paddy and vegetables.

5.3.5. Utility perception of farmers about plant protection methods.

The farmers of Alappuzha district had perceived the utility of plant protection methods more than the farmers of Thiruvananthapuram district. With regard to the utility perception about chemical method of plant protection 35.00 per cent of the farmers of Thiruvananthapuram district and 32.00 per cent of the farmers of Alappuzha district belonged to high perception category. With regard to cultural method of plant protection, 28.00 per cent of the farmers of Thiruvananthapuram district and 34.00 per cent of the farmers of Alappuzha district belonged to high perception category. With regard to mechanical method of plant protection less than one-fourth of the farmers of both the districts beloged to high perception category. They perceived the utility of chemical and cultural methods of plant protection significantly more than those of Thiruvananthapuram district. There was no significant difference in the perception about the utility of mechanical method of plant protection among the two groups of farmers. The farmers of both the districts did not perceive the utility of biological, physical and integrated methods of plant protection.

5.3.5.1. Utility perception of farmers about chemical method of plant protection.

The farmers of Alappuzha district perceived the utility of the two practices of chemical method of plant protection viz., 'the quantity of chemical to be used/acre' and 'number and interval of application' of the chemical more than the farmers of Alappuzha district .The majority of farmers of both the districts belonged to high perception category for the practice 'selection of chemical' for the chemical control of pests and diseases in paddy and vegetables.The lowest number of farmers of both the districts belonged to high perception category for the practice, 'quantity of chemical to be taken/pump load'for both the crops. The utility of the practice the 'precautions to be taken while using pesticides' was perceived more by the farmers of Thiruvananthapuram district than the farmers of Alappuzha district.

5.3.5.2. Utility perception of farmers about cultural method of plant protection.

There was significant difference among the farmers of Thiruvananthapuram and Alappuzha districts with regard to their perception about the utility of cultural method of plant protection. The farmers of Alappuzha district perceived more about the utility of the seven cultural practices namely 'selection of variety', 'monitoring for pests in nursery','synchronised planting', 'plant population/sq.m.', 'weeding operation', 'monitoring for pests in main field', and 'application of nitrogenous fertilizers'.Majority of farmers of Alappuzha district belonged to high perception category for the above seven practices than the farmers of Thiruvananthapuram district. The farmers of Alappuzha district perceived significantly more about utility of all the six practices under cultural method of plant protection in vegetables than the farmers of Thiruvananthapuram district.Majority of the farmers of Alappuzha district belonged to high perception category for all the six cultural practices in vegetables when compared to the farmers of Thiruvananthapuram district.

5.3.5.3. Utility perception of farmers about the mechanical method of plant protection .

There was no significant difference between the farmers of Thiruvananthapuram and Alappuzha districts with respect to their perception about the utility of the practices under mechanical method of plant protection in paddy and vegetables . A similar trend was noticed in their perception level for the mechanical method of plant protection

5.3.6. Practicability perception of farmers about plant protecton methods.

The farmers of Alappuzha district perceived the practicability of chemical and cultural methods of plant protection more than the farmers of Thiruvananthapuram district.The percentage of farmers belonging to high perception category for the chemical method of plant protection was 32.00 and 27.00 respectively for the districts, Thiruvananthapuram and Alappuzha.With regard to cultural method of plant protection 28.00 per cent of the farmers of Thiruvananthapuram district and 21.00 per cent of the farmers of Alappuzha district belonged to high perception category.In the case of mechanical method of plant protection 21.00 per cent of the farmers of Thiruvananthapuram district and 16.00 per cent of the farmers of Alappuzha district belonged to high perception category. There was no significant difference between the farmers of Thiruvananthapuram and Alappuzha districts with respect to their practicability perception about mechanical method of plant protection.The farmers of both the districts did not perceive the practicability of biological, physical and integrated methods of plant protection.

5.3.6.1 Practibility perception of farmers about chemical method of plant protection

Out of the five practices under chemical method of plant protection the farmers of Alappuzha district perceived significantly higher the practibility of the two practices namely 'quantity of chemical to be used /acre' and the 'number and interval of application of the chemical'. The majority of the farmers of both the districts belonged to high perception category for the practice 'selection of the chemical' for chemical plant protection in paddy and vegetables.

5.3.6.2 Practicability perception of farmers about cultural method of plant protection.

Out of the nine cultural practices of plant protection in paddy, seven practices viz, 'selection of variety','monitoring for pests in nursery', 'synchronised planting', 'plant population/sq.m.', 'weeding operation','monitoring for pests in main field', and 'application of nitrogenous fertilizers' had been perceived significantly higher for practicability by the farmers of Alappuzha district.The percentage of farmers belonging to high perception category was more for the above practices in Alappuzha district than in Thiruvananthapuram district.The farmers of Alappuzha district perceived the practicability of 'summer ploughing', and 'water management 'significantly lesser than the farmers of Thiruvananthapuram district.

5.3.6.3. Practicability perception of farmers about mechanical method of plant protection.

The farmers of both the districts did not show any significant difference in their perception about the practices under mechanical method of plant protection in paddy as well as in vegetable cultivation. A similar trend was noticed among the farmers of both the districts with regard to their perception levels for mechanical method of plant protection.

5.3.7. Relationship between independent and dependent variables.

Correlation analysis with regard to the farmers of Thiruvananthapuram districts revealed that out of the 12 independent variables, seven variables namely, economic motivation, crop yield index, contact with extension agency, information source utilisation, scientific orientation, risk orientation and management orientation indicated positive and significant relationship with knowledge,adoption, utility perception and practicability perception. With regard to the dependent variable attitude, two independent variables namely farm size and farming experience were found to have significant relationship. With regard to the farmers of Thiruvananthapuram district, multiple regression analysis revealed that scientific orientation was significantly contributing to variations in knowledge and adoption.In the case of utility perception, economic motivation, crop yield index and scientific orientation were the crucial variables contributing to variations in utility perception while in the case of practicability perception also economic motivation, crop yield index and scientific orientation were found significant in contributing to variations in the practicability perception.

With regard to the farmers of Alappuzha district, nine variables namely farm size, annual income, economic motivation, crop yield index, contact with extension agency information source utilisation, scientific orientation, risk orientaion and management orientation showed positive and significant relationship with knowledge, attitude, adoption, utility perception and practicability perception. The multiple regression analysis revealed that crop yield index and scientific orientation were contributing significantly to the variations in knowledge.Scientific orientation was found significantly contributing to the variations in attitude as well as in utility perception. With regard to adoption, crop yield index and scientific orientation were the crucial variables showing contribution to the variations in adoption.It was also found that managment orientation had siginificant contribution in explaing the variations in practicability perception.

5.3.8. Inter correlation among dependent variables.

Inter correlation analysis among the dependent variables revealed that with regard to the farmers of Thiruvananthapuram district knowledge had positive and significant relationship with attitude,adoption , utility perception and practicability perception. Attitude had positive and significant relationship with all the other four dependent variables.Adoption had positive and significant relationship with utility perception and practicability perception while utility perception had positive and significant relationship with practicability perception.

With regard to the farmers of Alappuzha district inter correlation analysis revealed that all the five dependent variables had positive and significant relationship with each other.

5.3.9. Indigenous practices of plant protection methods followed by farmers.

The practice 'controlled application of nutrients for reducing pest and disease attack' was judged as the most effective and scientifically rational practice in paddy cultivation. With regard to vegetable cultivation the practice 'use of *thulsikeni* in *pandals* to trap and kill fruit flies' emerged out as the most effective and scientifically rational practice .

5.3.10. Perception of farmers about the impact of pesticides on environmental aspects

The farmer's perception about the impact of pesticides on environmental aspects was very low for all the items selected and most of the farmers belonged to low perception category for their perception about the selected aspects of impact of pesticides on environment

5.3.11. Constraints experienced by the farmers in the adoption of plant protection technology.

The constraint, 'untimely supply and high cost of inputs' was the first and most important constraint experienced by the farmers of Thiruvananthapuram district followed by 'difficulty in finding the dosage of chemical' and 'difficulty in the selection of alternate chemicals'. The constraint 'lack of proper drainage facilities' was the most serious constraint experienced by the farmers of Alappuzha district followed by 'difficulty in finding the dosage of chemicals' and 'pest and disease problem'.

5.3.12. Suggestions to overcome the constraints in the adoption of plant protection technology given by the farmers and experts.

The important suggestions given by the farmers to overcome the constraints were 'to develop simple and more compatible plant protection technologies', 'ensure adequate drainage facilities ', 'develop low cost technologies for the control of pests and diseases'.To 'impart adequate training to farmers on IPM practices' and 'to give more extension support' were comparatively more important suggestions given by the experts to overcome the constraints,perceived by the farmers.

5.4. Strategic model for the popularisation of effective plant protection technology.

The effective popularisation of plant protection technology is contemplated to be achieved through the co-ordination and linkage among the multiple agencies engaged in plant protection technology generation and its transfer in agriculture . They are operating at Research System Level (R.S.L), Extension System Level (E.S.L), Input System Level(I.S.L) and , Farmer System Level (F.S.L).

5.4.1. Research System Level

Research System should be geared up to formulate research programmes to evolve multiple resistant crop varieties to pests and diseases and to develop low cost plant protection technologies. Considering the importance of ecologically sustainable agriculture under present context , the research system should give more emphasis in developing I P M strategies which composes the judicious use of chemical, cultural, mechanical, biological and physical methods of plant protection. Rearing and multiplication of natural enemies become essential for the easy launching of biological method of plant protection which is one of the essential components of I P M. Farmers' methods of pest observations and indigenous methods of plant protection should be taken into account in developing new research areas. A suitable blending of indigenous technical know-how of plant protection practices being followed by the farmers and the modern methods of plant protection being generated by the research system is also warranted . The research system should also organise periodical public awareness programmes on judicious use of plant protection chemicals which in turn help in reducing environmental pollution and health hazards, making effective use of print and electronic media .

Research system should involve in public awareness programmes, contributing to publications, news paper columns, leaflets and also information support through radio, T.V. and film shows, enhancing the involvement of extension workers, input dealers, farmers and the related, in farm trials, demonstrations, campaigns, seminars, trainings and should form interdisciplinary committees for effective launching of plant protection programmes. While organising plant protection training programmes more emphasis should be given to the biological, physical and integrated methods of plant protection to enhance the knowledge among farmers and extension workers about these methods in which they lack sufficient technical know-how.

5.4.2. Extension System Level

Strong extension system is necessary for popularising effective plant protection technology in the field of agriculture. It is known that there exists a wide gap between knowledge production and its utilisation by the farmers in the actual fields. Extension system should organise various extension programmes with the help of research system like farm trials, exhibitions, demonstrations, campaigns, farmers' days, seminars,trainings etc., for popularising effective plant protection technology.IPM is considered as one of the essential aspects of modern agricultural technology to maximise production and to minimise cost of production, environmental pollution, animal and human health hazards by discouraging indiscriminate and excessive use of chemical pesticides. Special efforts as suited to the farmers' profile characteristics may be taken up through mass media and group methods so as to reach the unfamiliar clients for effective dissemination of information about plant protection technology.

Extension system should organise consultancy services and feed back of field experiences to research system for more effective execution of IPM programmes. Specific training programmes to farmers on need based application of plant protection chemicals, on their dosage, precautions to be undertaken while using pesticides and their impact on environmental aspects may be organised by extension personnel which would ultimately result in the increased adoption of suitable combination of plant protection methods. Surveys need to be organised to study the prevalence of natural enemies of pests in different regions to conserve the native species of parasites and predators for creating a favourable condition to increase their population.

5.4.3. Input System Level

Input agencies should provide timely information support, and supply of plant protection equipments, chemicals and light traps at low cost so that non-availability of inputs may not become a serious constraint.

They should organise farmer contact programmes, farm trials, training to farmers and extension workers, demonstrations, film shows and also feed back of the field experiences and problems to research systems. There by they can play a vital role in the effective use of plant protection methods in the field of agriculture.

5.4.5. Farmer System Level

Farmers are the ultimate users of plant protection technology . Successful implementation of plant protection technology depends largely on influencing the farmers in adopting the technology. Farmers are inclined to adopt simple and low-cost technologies since such innovations can be put into practice with low outlay of capital. Farmers must be prepared to make regular visits to research stations and utilise the service of extension and input systems. They should be motivated to participate in various extension programmes, farm trials, exhibitions, demonstrations, campaigns, farmers' days, seminars, trainings, group discussions, and help in feed back. The farmers should be educated on the need based use of pesticides.

The prospect of effective plant protection lies in the community or group adoption of simple practices like summer ploughing, land preparation, synchronous planting, pest monitoring, pesticide purchase, weeding and water management practices. The farmers are to be assured of remunerative price for their produce.

The co-ordination and communication among all the groups involved in plant protection are essential so as to bring about a joint action programme for the implementation and popularisation of effective plant protection technology in the field of agriculture.

Considering the importance of popularising effective plant protection technology among the farmers in ecologically sensitive rice and vegetable production systems in Kerala, an attempt is made here to integrate the salient findings of the present study with those of the researcher's observations, experience and on the basis of her discussions with the panel of experts in the form of a strategic model. The suggested strategic model for the popularisation of effective plant protection technology is furnished in FIG.9.

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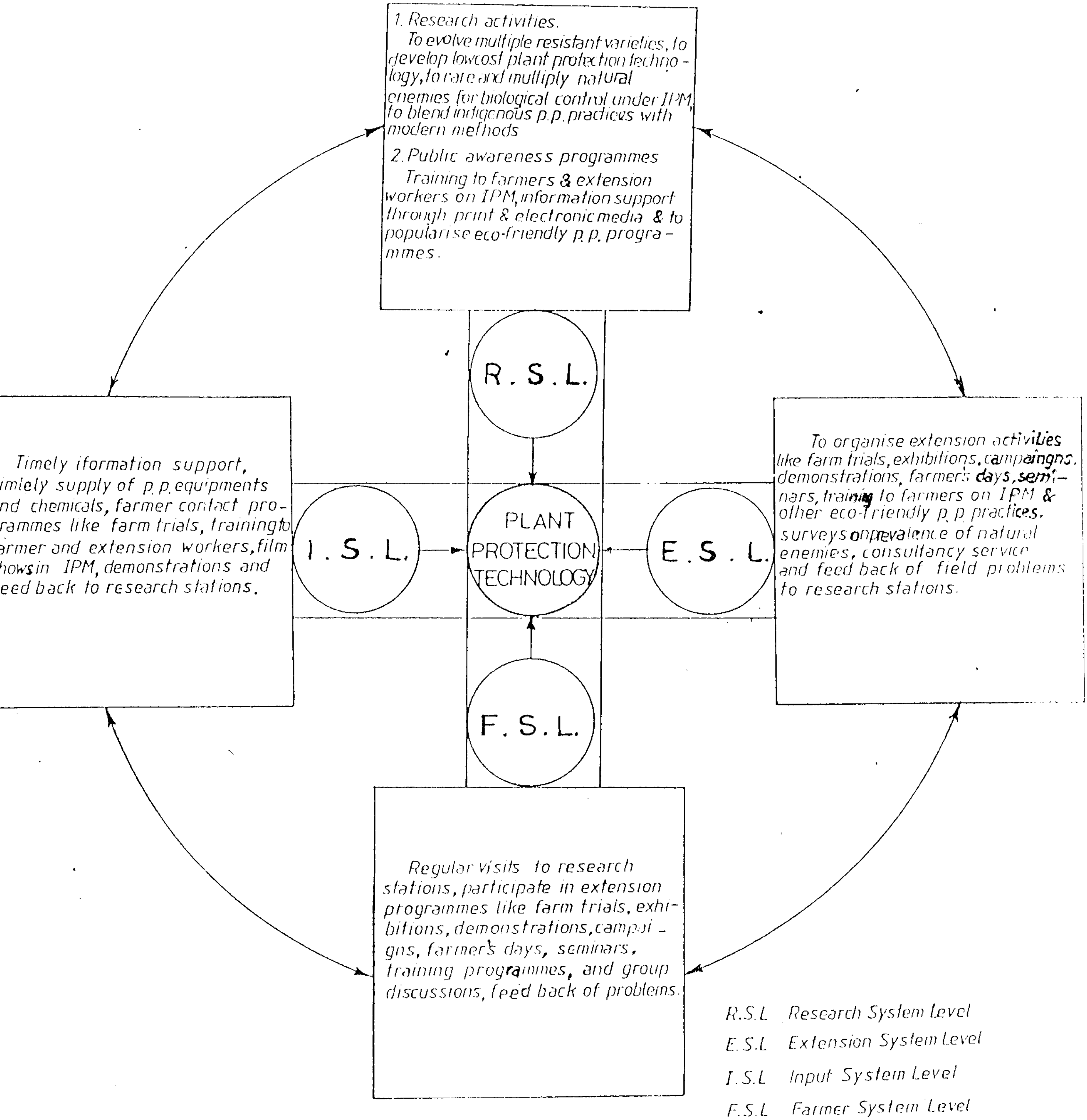

FIG. 9. SUGGESTED MODEL FOR THE POPULARISATION OF EFFECTIVE PLANT PROTECTION TECHNOLOGY

5.5. Suggested areas of future research

5.5.1. A similar study can be taken up among the farmers growing other major crops.

5.5.2. Comparative studies can be taken up among the farmers adopting indigenous methods of plant protection and modern methods of plant protection.

5.5.3. The training needs of farmers in the field of integrated plant protection method can be studied.

5.5.4. The training needs of extension workers in the field of plant protection technology can be studied.

5.5.5. Indepth studies can be made on knowledge gaps with regard to the impact of pesticides on environmental aspects.

5.5.6. Studies can be made to analyse the knowledge of farmers about the conservation of natural enemies, for the biological method of plant protection.

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* **Orginal not seen.**

APPENDICES

APPENDIX I

Kerala Agricultural University

Department of Agricultural Extension, College of Agriculture

Vellayani - 695522

Differential adoption of plant protection technology by farmers of Kerala - A critical analysis

Interview Schedule

Part - I

State | District
Sub-division | Block
Krishi Bhavan | Village
Name of the farmer | Address

1.Family educational status

Sl. No.	Family members	Illi-terate	Can read and write	Primary school	Middle school	High school	College and above

2. Farm size

What is the total area of land possessed by your family

(i) Wetland .... cents

(ii)Dryland .... cents

Total .... cents

3.Annual income

What is the annual income of your family ?

(i) Income from agriculture Rs. ....

(ii)Income from other sources Rs. ....

4.Farming experience

For how many years you are engaged in farming ?

.... years .... months.

5.Cosmopoliteness

(1)How many times do you visit the nearby town ?

Never/once in a month/once in a fortnight/once in a week/two or more times in a week.

(2)Purpose of visit

Entertainment/other purposes/personal or professional/agricultural

(3)Membership in organisation outside the village
Non-member/member

6.Economic motivation

Do you agree with the following statements ?

Agree/Disagree

(1) A farmer should work towards larger yields and economic benefits.

(2) The most successful farmer makes more profits.

(3) A farmer should try new plant protection measures in his farm.

(4) All I want from my farm is to make just reasonable living for the family.

7.Crop yield index

	1991-92			1992-93		
		Yield in kg/acre			Yield in kg/acre	
Crops	Area cultivated (acre)	For respondent	For village	Area cultivated (acre)	For respondent	For village
A.Paddy						
Viruppu						
Mundakan						
Puncha						
B.Vegetables						
Bhindi						
Brinjal						
Cucurbits						
Cowpea						

8.Contact with extension agency

Please indicate your frequency of contact and purpose of contact with each of the following extension personnel.

Sl No.	Extension agents	Frequency of contact			Purpose of contact	
		Never	Sometimes	Regularly	Non - agricultural	Agricultural
(1)	Agricultural officer					
(2)	Agricultural assistant					
(3)	Agricultural University					
(4)	Veterenary doctor					
(5)	Irrigation department					
(6)	Panchayat					
(7)	Cooperative society					
(8)	Field officers of bank					
(9)	Input dealers					

9.Information source utilisation

Kindly indicate the sources through which you get information with regard to plant protection measures for paddy and vegetables.

Sl No	Sources of information	Frequency Never	Sometimes	Regularly
A.	Personal localite sources			
1.	Family members			
2.	Friends			
3.	Neighbours			
4.	Relatives			
5.	Village leader			
6.	Contact farmer			
7.	Trained farmer			
8.	Demonstration farmer			
B.	Personal cosmopolite sources			
1.	Agricultural officer			
2.	Agricultural assistant			
3.	Agricultural university			
4.	Veterinary doctor			
5.	Irrigation department			
6.	Panchayat			
7.	Cooperative society			
8.	Field officers of bank			
9.	Input dealers			
C.	Mass media sources			
1.	Television			
2.	Radio			
3.	Agricultural film			
4.	Newspaper			
5.	Leaflets			
6.	Exhibition			
7.	Poster/Chart			
8.	Printed photographs			
9.	Field board			
10.	Other farm publications			

10.Scientific orientation

Please indicate the degree of your agreement/disagreement or undecideness about each of the following statements.

Sl. No	Statements	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
1.	Scientific plant protection measures don't give better results to a farmer than old methods.					
2.	A good farmer experiments with new ideas in plant protection technology.					
3.	The traditional methods of plant protection have to be changed inorder to raise the standard of living of a farmer.					
4.	A farmer with a lot of farm experience should apply scientifc plant protection measures.					

11.Risk orientation

Please give your agreement/disagreement or undecideness about each of the following statement.

Sl. No.	Statements	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
1.	A farmer should grow larger number of crops to avoid greater risks involved in growing one or two crops.					
2.	A farmer should take more of a chance in making a big profit than to be content with a smaller but less risky profit.					

Sl. No.	Statements	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
3.	A farmer who is willing to take greater risk than the average farmer usually does better financially.					
4.	It is good for a farmer to take risk when he knows his chances of success is fairly high.					
5.	It is better for a farmer not to try a new farming method unless most others in the locality have used it with success.					
6.	Trying entirely a new method in farming by a farmer involves risk, but it is worth.					

12. Management orientation

What is your opinion about the following statements ? Please indicate (√) your agreement or disagreement with each of the statements given below

a. Planning orientation

1. Each year one should think afresh about the crops to be cultivated in each type of land.
2. It is not necessary to make prior decision about the variety of crop to be cultivated .
3. The amount of seed ,fertilizers and plant protection chemicals needed for raising a crop should be assessed before cultivation.
4. It is not necessary to think ahead of the cost involved in raising a crop.
5. One need not consult any agricultural expert for crop planning.

6.It is possible to increase the yield through farm production plan.

b.Production orientation

1.Timely planting of a crop ensures good yield.

2.One should use as much fertilizer as he likes.

3.Determining fertilizer dose by soil testing saves money.

4.For timely weed control one should even use suitable herbicides.

5.Seed rate should be given as recommended by the specialists.

6.With low water rates one should use as much irrigation water as possible.

c.Marketing orientation

1.Market news is not so useful to a farmer.

2.Farmer can get good price by grading his produce.

3.Ware house can help the farmers to get better price for his produce.

4.One should sell his produce to the nearest market irrespective of price.

5.One should purchase his inputs from the shop where his relatives purchase.

6.One should grow those crops which have more market demand.

Part -II

1. Attitude of farmers towards chemical method of plant protection.

Please state the degree of agreement or disagreement with each of the following statements.

Sl. No.	Statements	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
1.	Scientifc method of chemical plant protection is an effective way of controlling pests and diseases in crops.					
2.	Control of pests and diseases through chemical method of p.p.is not economical.					
3.	It is possible to solve our food problem by adopting scientific chemical plant protection measures.					
4.	The time and energy spent for chemical method of plant protection could be utilised for some other productive purposes.					
5.	It is prestigious to be a farmer adopting chemical method of plant protection.					
6.	Any farmer can afford to chemical method of plant protection scientifically.					

Sl. No.	Statements	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
7.	The environmental hazards resulting from unscientific chemical plant protection is less.					
8.	I dot not persuade my fellow farmer to adopt scientific chemical plant protection measures.					
9.	There has been a considerable reduction in crop loss after the introduction of plant protection chemicals.					

2. Level of knowledge, extent of adoption and perception about the utility and practicability of plant protection methods.

Please indicate your level of knowledge, extent of adoption and perception about the utility and practicability of the following methods of plant protection for pests/ diseases in paddy and vegetable cultivation.

A. 1. Chemical method of plant protection in paddy/vegetables.

Sl. No Plant protection practices.	About knowledge		About adoption		About utility and practicability perception					
					Utility			Practicability		
	Correct	Incorrect	Actual area adopted as per recommen-. dation(acre or quantity used (kg))	Total area culti- vated/ (acre) (quantity required (kg))	Extremely useful	Use ful	Not use ful	Extremely practi- cable	Practi- cable	Not practi- cable
A.Paddy										
a.Stemborer										
1.Selection of chemical([illegible])										
2.Quantity of chemical(in kg) per/acre										
3.Quantity of chemical(in kg) per/pump load										
4.Number and interval of([illegible]) application										
5.Method of application([illegible])										
b.Gall fly										
1.										
2.										
3.										
4.										
5.										
C.Rice bug										
1.										
2										
3.										
4.										
5.										
d.Leaf folder										
1.										
2.										
3.										
4.										
5.										
e.Case worm										
1.										
2.										
3.										
4.										
5.										

Sl. No	Plant protection practices.	About knowledge		About adoption		About utility and practicability perception					
						Utility			Practicability		
		Correct	Incorrect	Actual area adopted as per recommendation (acre) or quantity used (kg)	Total area cultivated (acre) or quantity requirement (kg)	Extremely useful	Use ful	Not use ful	Extremely practi· cable	Practi- cable	Not practi- cable
	f.Blast										
	1.										
	2.										
	3.										
	4.										
	5.										
	g.Brown leaf spot (Helminthosporium leaf spot)										
	1.										
	2.										
	3.										
	4.										
	5.										
	h.Sheath rot										
	1.										
	2.										
	3.										
	4.										
	5.										
	i.Bacterial leaf blight										
	1.										
	2.										
	3.										
	4.										
	5.										
	B.Vegetables										
	i Bhindi										
	a Fruit and shoot borer										
	1.										
	2.										
	3.										
	4.										
	5.										

Sl. No Plant protection practices.	About knowledge		About adoption		About utility and practicability perception					
					Utility			Practicability		
	Correct	Incorrect	Actual area adopted as per recommendation (acre) (quantity used (kg))	Total area cultivated (acre) [illegible]	Extremely useful	Useful	Not useful	Extremely practicable	Practicable	Not practicable
b. Jassids										
1.										
2.										
3.										
4.										
5.										
c Downy mildew										
1.										
2.										
3.										
4.										
5.										
ii Brinjal										
a. Fruit and shoot borer										
1.										
2.										
3.										
4.										
5.										
b. Lace wings, mealy bugs and other sucking pests										
1.										
2.										
3.										
4.										
5.										
c. Leaf spot										
1.										
2.										
3.										
4.										
5.										

Sl. No Plant protection practices.	About knowledge		About adoption		About utility and practicability perception					
					Utility			Practicability		
	Correct	Incorrect	Actual area adopted as per recommen-. dation(acre) (or quantity used Kg)	Total area culti- vated (acre) or quantity required	Extremely useful	Use ful	Not use ful	Extremely practi- cable	Practi- cable	Not practi cable
iii.Cucurbits										
a.Fruit fly										
1.										
2.										
3.										
4.										
5.										
b.Epilachna beetle										
1.										
2.										
3.										
4.										
5.										
c Plant lice										
1.										
2.										
3.										
4.										
5.										
d.Powdery mildew										
1.										
2.										
3.										
4.										
5.										
iv.Cowpea										
a.Pea aphid										
1.										
2.										
3.										
4.										
5.										
b.Pod borer										
1.										
2.										
3.										
4.										
5.										

Sl. No	Plant protection practices.	About knowledge		About adoption		About utility and practicability perception					
						Utility			Practicability		
		Correct	Incorrect	Actual area adopted as per recommen-. dation (acre) or quantity used (kg)	Total area culti-vated (acre) or quantity required	Extremely useful	Use ful	Not use ful	Extremely practi-cable	Practi-cable	Not practi-cable
c.Leaf spot											
1.											
2.											
3.											
4.											
5.											

h. Please indicate your knowledge about, adoption of and perception about the utility and practicability of the precautions to be undertaken while using pesticides for the chemical control of pests/ diseases in paddy as well as in vegetables.

Sl. No	Precautions	About knowledge		About adoption		About utility and practicability perception					
						Utility			Practicability		
		Correct	Incorrect	Adoption	Non adoption	Extremely useful	Use ful	Not use ful	Extremely practi-cable	Practi-cable	Not practi-cable
1.	Do not mix the chemicals with bare hands.										
2.	Do not eat or drink while using pesticides.										
3.	Do not apply the chemicals against wind.										
4.	Do not wash the empty containers in streams/channels/ rivers etc.										
5.	Destroy the empty containers immediately after use.										

B.Cultural method of plant protection

1.Cultural method of plant protection (paddy)

Sl. No	Plant protection practices	About knowledge: Correct	About knowledge: Incorrect	About adoption: Actual area adopted as per recommendation (acre)	About adoption: Total area cultivated (acre)	Utility: Extremely useful	Utility: Useful	Utility: Not useful	Practicability: Extremely practicable	Practicability: Practicable	Practicability: Not practicable
1.	Summer ploughing										
a.	The time of summer ploughing										
2.	Selection of variety										
a.	Name of variety										
3.	Monitoring for pests in nursery										
a.	The time interval for monitoring										
4.	Synchronised planting										
a.	The time of planting										
5.	Plant population/sq.m.										
a.	The number of hills/sq.m.										
6.	Weeding operation										
a.	The number of weedings										
7.	Monitoring for pests in mainfield										
a.	The time interval for monitoring										

Sl. No	Plant protection practices	About knowledge		About adoption		About utility and practicability perception					
						Utility			Practicability		
		Correct	Incorrect	Actual area adopted as per recommendation (acre)	Total area cultivated (acre)	Extremely useful	Useful	Not useful	Extremely practicable	Practicable	Not practicable
8.	Water management										
a.	The levels of water to be maintained										
b.	The time of draining the water										
9.	Application of nitrogenous fertilizers										
a.	The quantity/acre										
b.	The number of split applications										

B.2. Cultural method of plant protection in vegetables

Sl. No	Plant protection practices	About knowledge		About adoption		About utility and practicability perception					
						Utility			Practicability		
		Correct	Incorrect	Actual area adopted as per recommendation (acre)	Total area cultivated (acre)	Extremely useful	Useful	Not useful	Extremely practicable	Practicable	Not practicable
1.	Monitoring pests in nursery										
a.	The time interval for monitoring										
2.	Synchronised planting										
a.	The time of planting										

Sl. No	Plant protection practices	About knowledge		About adoption		About utility and practicability perception					
						Utility			Practicability		
		Correct	Incorrect	Actual area adopted as per recommendation (acre)	Total area cultivated (acre)	Extremely useful	Useful	Not useful	Extremely practicable	Practicable	Not practicable
3.	Plant population/sq.m.										
a.	The number of hills/sq.m.										
4.	Weeding operation										
a.	The number of weedings										
5.	Monitoring for pests in mainfield										
a.	The time interval for monitoring										
6.	Application of nitrogenous fertilizers.										
a.	The quantity/acre										
b.	The number of applications.										

C.Mechanical method of plant protection

Sl. No	Plant protection practices	About knowledge		About adoption		About utility and practicability perception					
						Utility			Practicability		
		Correct	Incorrect	Actual area adopted as per recommendation (acre)	Total area cultivated (acre)	Extremely useful	Use ful	Not use ful	Extremely practicable	Practicable	Not practicable
A.Paddy											
1.	About the collection and destruction of egg masses and other stages of pests.										
2.	About the collection and destruction of affected plant parts or plants.										
B.Vegetables											
1.	About the collection and destruction of egg masses or other stages of pests.										
2.	About the collection and destruction of affected plant parts or plants.										

D. Biological method of plant protection in paddy

Sl. No	Plant protection practices	About knowledge		About adoption		About utility and practicability perception					
						Utility			Practicability		
		Correct	Incorrect	Actual area adopted as per recommendation (acre)	Total area cultivated (acre)	Extremely useful	Useful	Not useful	Extremely practicable	Practicable	Not practicable
1.	Conservation of natural enemies.										
a.	The application of pesticides when ETL crosses for pest.										
b.	Better application method.										

E. Physical method of plant protection in paddy

Sl. No	Plant protection practices	About knowledge		About adoption		About utility and practicability perception					
						Utility			Practicability		
		Correct	Incorrect	Actual area adopted as per recommendation (acre)	Total area cultivated (acre)	Extremely useful	Useful	Not useful	Extremely practicable	Practicable	Not practicable
1.	Using light traps										
a.	The number of light traps to be kept.										
b.	The time of keeping light traps										
c.	The time interval at which pests are monitored										

F. Integrated method of plant protection in paddy/vegetables.

Sl. No	Practices	About knowledge		About adoption		About utility and practicability perception					
						Utility			Practicability		
		Correct	Incorrect	Actual area adopted as per recommendation (acre)	Total area cultivated (acre)	Extremely useful	Useful	Not useful	Extremely practicable	Practicable	Not practicable
1.	Combination of methods										
a.	Combining different methods with the concept of IPM.										
b.	The conservation of natural enemies										

Part III A

1.Indigenous practices of plant protection methods being followed by farmers.

Please mention the indigenous/local practices being followed for the control of pests/diseases in paddy and vegetables

Sl. No.	Practices
A.	Paddy
B.	Vegetables

2. Perception of farmers about the impact of pesticides on environmental aspects

Please indicate whether the following statements are correct or not with regard to the impact of pesticides on environmental aspects.

Sl. No.	Statements	Very correct	Correct	Not correct
1.	Plant protection chemicals destroy soil fertility.			
2.	Unscientific application of plant protection chemicals results in environmental pollution.			

Sl. No.	Statements	Very correct	Correct	Not correct
3.	Certain plant protection chemicals become harmful to fish when applied in excess quantities.			
4.	Certain plant protection chemicals, when applied in excess quantities accumulate in human body at toxic level through consumption of fish and meat.			
5.	Unscientific application of pesticides results in resurgence of pests.			
6.	Unscientific application of pesticides destroys natural enemies.			
7.	Certain pesticides accumulate in milk and milk products.			
8.	Certain pesticides due to unscientific applicaion , present in water and become harmful to fish, birds and man.			
9.	Pesticides are not harmful when applied in scientific way.			
10.	Unscientific application of plant protection chemicals destroys soil biota.			

Part III B

1.Constraints encountered by the farmers in the adoption of plant protection technology.

Below are given the constraints encountered by the farmers in the adoption of plant protection technology for rice and vegetables. Please listen to each of them, when I shall read out and indicate whether you had experienced similar problems or not.

Sl. No	Constraints	Yes/No
1.	Pests and disease problems	
2.	Lack of adequate irrigation facilities	
3.	Lack of proper drainage facilities	
4.	High labour cost and shortage of labour in peak season	
5.	Untimely supply and high cost of inputs	
6.	Weed problem	
7.	Lack of technical guidance	
8.	Difficulty in the selection of alternate chemicals	
9.	Lack of knowledge	
10.	Difficulty in finding the dosage of chemical	

Sl. No	Constraints	Yes/No
11.	Poor supervision and management	
12.	Limited finance	
13.	Increased cost of cultivation due to adoption of plant protection	
14.	High risk involved	
15.	Difficulty to implement mechanical method of p.p.	

2. Suggestions to overcome the constraints in the adoption of plant protection technology

Please give your valuable suggestions to overcome the constraints in the adoption of plant protection technology.

APPENDIX II

KERALA AGRICULTURAL UNIVERSITY

Dr. G.T. Nair,
Professor & Head.

Department of Agricultural Extension,
College of Agriculture,
Vellayanai-695522.

Dear Sir/Madam,

This is in relation to the research study taken by Smt.B.Meera, Ph.D. Scholar in the department of Agricultural Extension. Her research problem is 'Differential adoption of plant protection technology by farmers of Kerala - A critical analysis'.

She has identified six methods of plant protection for the study. Specific practices with sub-practices under possible dimensions related to the adoption of each method of plant protection in paddy and vegetables (bhindi, brinjal, cucurbits and cowpea) were also identified. You are requested to decide upon.

(1) The importance of each method of plant protection and (2) the importance of the specific practices and sub-practices under different dimensions related to the adoption of each method of plant protection in paddy and vegetable cultivation.

Please put a tick mark (✓) in the appropriate column in a five point continuum. viz., ' Most Important ', ' More Important ', ' Important (Impt.) ' Less Important ' and 'Not Important ' for fixing the importance of each specific practice , sub-practice and method.

I once again request you,to give your valuable judgement to enable the researcher to select the important plant protection methods , their practices and sub-practices in paddy and vegetable cultivation.

Thanking you in advance for your contribution in completing this portion of her research work.

With regards,

Yours sincerely,

(Dr. G.T. NAIR)

1. Importance of the methods of plant protection in paddy and vegetable cultivation.

Sl. No.	Plant protection (p.p.) methods	Response category				
		Most Impt.	More Impt.	Impt.	Less Impt.	Not Impt.
1.	Chemical method of p.p.					
2.	Cultural method of p.p.					
3.	Biological method of p.p.					
4.	Mechanical method of p.p.					
5.	Physical method of p.p.					
6.	Integrated method of p.p.					

2. The plant protection practices and sub-practices in paddy and vegetable cultivation.

Sl. No.	Plant protection practices	Response category				
		Most Impt.	More Impt.	Impt.	Less Impt.	Not Impt.
I.	Chemical method of p.p.					
i.	Selection of the chemical					
ii.	Quantity of chemical to be used/acre					
iii.	Quantity of chemical to be taken/pump load					
iv.	Method of application					
v.	Time of application					
vi.	Number and interval of applications					
a)	Number of applications					
b)	Interval of applications					
vii.	Precautions to be taken while using the plant protection chemicals					

Sl. No.	Plant protection practices	Response category				
		Most Impt.	More Impt.	Impt.	Less Impt.	Not Impt.
II.	Cultural method of p.p.					
i.	Summer ploughing (for paddy)					
a)	Time of first summer ploughing					
b)	The number of ploughings					
ii.	Selection of variety (for paddy)					
a)	Name of the variety sown					
iii.	Land levelling in nursery (for paddy)					
a)	Number of levellings					
b)	Implement used for levelling					
c)	Precautions to be followed during levelling					
iv.	Monitoring for pests/diseases in nursery (for paddy and vegetables)					
a)	Time at which monitoring is to be commenced					
b)	Time interval for monitoring pests/diseases					
v.	Land levelling in main field (for paddy and vegetables)					
a)	Number of levelling					
b)	Equipment used for levelling					
c)	Precautions to be followed during levelling					
vi.	Synchronous planting (for paddy and vegetables)					
a)	Time of planting.					

Sl. No.	Plant protection practices	Response category				
		Most Impt.	More Impt.	Impt.	Less Impt.	Not Impt.
vii.	Plant population/sq.metre (for paddy and vegetables)					
a)	Number of hills/sq.metre					
viii.	Weeding operation (for paddy and vegetables)					
a)	Number of weedings					
b)	Time of hand weeding					
ix.	Monitoring for pests/diseases in main field (for paddy and vegetables)					
a)	Time at which monitoring is to be commenced					
b)	Time interval for monitoring					
x.	Water management in main field					
a)	Levels of water to be maintained.					
b)	Time of draining the field					
xi.	Application of nitrogenous fertilizers (for paddy and vegetables)					
a)	Selection of fertilizer					
b)	Quantity of nitrogenous fertilizer/acre					
c)	Number of split applications					
d)	Time of applications					
e)	Method of applications					
f)	Precautions to be followed during applications					
g)	Precautions to be followed after applications					

Sl. No.	Plant protection practices	Response category: Most Impt.	More Impt.	Impt.	Less Impt.	Not Impt.
III.	Mechanical method of p.p. (for paddy and vegetables)					
a)	Collection and destruction of egg masses and other stages of pests					
b)	Collection and destruction of affected plant parts or plants by pests/diseases.					
IV	Biological method of p.p.					
i.	Conservation of natural enemies					
a)	Applications of pesticides when E.T.L (Economic Threshhold Level) crosses for pest					
b)	Name of the chemical					
c)	Quantity of the chemical					
d)	Better application method					
e)	Type of formulation to be used					
V.	Physical method of p.p.					
i	Using light traps					
a)	Time of keeping light traps					
b)	Time interval at which pests are monitored					
c)	The number of light traps to be kept/acre					
d	Precautions to be taken for adoption					
VI.	Integrated method of p.p. (for paddy and vegetables)					
i.	Combination of methods.					
a.	Combining different methods with the concept of IPM.					
b.	Conservation of natural enemies					

APPENDIX III- A

KERALA AGRICULTURAL UNIVERSITY

Dr. G.T. Nair,
Professor and Head.

Department of Agricultural Extension,
College of Agriculture,
Vellayani - 695522.

Dear Sir/Madam,

This is in relation to the research study undertaken by Smt. B. Meera,Ph.D scholar in the department of Agricultural Extension. She is trying to develop a scale on 'Attitude of farmers towards chemical method of plant protection '.

In this regard some statements expressing the attitude are listed. On the right hand side of each statement there is a set of columns representing the degrees of relevance of the statements. You are requested to put tick mark (✓) in the appropriate column to indicate your judgement about the statement as to its degrees of relevance, on the four point continuum viz. 'Very much relevant'(V.M.R.)'Much relevant'(M.R.) 'Somewhat relevant'(S.R.) and 'Not relevant'(N.R.). The statements indicates the expression of the farmers in the real sense and not of yours as a judge. Please see that no statement is left out and feel free to add some more if needed to be and score them.

Thanking in advance for your kind contribution in completing this portion of her research work.

With regards,

Yours sincerely,

(Dr. G.T. NAIR)

Attitude of farmers towards chemical method of plant protection

Sl. No.	Statements	V.M.R.	M.R.	S.R.	N.R.
* 1.	A scientific farmer is one who practices chemical plant protection measures.				
* 2.	Resurgence of pests can be prevented through scientific chemical plant protection measures.				
* 3.	There is no means of increasing agricultural production other than practising chemical method of p.p. measures.				
* 4.	It is risky to adopt chemical method of p.p.by a poor farmer.				
* 5.	Scientific applications of p.p. chemicals will distroy human population.				
6.	It is difficult to select p.p. chemicals for the pests/diseases.				
* 7.	P.p. chemicals spoil the soil.				
8.	Traditional methods to control pests and diseases are very effective.				
* 9.	One has to apply p.p. chemicals to make the crop profitable.				

Sl. No.	Statements	V.M.R.	M.R.	S.R.	N.R.
* 10.	Any farmer can afford to chemical method of p.p. scientifically.				
* 11.	Proper utilization of p.p. chemicals will bring prosperity to our nation.				
12.	P.p. chemicals will not give additional financial returns in relation to the cost involved.				
* 13.	P.p. chemicals will affect the growth of plants.				
14.	Adoption of scientific chemical p.p. measures is against the good qualities of a scientific farmer.				
15.	Scientific chemical p.p. is a time consuming process.				
16.	I would recommend my fellow farmers to go for p.p. chemicals for pest control.				
* 17.	Scientific method of chemical p.p. is an effective way of controlling pests and diseases in crops.				
* 18.	We can very well increase the agricultural production without practising scientific chemical p.p.measures.				
19.	P.p. chemicals will increase the cost of cultivation of crops.				
20.	The growth of plants will be ensured by p.p chemicals.				

Sl. No.	Statements	V.M.R.	M.R.	S.R.	N.R.
21.	P.p. chemicals are not harmful to human health.				
* 22.	Scientific application of p.p chemicals will deteriorate the environment.				
23.	A real farmer will not advise his fellow farmers to adopt scientific chemical p.p. measures.				
* 24.	Following chemical method of p.p. will be a wasteful expenditure to our nation.				
* 25.	A farmer can resort to resistant /tolerant varieties instead of going for p.p. chemicals.				
26.	Adoption of scientific chemical p.p.measures would save a lot of crop production wastage.				
27.	An ordinary farmer cannot afford to scientific chemical p.p.measures .				
28.	P.p.chemicals do not cause any hindrance to the uptake of nutrients by the plants.				
* 29.	It is good for a farmer to adopt scientific chemical p.p. measures when he knows his chances of success is fairly high.				
30.	Adoption of scientific chemical p.p. measures definitely gives higher financial returns.				

Sl. No.	Statements	V.M.R.	M.R.	S.R.	N.R.
31.	I don't like to be a farmer adopting scientific chemical p.p.measures.				
* 32.	The p.p.measures what our forefathers practised is still the best way to control pests and diseases.				
33.	Chemical method of p.p can be practised by any ordinary farmer.				
* 34.	Control of pests and diseases through chemical method of p.p. is not economical.				
35.	Chemical method of p.p. won't help to enhance agricultural production.				
36.	There must be a law to enforce farmers to adopt scientific chemical method of p.p.				
37.	I advice a farmer to use p.p chemicals to increase crop production.				
* 38.	The time and energy spent for chemical method of p.p. could be utilised for some other productive purposes.				
* 39.	P.p.chemicals will not give returns in relation to the cost involved.				

Sl. No.	Statements	V.M.R.	M.R.	S.R.	N.R.
* 40.	I do not persuade my fellow farmer to adopt Scientific chemical p.p. measures.				
* 41.	It is possible to solve our food problem by adopting scientific chemical p.p. measures .				
* 42.	It is prestigious to be a farmer adopting chemical method of p.p.				
43.	Considerable time and energy can be saved by adopting chemical method of p.p.				
44.	Additional financial returns obtained through the adoption of chemical method of p.p. is less.				
* 45.	The best way of reducing the cost of cultivation of crops is to stop the application of p.p.chemicals.				
* 46.	To become a successful farmer one must adopt chemical method of p.p. scientifically.				
* 47.	It is worth to adopt chemical method of p.p.				
* 48.	When crop insurance is the saviour of the crop we need not apply p.p chemicals.				
* 49.	There has been a considerable reduction in crop loss after the introduction of p.p.chemicals.				

Sl. No.	Statements	V.M.R.	M.R.	S.R.	N.R.
* 50.	The environmental hazards resulting from unscientific chemical p.p.is less.				
51.	Application of p.p. chemicals makes an additional expenditure to the farmers.				
52.	Application of p.p. chemicals would ruin the cattle population as it depends on crops.				
53.	One cannot consider scientific chemical p.p. measures as an effective way to control pests and diseases.				
* 54.	A crop requires more nutrients when we apply p.p. chemicals.				

* Selected for item analysis.

V.M.R. Very Much Relevant.

M.R. Much Relevant.

S.R. Somewhat Relevant.

N.R. Not Relevant.

APPENDIX III -B

Statements on attitude of farmers towards chemical method of plant protection with critical ratio('t'value)

Sl. No.	Statements	't'value.
1.	A scientific farmer is one who practises chemical plant protection measures	1.92
2.	Resurgence of pests can be prevented through scientific chemical plant protection measures.	1.58
3.	There is no means of increasing agricultural production other than practising chemical p.p. measures.	2.72
4.	It is risky to adopt chemical method of p.p.by a poor farmer.	2.65
5.	Scientific applications of p.p. chemicals will distroy human population.	4.2
6.	P.p chemicals spoil the soil	2.10
7.	One has to apply p.p. chemicals to make the crop profitable.	5.32
* 8.	Any farmer can afford to chemical method of p.p. scientifically.	6.58
9.	Proper utilization of p.p. chemicals will bring prosperity to our nation.	2.55
10.	P.p. chemicals will affect the growth of plants.	1.88
* 11.	Scientific method of chemical p.p. is an effective way of controlling pests and diseases in crops.	7.76
12.	We can very well increase the agricultural production without practising scientific chemical p.p.measures.	4.32

Sl. No.	Statements	't'value.
13.	Scientific application of p.p chemicals will deteriorate the environment.	4.28
14.	Following chemical method of p.p. is a wasteful expenditure to our nation.	3.65
15.	A farmer can resort to resistant/ tolerant varieties instead of going for p.p. chemicals.	4.05
16.	It is good for a farmer to adopt scientific chemical p.p. measures when he knows his chances of success is fairly high.	3.81
17.	The p.p.measures what our fore-fathers practised is still the best way to control pests and diseases.	4.30
18.*	Control of pests and diseases through chemical method of p.p. is not economical.	6.78
19.*	The time and energy spent for chemical method of p.p. could be utilised for some other productive purposes.	12.20
20.	P.p.chemicals will not give returns in relation to the cost involved.	5.12
21.*	I do not persuade my fellow farmer to adopt sientific chemical p.p. measures.	8.25
22.*	It is possible to solve our food problem by adopting scientific chemical p.p. measures .	7.85
23.*	It is prestigious to be a farmer adopting chemical method of p.p.	7.73
24.	The best way of reducing the cost of cultivation of crops is to stop the application of p.p.chemicals.	1.75

Sl. No.	Statements	't'value.
25.	To become a successful farmer one must adopt chemical method of p.p. scientifically.	1.63
26.	It is worth to adopt chemical method of p.p.	2.46
27.	When crop insurance is the saviour of the crop we need not apply p.p chemicals.	0.69
* 28.	There has been a considerable reduction in crop loss after the introduction of p.p.chemicals.	6.65
* 29.	The environmental hazards resulting from unscientific chemical p.p.is less.	9.62
30.	A crop requires more nutrients when we apply p.p. chemicals.	1.94

* Selected for the final study.

APPENDIX IV

KERALA AGRICULTURAL UNIVERSITY

Dr.G.T. Nair,
Professor & Head.

Department of Agricultural Extention,
College of Agriculture,
Vellayani-695522

Dear Sir/Madam,

This is in relation to the research study taken by Smt. Meera , Ph.D. scholar in the department of Agricultural Extention. Her research problem is 'Differential adoption of plant protection technology by farmers of Kerala - A critical analysis '

She has identified various practices and their sub-practices under possible dimensions related to the adoption of six plant protection methods selected for paddy and vegetable (bhindi, brinjal, cucurbitaceous vegetables and cowpea) cultivation. It is assumed that all the practices and their sub-practices are important in technology acceptance, however they vary in their degree of importance.

It is therefore necessary to fix weightage for each of the practices and sub-practices based on their importance in plant protection in paddy and vegetable cultivation.

Kindly mark the importance of each of the identified practices and sub-practices related to the adoption of plant protection measures by giving a '✓ 'mark at the appropriate column with score, ranged from 1 to 10.

Thanking in advance for your contribution in completing this portion of her research work.

With regards,

Yours sincerely,

(Dr.G.T. Nair).

Please assign importance score of 1 - 10 for each of the following practices and sub-practices of plant protection.

Sl. No.	Plant protection practices	Weightage score 1 - 10	Score arrived
I.	Chemical method of p.p. (for paddy and vegetables)		
i.	Selection of chemical		9
ii.	Quantity of chemical used/acre		9
iii	Number and interval of applications		9
a)	Number of applications		9
b)	Interval between applications		9
iv.	Method of application		9
II.	Cultural method of p.p.		
i.	Summer ploughing (for paddy)		5
a)	The number of ploughings		5
ii.	Selection of variety (for paddy)		6
a)	Name of the variety sown		5
iii	Monitoring for pests/ diseases in nursery (for paddy and vegetables)		9
a)	Time interval for monitoring pests/diseases		9
iv.	Synchronous planting (for paddy and vegetables)		9
a)	Time of planting		8
v.	Plant population/sq.metre (for paddy and vegetables)		8
a)	Number of hills/sq.metre		7

Sl. No.	Plant protection practices	Weightage score 1 - 10	Score arrived
vi.	Weeding operation (for paddy and vegetables)		8
a)	Number of weedings		7
vii.	Monitoring for pests/ diseases in main field (for paddy & vegetables)		9
a)	Time interval for monitoring		9
viii.	Water management in main field (for paddy)		8
a)	Levels of water to be maintained.		8
b)	Time of draining the field		7
ix.	Application of nitrogenous fertilizers (for paddy and vegetables)		9
a)	Quantity of nitrogenous fertilizer/acre		8
b)	Number of split applications		8
III.	Mechanical method of p.p. (for vegetables)		
a)	Collection and destruction of egg masses of pests		7
b)	Collection and destruction of affected plant parts or plants by pests/diseases.		7
IV.	Biological method of p.p.		
i.	Conservation of natural enemies		8
a)	Applications of pesticides when E.T.L. (Economic Threshhold Level) crosses for pest.		8

Sl. No.	Plant protection practices	Weightage score 1 - 10	Score arrived
b)	Better application method		7
c)	Type of formulation to be used		7
v.	Physical method of p.p		
i	Using light trap		7
a)	Time of keeping light traps		7
b)	Time interval at which pests are monitored		7
c)	The number of light traps to be kept/acre		7
VI.	Integrated method of p.p. (for paddy and vegetables)		
i.	Combination of methods.		8
a)	Combining different methods with the concept of lPM		9
b.	Conservation of natural enemies.		8

APPENDIX V

KERALA AGRICULTURAL UNIVERSITY

Dr. G.T. Nair,
Professor and Head.

Department of Agricultural Extension,
College of Agriculture,
Vellayani- 695522.

Dear Sir/Madam,

This is in relation to the research study undertaken by Smt. B. Meera, Ph.D. scholar in the department of Agricultural Extension and her research problem is 'Differential adoption of plant protection technology by farmers of Kerala - A critical analysis'.

A list of indigenous/local practices of plant protection technology being practised by the farmers for paddy and vegetables (bhindi, brinjal, cucurbits and cowpea) cultivations is appended herewith. You are requested to kindly spare some of your valuable time to rate the effectiveness and the scientific rationality of each practice by marking '✓' in appropriate column, along with your remarks.

Thanking you in advance for your kind contribution in completing this portion of her reserch work.

With regards,

Yours sincerely,

(DR. G.T. NAIR)

Effectiveness and scientific rationality of the indigenous/local practices of plant protection being followed by farmers .

Sl. No.	Plant protection practices	Effectiveness				Scientific Rationality				Remarks
		HE	ME	LE	NE	HR	MR	LR	NR	
A.Paddy										
1.	Application of extract of drumstick , plant's, bark, chilli (Kanthari) and azafoetida, diluted to ten times for controlling rice bug.									
2.	Tying waste plastic threads/tapes across fields to keep away the birds during earhead stage.									
3.	Keeping wooden pegs/pedicel of coconut leaves at places in fields to help the birds to rest upon and pick up pests.									
4.	Draining water and preparing land as for paddy cultivation one month prior to actual cultivation to allow all weeds to germinate. Flood the field after two weeks, for another two weeks for destroying all the germinated weeds for weed control.									
5.	Using tolerant local varieties.									
6.	Controlled application of fertilizers for reducing pest and disease attack.									
7.	Organic farming for reducing pest and disease occurrence.									

Sl. No.	Plant protection practices	Effectiveness				Scientific Rationality				Remarks
		HE	ME	LE	NE	HR	MR	LR	NR	
	B.Vegetables									
1.	Application of wood ash @ 25 g/plant to reduce the attack of mealy bugs, aphids etc.									
2.	Application of lime @ 100g/pit to control yellowing or damping off.									
3.	Controlled application of chemical fertilizers to reduce pest and disease attack.									
4.	Organic farming to reduce pest and disease occurrence.									
5.	Use of *thulsikeni* in *pandals* to trap and kill fruit flies (ie.a mixture of crushed *thulsi* leaves, jaggery and little quantity of furadan or malathion in coconut shells).									
6.	Use of maggot traps in vegetable gardens (ie. palayanthodan banana + furadan in coconut shells).									

HE - Highly Effective
ME - Moderately Effective
LE - Least Effective
NE - Not at all Effective
HR - Highly Rational
MR - Moderately Rational
LR - Least Rational
NR - Not at all Rational

APPENDIX VI

The following procedure was used for computing adoption

1.Chemical method of plant protection

1.Selection of chemical	-a)	Actual area treated with the recommended chemical / Total area requiring chemical treatment
2.Quantity of chemical used/acre	-a)	Actual quantity of the chemical used/acre / Recommended quantity of the chemical/acre
3.Quantity of chemical taken/pump load	-a)	Actual quantity of the chemical/pump load / Recommended quantity of the chemical/pump load
4.Number and interval of application	-a)	Actual number of applications / Recommended number of applications
	b)	Actual interval of application followed / Recommended interval of application
5.Method of application	-a)	Actual area treated with recommended method of application / Total area requiring recommended method of application

2. Cultural method of plant protection

1. Summer ploughing (for paddy)	-a)	Actual area where summer ploughing was given / Total area sown with paddy
2. Selection variety	-a)	Actual area sown with recommended variety / Total area sown with paddy
3. Monitoring for pests in nursery (for paddy and vegetables)	-a)	Actual area monitored for pests as recommended / Total area sown.
4. Synchronised planting (for paddy and vegetables)	-a)	Actual area following synchronised planting / Total area sown
5. Plant population/sq.m. (for paddy and vegetables)	-a)	Actual area planted with recommended number of hills/sq.m. / Total area sown.
6. Weeding operation (for paddy and vegetables)	-a)	Actual area following recommended number of weedings. / Total area sown
7. Monitoring for pests in main field (for paddy and vegetables)	-a)	Actual area monitored for pests as recommended / Total area under paddy

8. Water management in main field (for paddy and vegetables)	-a) $\frac{\text{Actual area maintained with recommended level of water}}{\text{Total area under paddy}}$
9. Application of nitrogenous fertilizers. (for paddy)	-a) $\frac{\text{Actual area applied with recommended quantity of nitrogenous fertilizer}}{\text{Total area under paddy}}$

3. Mechanical method of plant protection

(for paddy and vegetables)

1. Collection and destruction of egg masses and other stages of pests.	-a) $\frac{\text{Actual area followed this practice}}{\text{Total area sown.}}$
2. Collection and destruction of affected plant parts or plants.	-a) $\frac{\text{Actual area followed this practice.}}{\text{Total area sown}}$

4. Biological method of plant protection

(for paddy)

1. Application of pesticides when E.T.L. crosses for pest	-a) $\frac{\text{Actual area followed this practice.}}{\text{Total area sown}}$
2. Better application method.	-a) $\frac{\text{Actual area followed this practice}}{\text{Total area sown}}$

5. Physical method of plant protection

1. The number of light traps to be kept/acre	-a) Recommended number of light traps. / Total area sown
2. The time of keeping light traps	-a) Number of light traps monitored at the recommended time / Total number of light traps.
3. The time interval at which the pests are monitored	a) Actual area following the recommended time interval / Total area sown

6. Integrated method of plant protection

(for paddy and vegetables)

1. Combining different p.p methods with the concept of IPM	-a) Actual area following different p.p. methods combined with the concept of IPM / Total area following p.p. operations.
2. Conservation of natural enemies	a) Actual area conserving natural enemies / Total area cultivating

DIFFERENTIAL ADOPTION OF PLANT PROTECTION TECHNOLOGY BY FARMERS OF KERALA - A CRITICAL ANALYSIS

BY
B. MEERA, M.Sc. (Ag.)

ABSTRACT OF THE THESIS
submitted in partial fulfilment of the requirement
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ABSTRACT

Indian agriculture has undergone intensive farming with the introduction of high yielding varieties of crops. Adoption of improved technology and management practices for boosting up production of food grains have resulted in serious pest and disease complexes warranting intensive and extensive use of plant protection chemicals. A number of limitations and adverse side effects such as pest resistance to pesticides, pesticide residues, health hazards, environmental pollution and ecological imbalance have been identified recently.

The components of plant protection technology were taken to study the differential adoption in important crops like paddy and vegetables by the farmers and explained the variations in their cognitive, affective and connative components of behaviour with a selected set of independent variables. The study analysed the indigenous practices of plant protection being followed by farmers and also their perception about the impact of pesticides on environmental aspects. The major constraints experienced by the farmers in the adoption of plant protection technology along with the suggestions to overcome the same were also studied.

The study was undertaken in two districts of Kerala viz., Thiruvananthapuram and Alappuzha. A sample of 120 farmers each from the two districts was selected and the total sample size for the study was 240. The data were collected using an interview schedule and analysed using suitable statistical techniques.

There was significant difference among the farmers of Thiruvananthapuram and Alappuzha districts with regard to their knowledge about chemical and cultural methods of plant protection. Majority of farmers of both the districts belonged to low knowledge group. The farmers of both the districts were ignorant about biological, physical and integrated methods of plant protection methods. Majority of the farmers of both the districts possessed favourable attitude towards chemical method of plant protection. The farmers of Alappuzha district were significantly higher adopters of plant protection methods than the farmers of Thiruvananthapuram district. Majority of the farmers of both the districts belonged to low perception category with regard to their perception about the utility and practicability of plant protection methods. Crop yield index and scientific orientation emerged as significant independent variables in the correlation and multiple regression analysis with regard to the farmers of both the districts.

The practices, viz., 'controlled application of nutrients for reducing pest and disease attack' in paddy and use of 'thulsikeni' in 'pandals' to trap and kill fruit flies in vegetables were judged as the most effective and scientifically rational practices adopted by farmers. The farmer's perception about the impact of pesticides on environmental aspects was very low and majority of them belonged to low perception category.

The constraint 'untimely supply and high cost of imputs' was the most important constraint experienced by the farmers of Thiruvananthapuram district, while 'lack of proper drainage facilities' was the most serious constraint experienced by the farmers of Alappuzha district. The most important suggestion given by the farmers to overcome the contraints was to 'develop simple and more compatible plant protection technologies' and the most important suggestion given by the experts to overcome the constraints experienced by the farmers was to 'impart adequate training to farmers as well as extension workers on IPM practices'.

The strategic model developed by integrating the salient findings of the present study, emphasised the importance of popularising effective plant protection technology among the farmers in ecologically senstive rice and vegetable production systems in Kerala.