FERTILISER USE BEHAVIOUR OF RICE FARMERS OF KERALA

By

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THESIS

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DECLARATION

I hereby declare that this thesis entitled '**Fertiliser Use Behaviour of Rice Farmers of Kerala**' is a bonafide record of research work done by me during the course of research and that this thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or any other similar title of any other University or Society

GEETHAKUTTY, P S

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CERTIFICATE

Certified that this thesis entitled **"Fertiliser Use Behaviour of Rice Farmers of Kerala"** is a record of research work done independently by **Smt Geethakutty, P S** under my guidance and supervision and that it has not previously formed the basis for the award of any degree fellowship or associateship to her

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Introduction

CHAPTER 1

INTRODUCTION

Under colonial domination spanning over two centuries Indian economy suffered in several ways Since agriculture was the major economic activity in the country the impact of colonial rule on Indian agriculture was particularly severe resulting in impoverishment of the twin bases of agriculture viz the farm land and the farmer From being a surplus producer of foodgrains India got transformed into a country with sizeable deficit in food production In a study on agricultural production productivity and availability from 1891 1947, Blyn (1966) found that increase in aggregate foodgrain production was a meagre average rate of 0 11 per cent per annum The country was forced to depend upon imported food supply from the west for many years after independence and there were years when the country had a ship to mouth existence It appeared to many western observers that India and the other countries in the underdeveloped world were losing their capacity to feed themselves (Brown 1965) In fact the situation was considered so hopeless by some that it would become necessary to apply the classical medical triage method to the underdeveloped countries depending on imported food Like doctors on the battle field trying to make the best out of limited resources the affluent countries will have to decide which starving countries to save and which to sacrifice (Paddock and Paddock 1968)

Around the period when Paddock brothers were proposing to leave India and other similar countries to their inevitable fate things were beginning to happen for ushering in of the Green Revolution with its accent on 'chemical-biological' technologies High yielding seed varieties and the related inputs such as fertilisers, plant protection chemicals, advanced agricultural research and farmers education programmes were the corner-stones of agricultural development Foodgrain production which was around 50 million tonnes in the fifties rose to 175 million tonnes in the eighties with long term rate of growth of around 3 per cent as against 0 11 per cent for the pre independence period

The newly introduced high yielding variety (HYV) technologies could be equated with increased fertiliser use as it is widely accepted that the higher potential of HYVs could be realised only through proper and balanced use of chemical fertilisers Due to the concerted efforts of the extension functionaries developmental agencies and input agencies fertiliser consumption in the country has increased considerably India is now the fourth largest consumer and producer of fertilisers in the world Still India continues to be at a lower level of fertiliser consumption at 52 2 kg/ha If one compares this with other developing countries like Egypt and China it could be realised that the Indian farmers are far behind in the consumption of fertilisers

Even within India there is wide variation among different States with regard to fertiliser consumption In comparison to Punjab having 159 kg/ha Tamil Nadu with 96 kg/ha and Uttar Pradesh having 75 kg/ha Kerala s position is quite backward with consumption at 53 kg/ha only during 1986-87 With the efforts of different agencies there has been a steady increase in the use of fertilisers by the farmers in Kerala during the last two decades In comparison to the 6264 tonnes of N 84961 tonnes of P_2O_5 and 2248 tonnes of K_2O used by the farmers in Kerala during 1961 62 the corresponding figures for 1987-88 were 70770 49350 and 62410 tonnes of N P_2O_5 and K_2O respectively (Government of Kerala 1989)

The State has developed its own agricultural research and extension systems to boost agricultural production The research system has developed sound package of practices and techniques for scientific cultivation of important crops in the state The extension system has implemented a number of developmental programme starting from multipurpose approach of CD programme (NES) to individual approach under the Training and Visit (T&V) system and to the group approach under group management programme in farming at present

Even with all these efforts how far the technologies and recommendations are transferred to and accepted by the farmers in our state is a question that remains to be answered

Many researchers (Singh (1980) Geethakutty (1982) Ingle et al (1987) Saxena et al (1990) and Singh (1990)) reported the wide gap between knowledge production and its utilisation by the farmers in the actual field situation Sen (1981) reported that the extent of adoption of fertilisers varied considerably from state to state and also had observed that the adoption rates varied from one size group of farmers to another Singh (1990) found that the farmers in general applied lower than the recommended doses of nitrogen phosphorus and potash Randhawa (1985) observed that nitrogenous fertilisers were applied to rice crop by all the farmers while phosphatic fertilisers were not used by all and potassic fertilisers were used by a small proportion only

Dealing with soils of Kerala NARP Status Report of KAU (1989) states that major part of the soils in Kerala are acidic in nature with large percentage of iron aluminium oxide and gravel in the soils As a result the soils possess the least cation exchange capacity water holding capacity and nutrient retentivity In other words the soils are not inherently fertile The phosphatic fixation is very high Due to high rainfall during the South West Monsoon a major part of the applied N and K is lost as a result of runoff and leaching Fertiliser use efficiency is only 30 to 35 per cent for N and 50 to 60 per cent for K in wetlands Toxicity due to higher concentration of soluble iron and aluminium occurs in low lying areas subject to rice culture Lack of irrigation during summer months is another limiting factor for increasing the fertiliser use efficiency in most of the paddy fields in Kerala

In such fields proper and balanced crop nutrition becomes essential for profitable and sustainable crop production Chemical fertiliser is the most important component of plant nutrients the other sources being organics and bio-fertilisers Use of organics is the oldest and most widely accepted practice of nutrient replenishment Biofertilisers also have a significant role to play in nutrient supply which is yet to become popular The crop response to organics and biofertilisers is not as spectacular as with chemical fertilisers But there is a thinking prevalent among a section of the environmentalists that farmers may rely solely an organics for crop nutrition and give up the use of chemical fertilisers completely As is well known there is limited scope to increase the use of plant nutrients through organic sources due to their scarcity Moreover the low nutrient content of organic sources and slow release of plant nutrients also render them incapable of meeting the higher needs of nutrients for crops especially of high yielding rice varieties What is needed at this juncture is the use of a judicious combination of chemical fertilisers organic manures and biofertilisers The supplementary and complementary use of inorganics organics and biofertilisers in addition to providing nutrients and improving soil physico chemical properties also will improve the use efficiency of applied chemical fertilisers

Sankaram (1992) suggested the need for use of both organics and inorganics together In his words To use both organics and inorganics as a blend is not a compromise but a compulsion as a solution to crop yield improvement The organics promote soil fertility in physical-biological terms for added inorganics to act with higher use efficiency and they also build up soil fertility for artificial fertilisers to be fruitful Mishra and Kapoor (1992) also noticed this necessity of using organics and inorganics as a blend They remarked There is no scope for reducing the consumption of chemical fertilisers since the level of crop productivity is not only to be maintained but is to be increased in coming years which is presumably not possible without the use of chemical fertilisers Under the present Indian conditions organic source of nutrients should be considered as supplement to chemical fertilisers and not as substitutes While presenting the importance of integrated nutrient management approach Kundu and Pillai (1992) reminded that all the available sources of plant nutrients have to be exploited in a judicious way and their efficient use ensured They have pointed to the fact that under conditions of intensive cropping the available nutrient reserves in the soil and supplied organics cannot meet the nutritional requirement of a crop like rice and under such conditions the use of chemical fertilisers in balanced proportion and in recommended quantities together with organics is an essentiality

But the increasing cost of chemical fertilisers resulting from withdrawal of government subsidies without corresponding proportionate increase in the price of produce deter the resource poor rice farmers from using them in the required quantities The inadequate availability of organics also raises problem in its proper use among farmers

The NARP Status Report of KAU (1989) highlighted the low and improper fertiliser use position of farmers in Kerala and emphasized the need for educating the farmers about the need for balanced fertiliser use Sulaiman (1989) studied about the acceptance of fertiliser management practices by the rice farmers of Kerala and observed that knowledge about fertiliser use is a deciding factor in the adoption of fertilisers Santha et al (1989) analysed the fertiliser consumption trend in Kerala and observed that substantial progress was achieved in fertiliser use during eightees and there was considerable variation in the levels of per hectare consumption of fertilisers in the different districts of the state The various studies indicate the wide variation existing in fertiliser use level of farmers in the country

The need for fertilisation of crops was not realised in the earlier days of subsistence farming as the nutrient removal was very low due to use of traditional varieties and non-intensive cropping practices However it has assumed much significance at present because of intensive farming activities which has led to the continuous mining of nutrients in the soil which poses a threat to crop productivity, soil fertility and to the sustainable agriculture at large The soil is to be enriched and replenished with plant nutrients continuously as there is continuous removal from the thin layer of life giving and life supporting earth This issue gains added urgency in the case of rice fields which are the factories of the major field crop and staple food of people in Kerala - paddy This necessitates an effective nutrient management which will improve and restore the fertility of rice fields and productivity of the crop and profitability of the farmers from their crops

In many of the rice field situations in Kerala 30 40 per cent of the applied fertilisers only are being utilised by the crop and the rest is lost through various pathways like leaching surface runoff volatalisation denitrification fixation in the soil etc Specific characteristics of the soil like iron toxicity fixation etc make utilization of the nutrients by the crops impossible These types of losses can be reduced and minimised through appropriate fertiliser management practices such as application in proper quantities applying at proper time split applications using low cost fertilisers and by adopting related management practices such as water management crop rotation with leguminous crops selection of fertiliser responsive varieties application of lime crop rotation with legumes management of weeds pests and diseases and soil test based fertiliser application All these dimensions of fertiliser use may have to be followed to maximise fertiliser use efficiency In a nutshell the behaviour of the farmers in relation to use of fertiliser in toto has to be improved rather than increasing the quantity of fertilisers alone

While studying the fertiliser use behaviour of rice farmers, the complexity and diversity of the field situations may have to be considered The rice farmers in Kerala belong to an increasingly complex interacting system of physical economic, biological and social environment which is being subjected to fluctuations In order to improve the fertiliser use behaviour of such farmers it is very much essential that an analysis of the technical situational and social system variables in relation to their fertiliser use behaviour also be attempted In any context the proper perception of the user is also an important factor for adoption Thus an understanding of the important technical and situational factors of fertiliser use behaviour becomes absolutely necessary in a study of fertiliser use behaviour Against this background the present study was initiated with the following specific objectives

Specific objectives

The specific objectives of the study are

(i) to develop an index for measuring the fertiliser use behaviour of rice farmers

(ii) to identify the factors contributing to fertiliser use behaviour as perceived by the farmers extension personnel scientists and input agencies

(iii) to correlate the selected personal socio-economic and socio-psychological characteristics of farmers with their fertiliser use behaviour

(iv) to identify the constraints in fertiliser use of rice farmers and

(v) to suggest a model for efficient fertiliser use behaviour of rice farmers

Scope of the study

Fertiliser being an expensive input forms a sizeable percentage of the farmers total cost of cultivation It is therefore of critical importance that every unit of this input be efficiently utilised Planning for high fertiliser use efficiency is important from the point of view of obtaining maximum yield so that the income and margin of profit of the farmers could be enhanced Also from the national perspective the wastage of scarce resources has to be reduced considerably The present study is an attempt in this direction wherein the important dimensions of fertiliser use behaviour and factors contributing to fertiliser use behaviour of farmers can be identified which can be given more emphasis by the extension personnel researchers and policy makers The study will also throw light on the significant behavioural characteristics of farmers relating to fertiliser use behaviour and the serious constraints faced by the farmers in fertiliser use Moreover using the index developed in the study the fertiliser use behaviour of the farmers could be measured and predicted which will help the research extension and input agencies to plan and implement fertiliser education programmes more effectively

Limitations of the study

The present research forms a part of the Doctorate degree programme which is a single student investigation and hence has the inherent limitations in terms of time money other resources Because of this important limitation the student researcher was forced to confine the study to selected locations and restricted sample size In spite of these intensive care was taken to conduct the study as scientifically and systematically as possible

The study covered only rice farmers whose fertiliser use behaviour need not resemble that of a coconut farmer vegetable farmer or a rubber grower and hence generalization of the findings of the study will be directly applicable only to rice farmers

Since the study covered two consecutive crop seasons the researcher had to depend on information which the respondents gave from their memory (recall data) about the quantity time of application yield and such other details By the very nature of things some degree of error could creep into the data However every effort was made to ensure that the data are as reliable as possible

In spite of these limitations the findings of this study are expected to throw substantial light on the fertiliser use behaviour of rice farmers in Kerala and their related problems and factors which would be of use in the successful implementation of fertiliser education strategies

Presentation of the thesis

The thesis is divided into six chapters including the present one The present chapter already covered the scope objectives and limitations of the study The second chapter deals with review of literature relevant to the study The details of the study area selection of respondents procedures adopted for development of the index selection and measurement of variables tools for data collection and statistical techniques used are covered in the third chapter

Methodology The fourth chapter deals with results of the study obtained while the fifth chapter discusses about the results in detail The sixth and final chapter presents the summary and implications of the study The references appendices and abstract of the thesis are given at the end

Theoretical Orientation

CHAPTER II

THEORETICAL ORIENTATION

The main objective of this chapter is to give an orientation to the concepts and constructs of fertiliser use behaviour of farmers and to present the different research findings in the area of study With this in mind a deep search into the past research efforts has been made with the aim of locating the problem in a theoretical perspective Accordingly the relevant literature is presented in this chapter under the following major heads

2 1 Concept of fertiliser use behaviour

2 2 Studies on use of fertilisers by farmers

2 3 Relationship of selected personal socio psychological and economic characteristics of farmers with their fertiliser use behaviour

2 4 Perceived importance of technological and situational factors contributing to the fertiliser use behaviour of farmers

2 5 Constraints in the use of fertilisers by farmers

2 6 Conceptual framework developed for the study

2 1 Concept of Fertiliser Use Behaviour

Behaviour is considered to be a collective term for the manifestation of life that is produced by any organism in relation to the environment A farmer s behaviour in relation to the changes in his environment is always subjected to change The farmer can be treated as a dynamic organism who is in constant interaction with his farm and home and societal environment In this interaction process he always acts within the framework of his personal economic socio-cultural and psychological characteristics and his perception about the interplay of the various factors and constraints in his environment Any activity undertaken by the farmer in this environment with a view to augmenting crop production can be considered as a manifestation of his behaviour Narrowing this concept to a specific behaviour viz fertiliser use fertiliser is viewed as any material that can supply required nutrients for the growth of crops The activities undertaken by the farmer in the process of supplying nutrients to crops can be viewed as the fertiliser use behaviour Within this broad framework the fertiliser use behaviour for the present study is operationally defined as the extent of use of the recommended fertilisers and manures for rice in terms of quantity of fertilisers and manures time of application number of split applications method of application type of fertilisers and manures and other related management practices such as water management liming land preparation soil testing and modification of fertiliser use etc

Many studies have been conducted in the past about fertiliser use But the scope of most of those studies was confined to only measurement of the quantity of fertiliser used or the gap in adoption of fertiliser use

2 2 Studies on use of fertilisers by farmers

Sohal and Shukla (1967) reported that only some percentage of farmers (16 60% in the case of nitrogen and 18 05% in the case of phosphorus) were found to use excess quantity of fertilisers above the recommended dosages

Jati and Tripathy (1972) in their study on adoption of fertilisers in Sambalpur revealed that only 73 80 per cent of paddy growers used fertilisers

Vellapandian (1974) stated that extent of adoption was the highest (79 20%) in respect of IR 20 paddy variety

Tripathy (1977) reported that 80 00 per cent of gap in yield was caused by non adoption of some technological units on various components of the high yielding rice technology The non adoption or low adoption of any one technological unit would create differential impact on adoption

Vijayaraghavan (1977) reported wide variation in the extent of adoption of all practices except seed rate by small farmers

Ganasekaran (1978) reported that there was wide variation in the extent of adoption of all the practices among paddy growing marginal farmers

Manivannan (1980) observed that 40 00 per cent of the farmers adopted recommended dose of nitrogenous fertilisers In respect of phosphorus and potassic fertilisers only 16 67 per cent of the respondents had adopted the recommended doses

Sen (1981) reported that the extent of adoption of fertilisers varied considerably from state to state At one end of the spectrum showing the least adoption was Assam with barely 5 00 per cent of farmers using fertilisers and at the other end was Punjab where more than 95 00 per cent of the cultivators used fertilisers The adoption rates were higher than the all India average in seven states including Kerala

Singh (1981) found that farmers in general applied lower than the recommended doses of nitrogen phosphorus and potash In terms of percentage of recommended dose all the three categories of farmers marginal small and medium applied significantly more amount of nitrogen in comparison to both phosphorus and potash and significantly more amount of phosphate than potash

The findings of Bidari (1982) Sivasankara (1986) Somashekarappa and Manimegalan (1987) and Bahadur (1988) revealed that majority of farmers had not gone upto recommended dose of fertilisers

Godi and Gowder (1983) indicated that recommendations involving high cost such as use of fertiliser and plant protection chemicals have been only partially adopted by majority of the farmers

Nanjaiyan (1985) found that 64 00 per cent of the respondents had medium level of adoption of recommended practices in the case of cultivation of IR-20 paddy

Randhawa (1985) found that nitrogenous fertiliser was applied to rice crop by all the farmers while phosphatic fertilisers was not used by all Potassic fertiliser was used only by a small proportion The majority of the farmers (59 60%) did not apply inc for rice crop

Sharma (1985) reported that average dose of fertilisers used by the farmers were far below the recommended levels in Rajasthan

Thamilmani (1985) reported that the rate of adoption of blue green algae (BGA) was low in the beginning and took a sudden increase in the later years It was further reported that the attributes of BGA and intensity of cropping had high direct effects on the adoption of BGA

Rajagopalan (1986) reported that majority (67 30%) of the paddy growers in Tanjavur district in Tamil Nadu adopted split application of nitrogenous fertilisers

Srinivasamurthy and Nagaraj (1986) indicated that though fertiliser use was generally accepted for irrigated crops in Karnataka, the recommended levels were not adopted However the levels of fertiliser for paddy and sugarcane were found to be nearer to recommended level

In his study on use of fertilisers Singh and Sarup (1986) in Himacnal Pradesh observed that the actual use of fertilisers by the sampled farmers in N P and K in all crops was far below the recommended doses

Jayaramaiah (1987) observed that majority of the farmers had used less than the recommended doses of nitrogen phosphorus and potash for all the three crops considered viz jowar groundnut and potato in Karnataka The majority of the farmers had used medium levels of NPK for paddy and ragi crops

Sulaiman (1989) indicated that the paddy farmers of Palakkad in Kerala State had a higher mean adoption score (27 27) than the farmers of Kannur (14 31) with regard to their adoption of fertiliser management practices It was seen that 42 00 per cent of the farmers in Kannur belonged to the low adoption category while there was none in Palakkad belonging to this category Forty three per cent of the farmers in Palakkad belonged to the high adopter category while none was found belonging to this category in Kannur

Siddaramaiah and Veerabadraiah (1987) reported that the percentage of farmers applying the recommended dose (full adoption) of fertilisers was only 30 00 to 43 00 per cent in paddy But partial adoption was observed to be 55 00 to 68 00 per cent

Reddy (1988) observed that though majority of farmers applied fertilisers the dose was less than 20 to 25 per cent of the recommended quantity

Theodre (1988) found that 55 00 per cent of the contact farmers and 34 00 per cent of other farmers adopted the application of farm yard manure rice About 65 00 per cent used less quantity than the recommended dose while 14 00 per cent followed a higher dosage The mean quantity of manures used was 3 7 tonnes/ha which came to about 75 00 per cent of the recommended organic manure

The Report also revealed that the adoption pattern of fertiliser use by the rice farmers in Kerala exhibited much variation in the different stages of crop growth About 25 00 per cent and 11 00 per cent of the farmers respectively had full adoption at basal stage for short and long duration varieties while none had full adoption at basal stage for the medium duration varieties

Athimuthu (1990) in his study on information management of rice technology had categorised the respondents as low medium and high based on their extent of adoption of nutrient use technology and observed that almost the same percentage of respondents were found under low and high categories and a little less than 20 00 per cent of the respondents alone belonged to medium category

Balaji (1992) while studying the fertiliser use pattern in Pondicherry had observed that none of the sample farmers applied fertilisers at the recommended rate In general the sample farmers applied fertilisers higher than the recommended level for all crops except gingelly and ragi In the case of paddy the farmers applied 51 40 per cent and 45 80 per cent respectively higher than the recommended levels for the first and second crops The farmers tended to apply more of nitrogen for paddy since they could see quick vegetative growth

Sah and Shah (1992) in their study on efficiency of fertiliser use in Gujarat found that proper adoption of soil test based recommendations was limited only to 22 00 per cent of farmers whereas over use was prevalent among one third of the sample farmers

2 3 Relationship of selected personal, socio-psychological and economic characteristics of farmers with their fertiliser use behaviour

Since studies on relationship of characteristics of farmers with the different components of fertiliser use behaviour are lacking, closely related studies on adoption of fertiliser are cited here Majority of these studies were done on the relationship of different variables with adoption of fertilisers in terms of quantity which forms only one dimension of the fertiliser use behaviour in the present study and not on a multi dimensional perspective The relationship with different variables are indicated below

a Education

The nature of relationship reported in earlier studies between education and adoption is presented below

Author with year	Relationship established
Sinha (1980)	Positive significant association
Geethakutty (1982)	-do-
Chandrakandan (1982)	-do-
Ramasamy (1983)	-do-
Santhisarup and Pandey (1984)	-do
Nanjaiyan (1985)	do-
Ramasamy et al (1986)	Positive relationship
Krishappa (1986)	Significant positive association
Tantray (1987)	No association
Sulaiman (1989)	Significant positive association

Based on the review a positive relationship between education and fertiliser use behaviour is anticipated in the present study

b Main occupation

Previous studies on fertiliser use and their relationship with main occupation are presented below

Author with year	Relationship established
Ayyadurai (1980)	Positively significant
Ramakrishnan (1980)	do
Avanthi (1981)	do
Sainath (1982)	No relationship
Saraf (1983)	do-
Yada and Jain (1984)	Positively significant relationship
Harish (1985)	Non significant relationship
Sreekumar (1985)	Positive significant relationship
Lalitha (1986)	do
Naika (1985)	Non significant relation
Manjunath (1986)	Positively significant
Tantray (1987)	Positive significant relationship
Reddy (1987)	do
Pandurangaiah (1987)	do
Goud (1988)	Non significant relationship
Singh *et al* (1989)	-do-
Athimuthu (1990)	Positive significant relationship
Krishnamurthy (1991)	Non significant relationship

Most of these studies found non significant relation and based on them a non significant relationship between occupation of farmers and their fertiliser use behaviour is hypothesised in the present study

c **Farm size**

Farm size is expected to have a direct bearing on the farmer s capacity to use inputs The findings of the past studies in this area are presented below

Author with year	Relationship established
Godhandapani (1985)	No association
Theodre (1988)	No significant relationship
Agarwal and Arora (1989)	No significant association
Haque (1989)	Positive significant relationship
Sagar (1989)	do
Reddy (1988)	do
Anantharaman *et al* (1985)	do
Krishnappa (1986)	-do
Olowu *et al* (1988)	do
Reddy and Reddy (1988)	do
Athimuthu (1990)	do

A positive relationship between farm size and fertiliser use behaviour is anticipated for the present study

d Area under rice

Like farm size area allocated for a particular crop may also influence the fertiliser use behaviour of farmers

Only one study could be located which had explained this relationship in the case of rice farmers Sulaiman (1989) observed that area under rice was significantly correlated with adoption of fertiliser management practices by the rice farmers of Palakkad and Kannur districts in Kerala state

In the case of cassava Sivaramakrishnan (1981) and Anantharaman et al (1985) had also reported positive relationship and substantial indirect effect of area under crop on adoption Anantharaman (1991) also indicated positive correlation between area under cultivation and managerial efficiency of cassava farmers

For the present study a positive correlation is anticipated between area under rice and the farmer s fertiliser use behaviour

e Annual income

The financial position of a farmer may definitely influence his resource utilisation of a non farm resource in the cultivation of a crop

The nature of relationship observed by different researchers in relation to this variable is presented below

Author with year	Relationship established
Viju (1985)	Positive significant relationship
Ramasamy et al (1986)	Positive relationship
Tantray (1987)	Positive relationship
Sulaiman (1989)	Significant positive relation
Palani (1987)	do
Shanmugasundaram (1987)	No significant relationship
Badgaonkar (1987)	Positive significant relation
Aziz (1988)	Positive significant association
Naik (1988)	Non significant relation
Agarwal and Arora (1989)	do
Anithakumari (1989)	do
Athimuthu (1990)	No relationship

A positive association between annual income and fertiliser use behaviour is expected in the present study based on the review

f Economic motivation

This variable refers to the mental disposition of the farmer in considering farming as a means of profit making

Past studies indicating the relationship between adoption behaviour of farmers and their economic motivation are reported below

Author with year	Relationship established
Nikhade and Thakre (1985)	Positive significant relation
Palvannan (1985)	Non significant relation
Viju (1985)	Positively significant
Khubde and Kalantri (1986)	-do
Prakashkumar (1986)	-do-
Krishnappa (1986)	do
Balan (1987)	do
Rameshbabu (1987)	do
Palani (1987)	do
Krishnamoorthy (1988)	do
Anitha Vijayan (1989)	do
Haque (1989)	do-
Mahipal and Khurde (1989)	-do-
Anithakumari (1989)	No relationship
Satheesh (1990)	Non significant relation
Gopala (1991)	do
Rajendran (1992)	Positive relationship

Based on the previous findings a positive relation between economic motivation and fertiliser use behaviour is anticipated in the present study

g Level of aspiration

This variable indicates the orientation of an individual towards a goal and his own perception about his present position and status in relation to the past and future The adoption behaviour of the farmers in relation to different practices will be in line to satisfy their level of aspiration

The nature of relationship observed between level of aspiration and adoption behaviour is summarised below

Author with year		Relationship established
Mani	(1980)	Positively significant
Sushama *et al*	(1981)	do
Thiagarajan	(1981)	Non significant
Ramagowda	(1983)	Positively significant
Rajendran	(1978)	Positively significant
Reddy	(1988)	do
Mahipal and Kherde	(1989)	do

In the present study a positive relation between level of aspiration and fertiliser use behaviour is hypothesized

h Rational decision making ability

Supe and Singh (1969) inferred that the act of an individual is considered rational to the extent to which he justifies his selection of most efficient means from among the available alternatives on the basis of scientific criteria for achieving maximum ends

The researcher could come across only one study indicating the nature of relationship of this variable with the behaviour of rice farmers Prasad (1983) observed that rational decision making ability was significant in explaining the variation in achievement motivation of rice farmers in progressive villages of Kerala

In the present study a positive relation between rational decision making ability of farmers and their fertiliser use behaviour is hypothesized

i **Innovativeness**

Innovativeness indicates the degree to which an individual exhibits interest and is ready in accepting new practices

The nature of relationship of this variable with adoption of farm technologies as reported by different researchers are listed below

Author with year		Relationship established
Suresh	(1987)	Positively significant
Krishnamoorthy	(1988)	-do-
Ajaykumar	(1989)	-do-
Anithakumari	(1989)	-do-
Ravi	(1989)	-do-
Singh	(1989)	No relationship
Krishnamurthy	(1991)	Positive relationship
Reddy	(1991)	do

A positive relationship between innovativeness of farmers and their fertiliser use behaviour is postulated for the study

j Attitude towards fertiliser use

The mental disposition or readiness organised in one s mind through experiences in a particular field will have an influence on all his activities related to that field Attitude of farmers towards fertilisers and their fertiliser use behaviour are thus likely to be well related The past studies indicating their relationship are reported

Author with year		Relationship established
Singh and Ray	(1985)	Positive relation
Shivasankara	(1986)	Positive relation
Balan	(1987)	Positive and significant relation
Sulaiman	(1989)	Positive significant relation
Singh	(1989)	Positive relation
Athimuthu	(1990)	Non significant relation

Based on the reviews presented a positive relation between attitude towards fertiliser use and fertiliser use behaviour of farmers is anticipated for the present study

k. Information source utilization

The review of studies showing the relationship between information source utilization and adoption of technologies are summarised below

Author with year		Relationship established
Godhandapani	(1985)	Positive and significant
Balasubramanian	(1985)	Positive and significant
Jayapalan	(1985)	-do
Wilson and Chaturvedi	(1985)	-do
Singh and Ray	(1985)	do
Nanjaiyan	(1985)	Non significant relation

Theodre	(1988)	Non-significant relation
Sulaiman	(1989)	Positive and significant relation
Athimuthu	(1990)	Positive relation

In line with the above findings a positive association between information source utilisation and fertiliser use behaviour of rice farmers is postulated for the present study

1 **Personal guidance on better farming**

The relationship established between personal guidance with the adoption of farm technologies as reported by researchers are presented

Author with year		Relationship established
Singh and Ray	(1985)	Significant positive association
Reddy and Reddy	(1985)	Positive relation
Sivasankara	(1986)	Significant positive relation
Sulaiman	(1989)	Non-significant relation
Suresh	(1987)	Positive relation
Balan	(1987)	Significant association
Jayaramaiah	(1987)	Non significant relation
Oluwa *et al*	(1988)	Positive relation

Based on the above review a positive relation between personal guidance on better farming and fertiliser use behaviour is hypothesized for the present study

m. Extension participation

Farmers gain information and knowledge on use of fertilisers by participating in extension programmes organised by different agencies also

The relationship between use of farm practices and extension participation established in past studies are listed below

Author with year		Relationship established
Manjunath	(1986)	Positive and significant
Shivasankara	(1986)	-do
Nataraju and Chennegowda	(1986)	Positive relationship
Pandurangaiah	(1987)	do-
Suresh	(1987)	-do-
Mahadevaiah	(1987)	Positive significant
Reddy	(1987)	do-
Ramegowda and Siddaramaiah	(1987)	-do-
Nandakumar	(1988)	Non-significant
Aswathanaryana	(1989)	Positively significant
Khare and Singh	(1989)	do

Gopala	(1991)	Non-significant
Reddy	(1991)	Positive significant

In the light of the above findings a positive relation is hypothesised between extension participation and fertiliser use behaviour of farmers

n Economic performance index

Economic performance index refers to the ratio value of the total output to total input incurred for a crop enterprise There are not many studies reported on the relationship of this variable with farmers fertiliser use behaviour

Sulaiman (1989) reported that there was no significant relationship between economic performance index and fertiliser management practices of rice farmers in Palakkad and Kannur districts of Kerala

For the present study a positive relation between economic performance index and fertiliser use bahaviour of rice farmers is postulated

o Irrigation index

Irrigation is a determinant factor in crop production and productivity Availability of irrigation water can definitely influence the fertiliser use behaviour of rice farmers

The nature of relationship of this variable with adoption behaviour as reported by the researchers is summarised below

Author with year		Relationship established
Singh	(1978)	Positive relationship
Perumal and Mariappan	(1982)	-do-
Kaur and Bharathukumar	(1984)	do
Shivaraja	(1986)	-do-
Ramasamy et al	(1986)	do
Krishnappa	(1986)	Significant positive relation

A positive relationship is postulated between irrigation index and fertiliser use behaviour of rice farmers in this study

p Soil test utilization index

Farmers who perceive the importance of soil testing is likely to apply fertilisers based on soil test results Hence soil test utilization index can naturally reflect the fertiliser use behaviour of a farmer

Balan (1987) had observed that majority of farmers who had adopted soil test recommendations were found to have optimum fertiliser use index

Sulaiman (1989) reported that soil test based fertiliser application is not properly perceived by the farmers which results on uneconomic use of fertilisers

Sah and Shah (1992) have observed that to a large extent proper adoption of soil test recommendations is closely associated with better farming practices and appropriate fertiliser use techniques

A positive relationship between soil test utilization index and fertiliser use behaviour of farmers is hypothesised for the present study

q **Knowledge about fertiliser use**

Rogers and Havens (1961) reported that farmers knowledge of fertiliser acted as intervening variable between the farmers attitude and use of fertilisers

Geethakutty (1982) observed that principle knowledge and procedural knowledge were significantly correlated with adoption of recommended practices by the rice farmers

Singh and Ray (1985) observed that knowledge about soil fertility and fertiliser management contributed positively and significantly to the level of fertiliser use of the farmers

Kaur and Bharathukumar (1984) reported that the knowledge level of farmers were positively and significantly related with the fertiliser use

Jayaramaiah (1987) reported that knowledge of fertiliser and its utility was significantly associated with adoption of NPK in groundnut potato and jowar

Theodre (1988) reported a significant relationship between knowledge about contingency farming practices and rate of adoption among the contact farmers

Krishnappa (1986) reported significant relationship between overall knowledge and adoption of fertilisers both in ragi and irrigated paddy

Sulaiman (1989) reported positive and significant relation between knowledge and adoption of fertilisr management practices of rice farmers

Based on the above reviews it is hypothesised that knowledge about fertiliser use and fertiliser use behaviour of rice farmers are positively related

2 4 Perceived importance of technological and situational factors contributing to fertiliser use behaviour of rice farmers

The technological and situational factors to a very large extent contribute to the fertiliser use behaviour of rice farmers Such factors identified by the various researchers in their studies are reported below

Singh (1978) reported that the factors like increase in irrigation facilities reduction in fertiliser prices promotional activities undertaken by different agencies etc had positive effect on fertiliser use

Yahanpath and Agarwal (1985) had observed in SriLanka that the price of rice, the price of nutrients and irrigation facilities are three major determinants in the fertiliser use of farmers

Chawdhary and Sain (1986) noticed that the variation in the fertiliser use of farmers are governed more by agroclimatic factors and the nature of crops grown than by an account of special standings of the farmers concerned

Kalita ana Phukan (1986) identified that factors like physiography infrastructural development distributional arrangement technology credit facilities and extension machinery can influence the fertiliser use by the farmers in Assam

Gupta _et al_ (1986) pointed out the unchallengeable efficiency of fertiliser and manure use in situations where there are inputs like irrigation good quality seeds and pesticides

Ramasamy _et al_ (1986) observed that the factors like season source of irrigation rice varieties price of rice price of fertilisers credit availability infrastructure facilities in the village availability of organic manure tenancy etc are important in influencing the use of fertilisers by the farmers

Sivananda (1987) found that the price factor was not an important variable affecting fertiliser use and the factors like extension of knowledge efforts in direction of promotion of fertilisers use through dissemination of technical know how and qualitative changes in input use support the fertiliser use in the field

Khare and Singh (1989) identified the major determinants of fertiliser consumption as literacy information sources extension exposure fertiliser use economics availability of credit and availability of hired labour

Desai (1989) observed the importance of the influence of the operating environment and pricing environment on the different factors of fertiliser consumption He suggested a drastic reorientation of the government policies for increasing fertiliser consumption of the country He also stressed the importance of non price factors such as availability of fertilisers credit infrastructure distribution system and the extension work for better fertiliser use efficiency

Parthasarathy (1989) opined that imaginative planning sensitive demand estimation mechanism and bold provisioning by the Government would considerably help the farmers in increasing fertiliser use He also suggested for the promotion work by the manufactures at the village level with suitable support of services distribution and credit supply

Lal and Shukla (1990) observed that the extent of fertiliser use depends on cropped area cropping pattern cropping intensity amount and distribution of rainfall soil test values targeted yield levels availability of irrigation water crop productivity and farmers decision on economic return

Panda (1990) indicated that the fertiliser use in any region would depend on factors like soil fertility extent of availability of optimum moisture and other climatic conditions, cropping pattern genetic character of crops use of inputs other than fertilisers distribution and availability of fertilisers

Perrot and Weaver (1992) in analysis of indigenous knowledge and fertiliser strategies identified that farmers have complex taxonomies of soils and paddy types and a knowledge of these taxonomies is necessary for understanding farmers rationale for fertiliser management

As could be observed from the studies reviewed above there are a number of factors which contribute to the fertiliser use behaviour of rice farmers Identification of the importance of those factors will help in proper planning of a fertiliser education and extension strategy With this in mind the importance of such factors as perceived by the rice farmers agricultural extension personnel agricultural scientists, and the input dealers was studied

2 5 Constraints in the use of fertilisers by farmers

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

Zinyama (1988) referred to any problem or limitations as constraints

The constraints in fertiliser use as identified by the various researchers are summarised below

Author with year		Constraints identified
Tripathi *et al*	(1982)	Non availability of credit loss of fertiliser through leaching and run off adverse effects of fertiliser on soil and induction of diseases and pests
Bidari	(1982)	Inadequate supply of fertilizers lack of desired type of fertiliser
Waghamare and Pandit	(1982)	Lack of knowledge, lack of technical guidance lack of money high cost of inputs and non availability of credit
Jayakrishnan	(1984)	Delay in getting soil test results lack of experience about the advantage of soil test result and tedious nature of work
Kaur and Bharathukumar	(1984)	High price of fertilisers lack of irrigation facilities weed growth untimely supply of fertilisers and availability of fertilisers at accessible places
Srinivasamurthy	(1985)	No way to cover the risk of investment on fertiliser if crop fails for any reason crop loan not available at reasonable rate the amount of crop loan inadequate lack of proper understanding about the net income due to fertiliser use

		fertiliser sale point not being nearby and uncertainty of canal water supply during crucial periods
Lal	(1986)	Difficulties in the supply of fertilisers high price of fertilisers ignorance about suitable type dose and method of application of fertilisers lack of irrigation facilities non availability of desired fertiliser lack of technical guidance, unfavourable climatic conditions transportation problems
Kalita and Phukan	(1986)	Peculiar physiography lack of infrastructural development inadequate distributional arrangement lack of suitable technology poor purchasing capacity of the farmers lack of proper motivation and inadequate knowledge of farmers
Sivashankara	(1986)	Lack of irrigation facilities problem of weeds problem of labourers non availability of desired fertiliser at accessible place non availability in time non availability of adequate quantity of fertilisers high price of fertilisers lack of crop insurance and high interest rate for loans
Ramesh	(1986)	Financial difficulty and high cost of fertilisers
Rajagopalan	(1986)	Want of knowledge on improved practices
Jayaramaiah	(1987)	High prices of fertilisers inadequate supply of fertilisers lack of desired type of fertilisers non availability of credit lack of soil testing facilities and adulteration in fertilisers

Singh and Singh	(1987)	Lack of credit poor technical knowledge non availability of suitable crop varieties and poor irrigation facilities
Siddaramaiah and Veerabhadraiah	(1987)	Lack of knowledge and lack of financial resources
Agro Economic Research Centre(1988)		Distance to the fertiliser depot
Patnaik	(1988)	High depth of standing water in the field and flow of surface water from field to field
Sulaiman	(1989)	High cost of fertilisers high rate of interest of crop loan uncertainty of irrigation water availability
Singh and Ray	(1989)	High price of fertiliser lack of detailed knowledge about fertiliser lack of soil testing facility non availability of fertilisers in nearby place and time adulteration inadequate irrigation facilities
KAU NARP Status Report	(1989)	Lack of knowledge of technical aspects and economical aspects of balanced use of fertilisers among farmers and lack of optimum fertiliser schedules for different soils and different regions non availability of organic manure high cost of organic manure farmers not convinced of the benefit of liming and high cost of fertilisers
Athimuthu	(1990)	Lack of understanding the recommendation of soil testing laborataries, remembering the method of application of nutrients pronouncing and recollecting the alternate nutrients getting unprecise and distorted information inade quacy of water heavy rain

delayed supply of inputs non availability of required brand inadequate organic manure high cost of nutrients labour and lack of support price lack of transport

The review of constraints in fertiliser use presented above indicates the scenario of problems and limitations in the use of fertilisers by the farmers

2 6 Conceptual frame work developed for the study

Based on the review presented a conceptual model was developed for the study which is presented in Fig 1

The model consists of five concentric circles The outermost circle represents the rice farmer as a member of the social system and the four inner circles represent the related subsystems The second circle represents the expected behavioural characteristics of the farmer which is related to his fertiliser use behaviour The third one portrays the technical and situational factors which could influence the fertiliser use behaviour The limiting factors or the constraints in fertiliser use behaviour are outlined in the fourth circle The inner most circle (fifth one) with its connected four small circles represents the specific manifested behaviour the fertiliser use behaviour which is taken as the dependent variable for the study The small

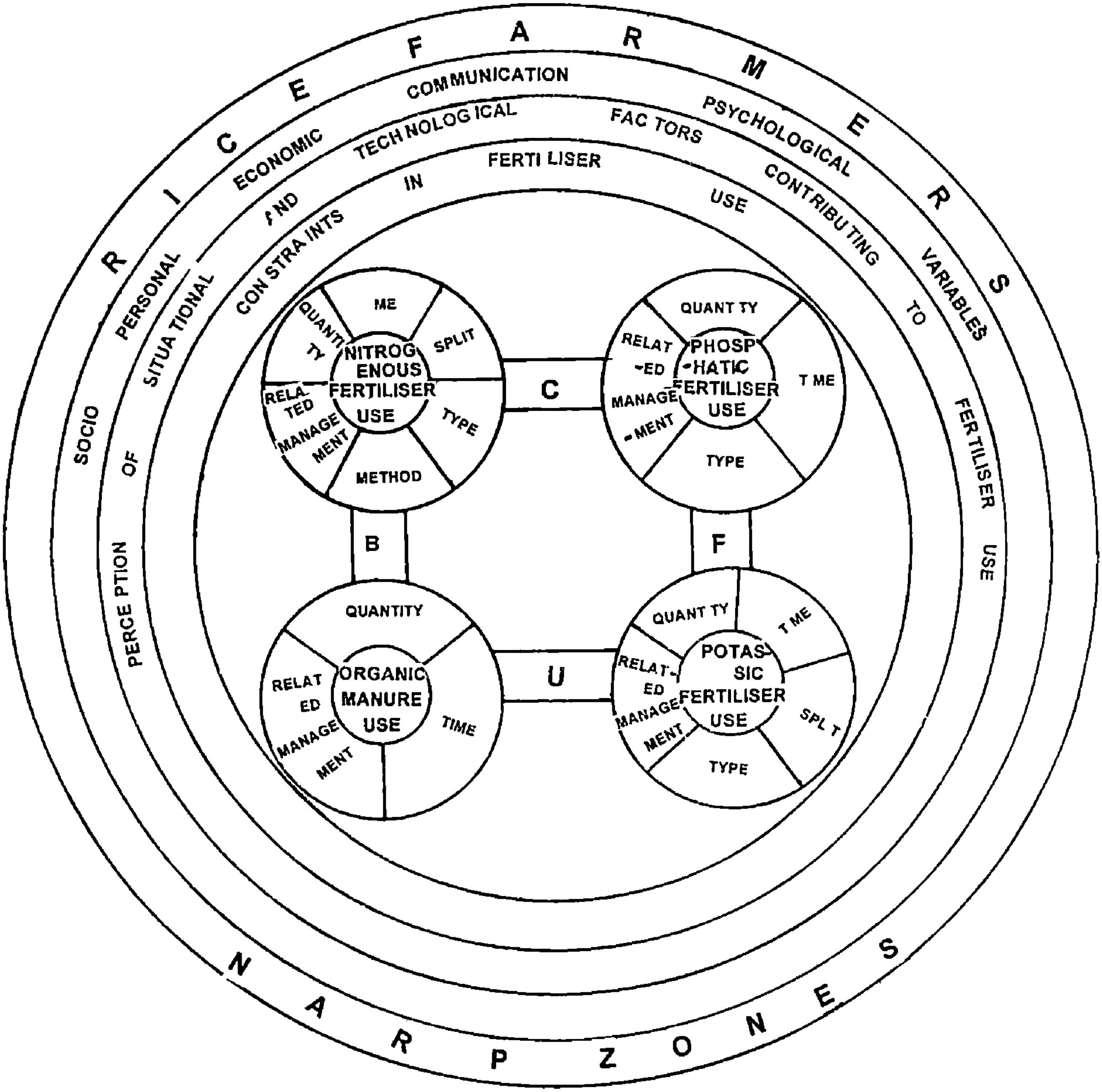

FIG 1 CONCEPTUAL FRAME WORK OF THE STUDY

circles represent the three major fertiliser nutrients (NPK) and the organic manures The use dimensions of the three nutrients and manures are identified as the segments within small circles

Methodology

CHAPTER III

METHODOLOGY

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

3 1 Locale of the study

3 2 Selection of the respondents

3 3 Selection, operationalisation and measurement of dependent variable

3 4 Selection, Operationalisation and measurement of independent variables included in the study

3 5 Identification of factors contributing to fertiliser use behaviour and constraints experienced by farmers

3 6 Procedure employed in data collection

3 7 Statistical tools used in the study

3 8 Hypotheses of the study

3 1 Locale of the study

3 1 1 Selection of the study area and its brief description

The study was conducted in Kerala State covering all the five agroclimatic zones Kerala State lies in the South-West corner of the Indian peninsula between 8° 18 and 12° 48' North latitudes and 74° 52 and 77° 22'East longitudes as a long narrow strip of land, 32 to 130 km wide between the Western Ghats in the East and the Arabian sea in the West The State is bound by Tamil Nadu in the South and Karnataka in the North Kerala is a small state in India, with an area of 38,863 sq km The land mass of Kerala has an undulating topography with highly diversified physical features and agro-ecological conditions The annual rainfall of the state is 2963 mm

The state is divided into five agroclimatic zones taking into consideration its physiography climate, soil characteristics, sea water intrusion irrigation facilities land use pattern and the recommendations of the Committee on Agro-climatic Regions and Cropping Patterns constituted by the Government of Kerala in 1974 The zones are Southern Zone, Central Zone, Northern Zone High Ranges Zone and the Special Zone of Problems Areas (NARP Status Report 1989)

A brief description of these five zones is presented hereunder

1. Southern zone

The southern zone comprises the districts of

Thiruvananthapuram Kollam Pathanamthitta Alappuzha and Kottayam with 21 Taluks 47 Development Blocks and 281 Panchayats The zone has a tropical humid climate Unlike in the other zones of the state, rainfall is comparatively well distributed in this zone with the result that the effective annual rainfall is more than that in other zones The annual average rainfall in the region is 2246 cm The mean maximum and minimum temperature of the zone are 34 06°C and 21 74°C respectively The soils are mostly lateritic the texture ranging from sand to sandy loam and clay loam The major crops of the zone are rice coconut tapioca pepper cashew rubber, arecanut, sugarcane pulses and banana

2. Central zone

The Central Zone consists of three central districts of Kerala Palakkad Thrissur and Ernakulam excluding the high ranges, the coastal saline tracts and other isolated areas like kole lands with special soil and physiographical conditions The zone consists of 17 Taluks 44 Development Blocks and 274 Panchayats The zone is characterized by comparatively heavier rainfall during the south-west monsoon and less rainfall during the north-east monsoon period leaving in between a dry spell of six months from December to May The mean maximum and minimum temperature of the zone are 31 4°C and 21 1°C respectively The soil type is mainly laterite Rainfed cultivation is mainly prevalent in this region This region is the major rice growing tract of the state and accounts for about 50 per cent of the area under rice and 52 per cent of the production of rice in the state Coconut, arecanut, groundnut, vegetables, pulses banana and pineapple are the other important crops in this zone

3. Northern zone

This zone consists of the four northern districts of Kerala viz Kasaragod, Kannur, Kozhikode and Malappuram comprising 12 Taluks, 39 Development Blocks and 295 Panchayats with total geographical area of 10 94 600 ha The region gets rainfall in both monsoons and the annual average rainfall is 3379 mm There is a prolonged dry spell between December and May of every year The torrential rains during the months of June and July create crop hazards due to waterlogging The mean maximum and minimum temperature of the region are 33°C and 23°C respectively The main crops of the zone are rice coconut, banana, vegetables, cashew, etc

4 High range zone

This zone comprises the districts of Wynad and Idukki part of Palakkad district (Nelliampathy and Attappady) two panchayats of Pathananthitta district (Thannithode and Seethathode) three panchayats of Kollam district (Ariyankavu

Kulathoopuzha and Thenmala) and five panchayats of Thiruvananthapuram district (Peringamala Aryanad Vithura Kallikad and Amboori) Thus altogether the High Range zone constitutes nine Taluks 11 Development Blocks and 84 panchayats with a total geographical area of 21 77 250 ha covering 56 55 per cent of the area of the state Since the districts of the zone are not contiguous the agricultural characteristics differ widely Rice coconut and plantation crops are major crops of this zone

5 Special zone of problem areas (Problem zone)

This zone consists of five areas of Onattukara Kuttanad, Pokkali, Kole and Sugarcane lands spread over six districts, viz Alappuzha Kollam Kottayam Ernakulam Thrissur and Malappuram There are 23 Taluks and 39 Development blocks in this zone In this zone also the agricultural characteristics differ widely from one area to other Rice is a major crop in this area

3 1 2 Selection of area

As stated earlier all the five agroclimatic zones of the state were covered for the present study From each NARP zone the district with highest area under rice was selected to represent that agroclimatic zone The districts selected accordingly were

Sl No	Agroclimatic zone	Selected district
1	Southern zone	Kollam
2	Central zone	Palakkad
3	Northern zone	Kannur
4	High range zone	Wynad
5	Special zone of problem areas	Alappuzha

From each of these selected districts one Agricultural Sub Division was randomly selected Accordingly Kottarakara Agricultural Sub Division of Kollam district Alathoor Agricultural Sub Division of Palakkad district Payyannur Agricultural Sub Division of Kannur district Sulthan Batheri Agricultural Sub Division of Wynad district and Kuttanadu Agricultural Sub Division of Alappuzha district were selected for the study

In the third stage one Development Block was randomly selected from each selected Agricultural Sub Division The blocks thus selected were (1) Sasthamkotta (2) Alathoor (3) Thalipparamba (4) Sulthan Batheri and (5) Champakulam

From each of these selected blocks two Krishi Bhavans (Agricultural Extension Units at Panchayath level) were selected at random Accordingly Sooranadu North and Sooranadu South were selected from Sasthankotta Block while

Erimayoor and Kavasseri were selected from Alathoor Block Kurumathoor and Karimbam were selected from Thalipparamba Block Ambalavayal and Nenmeni were selected from Sulthan Batheri Block The Krishi Bhavans selected from Champakulam were Champakulam and Nedumudi Thus multi-stage sampling procedure was adopted in the present study for selection of the study areas The details about the sampling procedure are furnished in Table 1

3 2 Selection of the respondents

a **Farmers**

The study was designed to analyse the fertiliser use behaviour of rice farmers and hence the population for the study was defined in terms of the following criteria

(1) The farmers must have rice cultivation during the previous year (1991)

(2) They should have grown rice during the previous year (1991) for at least two seasons (Virippu and Mundakan)

Taking these criteria into account, the lists of rice farmers from each of the selected Krishi Bhavans were prepared with the help of the officials in the concerned Krishi Bhavans While preparing the list the area under rice cultivation for each individual farmer was also noted

FIG 2 MAP SHOWING AREAS SELECTED FOR THE STUDY

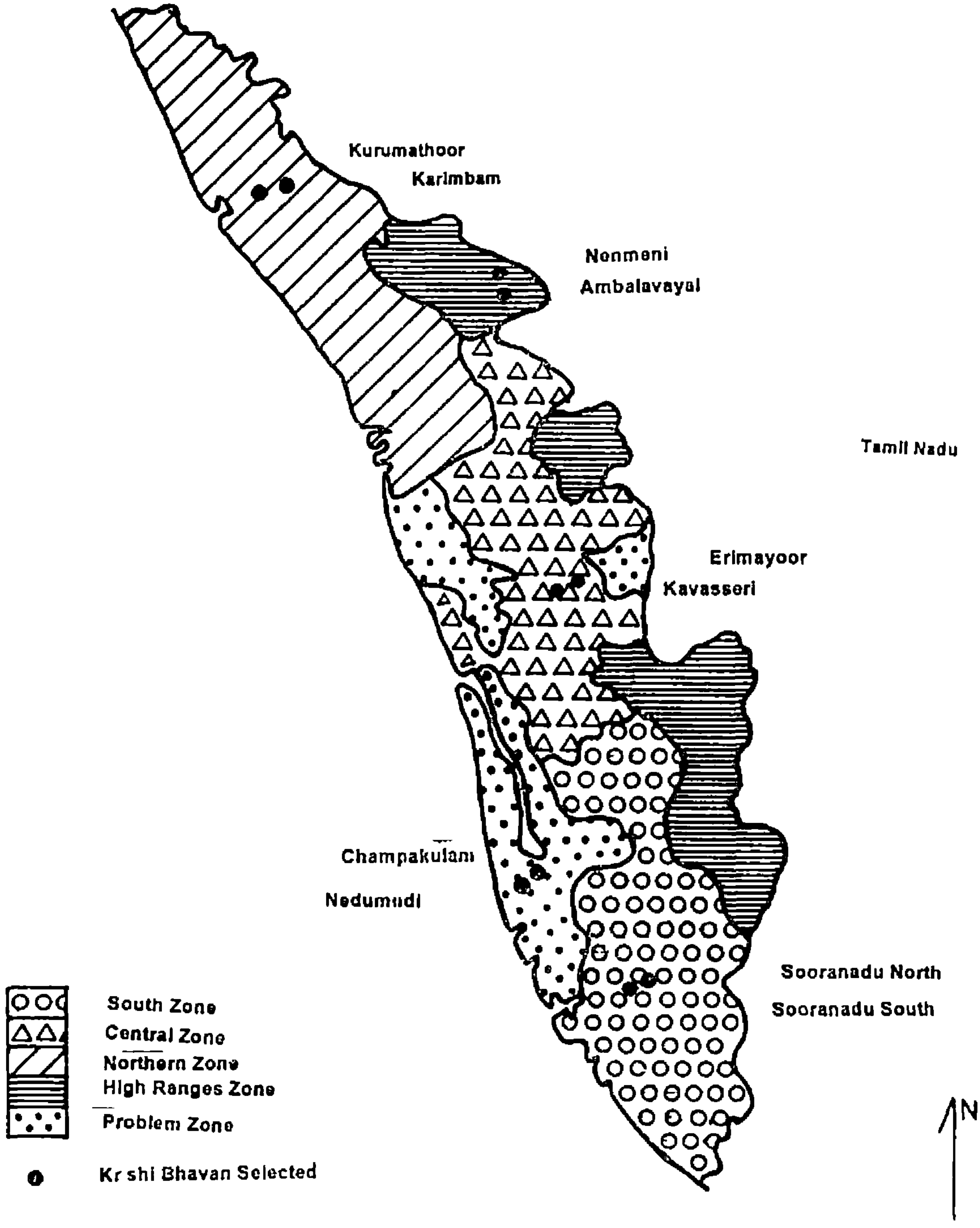

Table 1 Details about the sample of farmers selected for the study

Sl No	NARP zone	District selected	Agricultural Sub division	Block selected		Krishi Bhavan selected	No of farmers selected
1	Southern	Kollam	Kottarakara	Sasthamkotta	1	Sooranadu North	30
					2	Sooranadu South	30
2	Central	Palakkad	Alathoor	Alathoor	1	Erimayoor	30
					2	Kavasseri	30
3	Northern	Kannur	Payyannur	Thaliparamba	1	Karumathoor	30
					2	Karimbam	30
4	High ranges	Wynad	Soulthan Batheri	Sulthan Batheri	1	Ambalavayal	30
					2	Nenmeni	30
5	Problem zone	Alappuzha	Kuttanad	Champakulam	1	Champakulam	30
					2	Nedumudi	30
						Total	300

Thirty farmers were selected from each panchayat in such a way that farmers from all the categories viz large medium small and marginal were represented proportionately Thus a total sample of 300 (30 x 10) rice farmers were selected for the study

b. Scientists

A list of subject matter specialists of Kerala Agricultural University in the disciplines of Agronomy and Soil Science with field experience of rice crop and its fertiliser management was prepared From the list 40 scientists were selected at random as the responderts for the study

c. Extension personnel

A list of extension personnel (Agricultural Officers and Agricultural Assistants) in the Krishi Bhavans in the selected five Agricultural Sub Divisions was prepared From the prepared list 40 agricultural extension personnel were selected at random as respondents

d Input dealers

A list of fertiliser dealers in the selected five Agricultural Sub Divisions was prepared and a sample of 40 fertiliser dealers was drawn at random from the prepared list to form the respondents for the study

3 3 Selection, operationalisation and measurement of dependent variable

Fertiliser use behaviour was taken as the dependent variable for the study which was measured by developing an index called Composite Fertiliser Use Behaviour Index (CFUBI)

3.3.1 Measurement of fertiliser use behaviour

Based on discussion with the scientists in the disciplines of Agronomy and Soil Science of Kerala Agricultural University and Extension personnel of the State Department of Agriculture six dimensions related to fertiliser and organic manure use in rice cultivation were identified The dimensions were

1 Quantity of fertilisers and manures
2 Time of application of fertilisers and manures
3 Number of split applications of fertilisers and manures
4 Type of fertilisers and manures
5 Method of application of fertilisers and manures
6 Management practices related to application of fertilisers such as water management liming land preparation soil testing andmodified use of fertilisers

The relevance of inclusion of organic manures micronutrients and biofertilisers besides the three major nutrients was discussed with the scientists and extension personnel The consensus among the scientists and extension workers was to limit the study to the three major nutrients (NPK) and organic manures

Based on these identified six dimensions fertiliser use behaviour was operationally defined for the study as the extent of use of the recommended fertilisers and manures for rice in terms of quantity of fertilisers and manures time of application, number of split applications method of application type of fertilisers and manures and other management practices related to fertiliser application as water management liming land preparation soil testing and modified use of fertilisers

The identified six dimensions of fertiliser use behaviour were subjected to relevancy rating by scientists and extension personnel in relation to the three major nutrients and organic manures (Appendix I) This was done to ascertain whether all the six dimensions are equally applicable to the three major nutrients and organic manures or not The relevancy rating revealed that all the six dimensions were relevant in the case of nitrogenous fertilisers while only five dimensions were rated as relevant for potassic fertilisers and four dimensions for phosphatic fertilisers Only three dimensions were rated relevant in the case of organic manure (The dimensions which were rated as relevant by more than 80 00 per cent of the judges were selected)

The judges were further requested to assign weightage for each dimension in the range of 0 to 10 based on the importance they attach to each dimension in such a manner as to get a total of 10 for all the identified relevant dimensions They were asked to consider the importance of each dimension in relation to fertiliser use efficiency while assigning the weightage to each dimension The scores obtained by a particular dimension was added up and was divided by the number of judges to arrive at the weightage for a particular dimension This procedure was carried out in the case of all the identified relevant dimensions of major nutrients and organic manures (Appendix II) The identified dimensions along with their weightages are furnished in Table 2

Table 2 Dimensions and weightages for the fertilisers and manures

Sl No	Dimensions	Fertilisers and manures			
		N	P_2O_5	K_2O	OM
1	Quantity of fertiliser applied	4 0	4 0	4 0	5 0
2	Time of application	1 5	4 0	2 0	4 0
3	Number of split applications followed	1 5	NA	2 0	NA
4	Type of fertiliser used	1 0	1 0	1 0	NA
5	Method of application	1 0	NA	NA	NA
6	Related management practices followed	1 0	1 0	1 0	1 0
	Total	10 0	10 0	10 0	10 0

3 3 2 Selection of practices under the identified dimensions

The recommendations of fertiliser application for rice cultivation by the Kerala Agricultural University as given in the Package of Practices Recommendations of Crops (1989) under the above identified dimensions were listed out and the list was subjected to relevancy rating for further confirmation and for inclusion in the index (Appendix III)

The same judges involved in the above procedure mentioned earlier were involved in this exercise also

Initially 26 practices under nitrogenous fertilisers 12 practices under phosphatic fertilisers 14 practices under potassic fertilisers and 8 practices under organic manures were included

In order to ensure the relevancy of the enlisted practices to be included the relevancy rating was obtained Though the practices were from the Package of Practices Recommendations of Crops (1989) it was felt that all these practices need not necessarily have the same potential for adoption in all the areas Hence the relevancy rating was resorted to The judges (scientists of KAU and field extension workers of State Department of Agriculture) were requested to rate only those practices that have potential for adoption by the farmers as relevant and other practices as not relevant The mean relevancy score of each practice for each dimension was worked out and only those items with relevancy score above the mean socre were selected

Thus finally 48 practices were selected with 20 under nitrogenous fertilisers 10 under phosphatic fertilisers 12 under potassic fertilisers and 6 under organic manures (Appendix-III)

3 3.3 Formulation of CFUBI based on the selected practices under the identified dimensions of the fertilisers and manures

There are six dimensions for fertiliser use behaviour as operationalised in this study which are given below

1 Quantity of fertilisers and manures applied by the farmer (Qa)

2 Time of application of the fertilisers and manures (Ta)

3 Number of split applications of the fertilisers and manures (Ns)

4 Type of the fertilisers and manures used (Tf)

5 Method of application of the fertilisers and manures (Ma)

6 Adoption or related management practices to application of fertilisers and manures (Rm)

To achieve precision in measurement of these dimensions certain subdimensions of the main dimensions were also included in the index construction based on discussions with the subject matter specialists and relevancy rating Thus a list of subdimensions or attributes related to the identified main dimensions was prepared and was administered for relevancy rating to the faculty members in the discipline of Agricultural Extension of Kerala Agricultural University They were requested to examine the attributes critically and also to include additional attributes/sub dimensions if found necessary They were requested to rate the attributes on a three point continuum as most relevant (3) relevant (2) and least relevant (1) The attributes included were regularity in use extent of use properness of use complexity of the practice time lag in use and cost of the practice

The selection of the final attributes was based on the mean relevancy score which was obtained by summing up the weightages assigned by the number of judges responded (20) The attributes with their mean relevancy score are presented in Appendix-IV The attributes with mean relevancy score above the average mean were selected for the study Accordingly three attributes were considered regularity of use extent of use and properness of use

The operationalisation of each selected attribute and the scoring procedure followed are given below

(i) Regularity in use (Z1)

Regularity in use was defined as an indication of how a farmer had used the practice during the last two years In other words it was employed to understand whether the farmer was using the particular practice once in a while only or as and when required

The scoring pattern followed was

Regular	Sometimes	Never
2	1	0

(ii) **Extent of use (Z2)**

Extent of use was defined as the extent to which a farmer had used the practice in his field In other words it was used to know whether the practice was adopted in the full area under rice cultivation or part of the cultivated area only

The scoring pattern followed was

75% and above	Above 50% below 75%	Above 25% below 50%	25% and below	Nil
4	3	2	1	0

(iii) **Properness of use (Z3)**

It was defined as the degree of accuracy with which a particular practice was used by a farmer In other words it was used to know whether the rarmer was following the practice in the appropriate manner as recommended or not

The scoring procedure followed was

Proper	Improper	Highly improper	Nil
3	2	1	0

Proper — Within 5 00 per cent margin above or below the recommendation

Improper — Within 5 01 per cent to 25 00 per cent above or below the recommendation

Highly improper — Within 25 01 per cent above or below the recommendation

3 3 4 Operationalisation and measurement of the identified components of the index

1 Index of quantity of fertilisers used (Qa)

Qa refers to the actual quantity of the particular fertiliser nutrient applied by the farmer and was obtained by the following formula (In the case of organic manures the actual quantity of organic manure applied itself was taken into account and not the quantity of its nutrients)

$$Qa_j - \frac{A_j}{R_j} \quad X \quad Z$$

where

Qa_j - Index of the quantity of any fertiliser nutrient used by the j^{th} farmer

A_j = Quantity of any fertiliser nutrient usually applied by the farmer

(In the case of adoption above the recommended quantity the recommended quantity is taken as A_j since the over use factor is taken care of by the attribute of properness of use)

R_j = Quantity of fertiliser nutrient recommended

$$Z = \frac{z1 + z2 + z3}{M}$$

where

M = maximum of z1 z2 and z3

z1 = regularity in use

z2 extent of use

z3 = properness of use

The maximum that could be obtained for the index was 1 and the minimum zero

2 Index of time of application of fertilisers (Ta)

Time of application indicates the temporal dimension of the recommended applications for a fertiliser which also covers the split applications which reflect the time span

Scoring procedure adopted was

(Upto two days before or after the recommended time)	(Upto one week before or after the recommended time	No application
3	1	0

The formula for measuring the index of timeliness was

$$Ta_j = \frac{Atf}{Atr} \times Z$$

where

Ta_j - Index of timeliness of fertiliser application by the j^{th} farmer

Atf Average of the actual timeliness followed by the j^{th} farmer for application of the different fertiliser nutrients and or split applications if any

Atr Average of the recommended timeliness of the application of different fertiliser nutrients and or split applications

$$Z - \frac{z1 + z2 + z3}{M}$$

where

M = maximum z1 z2 and z3

z1 average of the regularity of use

z2 average of the extent of use

z3 - average of the properness of use

The range of the index was between 1 and 0

3 Index of number of split applications (St)

This refers to the number of times or splits in which the fertiliser was applied to rice crop by the farmer This was considered in the case of nitrogenous and potassic fertilisers in which case only this practice is recommended

The formula used for measuring this dimension was

$$St_j = \frac{SA}{SR} \times Z$$

where

St_j Index of number of split applications practiced by the j^{th} farmer in the case of a fertiliser

SA = Number of split applications followed by the j^{th} farmer

SR = Number of split applications recommended for the fertiliser

$$Z - \frac{z1 + z2 + z3}{M}$$

where

M - maximum of z1 z2 and z3

z1 average of regularity of split application

z2 - average of extent of use of split application

z3 - average of properness of split application

The highest score of the index was 1 and minimum zero

4 Index of type of fertiliser used (Tf)

This indicates the type of fertiliser used by the farmer which refers to the straight fertiliser complex fertiliser or fertiliser mixture for the particular fertiliser nutrient

The scoring pattern suggested by experts for the different sources of fertiliser nutrients was

Straight fertiliser	Complex fertiliser	Mixture
3	2	2

As straight fertilisers were rated as superior to complex or mixture fertilisers by the experts it was assigned a higher score of 3 while in the case of other two sources a score of 2 was assigned The straight fertiliser is considered as a more desirable type of fertiliser

The formula used for measuring the source of fertiliser nutrient is as follows

$$Ty_j \quad \frac{Afg}{Dfg} \times Z$$

where

Ty_j = index of fertiliser used by the j^{th} farmer

Afg – average score for the type of fertilisers in different applications including different split applications

Dfg - average score for the desired fertilisers for the different applications

$$Z = \frac{z1 + z2}{M}$$

where

M maximum of z1 + z2

z1 - regularity in the use of the type of fertiliser

z2 = extent of use of the type of fertiliser

The range of the index was between 1 and 0

5 Index of method of application of fertiliser (Ma)

This dimension refers to the way in which the fertiliser was applied such as broadcasting placement spraying etc and the form in which it was applied such as coaltar coating neem coating sulphur coating soil mixing etc

The method of application of fertilisers was studied only for nitrogenous fertilisers for which only this dimension was relevant There were six questions based on the method of application of nitrogenous fertilisers The farmer respondents were requested to give either Yes or No for these questions based on whether they followed it or not

$$Ma_j \quad \frac{nj}{\max nj} \times Z$$

where

Ma_j – Method of application of the fertiliser by the j^{th} farmer

nj = Number of positive responses obtained from the j^{th} farmer for the applicable questions on this dimension

Max nj – Maximum score obtainable for a respondent from all the six questions
(Average of the different split applications will be obtained)

$$Z - \frac{z1 + z2 + z3}{M}$$

where

M maximum of z1 z2 and z3

z1 regularity of the method of application

z2 extent of use of the method of application

z3 properness of the method of application

The range of the index was from 1 to 0

6 Index of related management practices in fertiliser application (Rm)

This component refers to those practices of rice cultivation which directly or indirectly contribute to the fertiliser use efficiency for the crop such as irrigation and water management land preparation soil test based fertiliser application liming use of cheapest source of fertiliser low volume spraying growing legume crops etc

The related management practices varied for different fertiliser nutrients

The formula used for quantification was

$$Rm_j \qquad \frac{P_j}{Max\ P_j} \times Z$$

where

Rm_j Index of related management practices in fertiliser application followed by the j^{th} farmer

P_j - Number of management practices adopted by the j^{th} farmer out of applicable practices

Max P_j Maximum number of management practices applicable to the particular fertiliser nutrient for the j^{th} farmer

$$Z \qquad \frac{z1 + z2 + z3}{M}$$

where

M - Maximum of z1 z2 and z3

z1 regularity of use of the related management practices z2 - extent of use of the related management practices

z3 = properness or the related management practices followed

The range of the index was between 1 and 0

3.3.5 Fertiliser use behaviour index (FUBI)

FUBI with reference to a particular fertiliser was obtained by the formula described as under

Let I_{hj} refers to the index value for the h^{th} component variable (h = 1 6) of the j^{th} farmer

Then the FUB index or a fertiliser is obtained as

$$I_j = \frac{100 \times \sum_{h=1}^{N_j} I_{hj} \cdot ah}{\sum_{h=1}^{6} ah}$$

where

I_j - FUB index of the j^{th} farmer for the particular fertiliser

N_j - Number of applicable dimensions for the j^{th} fertiliser (N_j 6 5 4 3
ie 6 dimensions in the case of N 4 dimensions in the case of P_2O_5 5 for K_2O and 3 for the organic manure)

ah = the weightage on the relevancy rating given for the h^{th} dimension variable

The index ranges between 0 and 100 After calculating the indices for the three major nutrients and organic manure separately the composite fertiliser use behaviour index (CFUBI) of the farmer was obtained by adding the indices and calculating its average

i e composite I_j (CFUBI)

$$= \frac{I_j \text{ of } N + I_j \text{ of } P_2O_5 + I_j \text{ of } K_2O + I_j \text{ of OM}}{4}$$

CFUBI also ranges between 0 and 100

3 3 6 Sandardisation of the Index

a Reliability of the index

Reliability refers to the precision of the instrument i e to the extent to which repeated measurement produces the same result According to Anastasi (1961) the reliability of a test refers to the consistency of scores obtained by the same individual on different occasions or with different sets of equivalent forms

In this study reliability was determined by split half method The question items included on the index were split into two separate forms with odd numbered questions in one form and even numbered questions in the other These two forms were simultaneously administered to 40 farmers from Thrissur district (non sample area for the study) Pearson product moment correlation was worked out between the two sets of scores obtained from the 40 farmers The correlation coefficient worked out between the two scores was 0 76 which was significant at 1 per cent level of significance indicating the high reliability of the index

b Validity of the index

The scale is valid when it actually measures what it claims to measure (Goode and Hatt 1952) The validity of the index was found in this study using content validity criterion validity and known group validity

Content validity

According to Kerlinger (1973) it is the representativeness or sampling adequacy of the contents the substance the matter and the topics of a measuring instrument Content validity of the index was established by two means The items selected for inclusion in the scale were based on authentic literature and discussion with the experts on the concerned areas which was one means of establishing content validity The opinion of the panel of the judges was obtained to find out whether the items were relevant/important for inclusion in the index or not based on which the items were selected, which was another means of establishing content validity

Criterion validity

Criterion validity was ascertained by comparing the index scores with one or more criteria known to measure the attribute under study In this study yield of the rice crop obtained by the farmers was taken as the criterion which is an accepted indicator of fertiliser use behaviour of rice farmers

In this study Average Yield Index (AYI) was developed and used to represent the average yield obtained by the rice farmer AYI was defined as the average of the grain yield per hectare obtained by a rice farmer for the previous two rice crops in comparison to the attainable yield in the locality for the corresponding seasons The attainable yield in the locality was obtained from the records maintained by the Krishi Bhavans

This index was developed to overcome the difficulty that may arise in comparing and averaging the yield of High Yielding Varieties and the local varieties grown by a farmer in the same season or in both the seasons

The formula by which AYI measured was

$$AYI - \frac{OY}{AY}$$

where

AYI = Average Yield Index

OY = Obtained yield by the farmer

AY = Attainable yield in the locality

The AYI ranged from 0 to 1

The fertiliser use behaviour indices and the calculated AYI of 40 rice farmers were correlated The same group of farmers selected for the estimation of reliability was employed in this case also

Pearson s product moment correlation coefficient (r) was used to correlate each farmers FUB index and his AY index The correlation coefficient value obtained was 0 74 which was significant and positive indicating a high degree of criterion validity of the index developed for the study

Known group validity

According to this method a test is administered among persons who are known to have a particular opinion or belonging to a particular category and the results are then compared with known facts (Bhatnagar 1990) For testing the validity of the items selected for the index two groups of farmers (15 farmers in each group) one known to be with good/high fertiliser adoption and the other with poor/low fertiliser adoption were selected from Thrissur district based on the opinion and guidance of the field level extension workers The CFUB Indices of these 30 farmers were worked out and the indices of these two groups were compared using t test which yielded a significant t value showing that the mean difference between the two groups was significant

3 3 7 Fertiliser Use Behaviour Index through Principal Component Analysis

Fertiliser Use Behaviour Index was also developed using Principal Component Analysis (PCA) which is an accepted method of developing an index in any multivariate data situation

Abraham and Koshla (1965) used PCA to form a single index of the level of incidence of pests and diseases in a field The index of overall incidences of pests and diseases based on simple ranking method was found to agree closely with the one based on PCA Similarly in this study CFUB Index was developed using Principal Component Analysis also

The data obtained from 300 farmers about their use of nitrogenous fertilisers phosphatic fertilisers potassic fertilisers and organic manure were analysed and their principal components were extracted through PCA The first principal component of the data of the use of fertilisers and organic manure were taken as the corresponding indices (Index of nitrogenous fertiliser use Index of phosphatic fertiliser use Index of potassic fertiliser use and Index of organic manure use)

As the second step the data on the above four indices were subjected to PCA and the Composite Fertiliser Use Behaviour Index (CFUBI) was developed

3 3 8 Comparison of the CFUBI by formula and CFUBI by PCA

The CFUBI of the 300 farmers which was calculated through the formula method was correlated with their CFUBI that was calculated through the PCA method which gave a correlation cofficient value of 0 53 which was significant at 1 per cent level of significance

The Multiple Regression Analysis was carried out with the first three components of CFUB Index developed through PCA and the CFUB Index developed through the formula The coefficient of determination (R^2) of the multiple linear regression equation with the first two principal components as predictors was found to be 89 4 per cent which was relatively high and statistically significant This established the predictability of the index developed through the formula method In other words it was found that the formula index could reflect a major portion of variability that the PCA index could reflect through its first three principal components

The correlations between the indices of N P_2O_5 K_2O fertilisers and organic manures of the two methods also yielded highly significant results (0 986 0 988 0 990 and 0 901 respectively) at 1 per cent level of significance

Factor loadings of the principal components

Factor loadings of the CFUB Index index of nitrogenous fertiliser use index of phosphatic fertiliser use index of potassic fertiliser use and index of organic manure use were calculated from their respective latent vectors (Appendix V) The variability explained by the indices were analysed through their highly contributing factor loadings

Fertiliser use behaviour dimensions ard yield of rice crop

Multiple Regression Analysis and step down regression analysis were carried out to arrive at the important dimensions of fertiliser use behaviour that could predict the variability in rice yield

3.4 Selection, operationalisation and measurement of Independent variables

The independent variables in the study refer to the behavioural characteristics of the rice farmers which were grouped as personal economic,communication and psychological variables However a grouping of the variables was not attempted to as it was felt that the groupings may not be mutually exclusive

3.4 1 Selection of independent variables

The independent variables were selected following the procedure outlined below

Based on review of literature, discussion with subject matter specialists and a reconnaissance survey, a list of 30 variables that could possibly have relationship with Fertiliser Use Behaviour of rice farmers was prepared The list of variables was administered to the qualified and experienced faculty members in the discipline of Agricultural Extension in the Kerala Agricultural University (KAU) and Tamil Nadu Agricultural University (TNAU) to serve as judges for rating the relevancy and exhaustiveness of the variables to be included

The judges were requested to critically go through the list of variables and indicate the relevancy of these variables in the study They were also requested to suggest any other variable which they considered relevant and were asked to rate the variables on a three point continuum ranging from most relevant, relevant and not relevant with weightages of 3 2 and 1 respectively From a total of 28 judges selected for rating, responses were obtained from only 20 judges

The variables were selected based on the mean relevancy score which was calculated by summing up the weightages obtained for a variable and dividing it by the number of judges responded The average mean score was worked out by dividing the sum of mean relevancy scores with the number of variables included in the list The variables with their mean relevancy score are given in Appendix-VI

Those variables with mean relevancy score above the average mean relevancy score were selected for a pilot study Thus out of 30 variables initially included in the list for the relevancy rating only 22 variables were selected for inclusion in the pilot study (Appendix-VI) The pilot study was conducted on a sample of 40 farmers in two panchayats (Madakkathara and Ollukkara in Thrissur district) which were outside the main study area These variables were correlated with the developed fertiliser use behaviour index (dependent variable) of the 40 farmers Those variables having a significant relationship with the dependent variable at 5 per cent level of significance alone were selected for the final study Accordingly 17 variables were finally selected for inclusion in the study The variables thus selected were Education, Main Occupation, Farm size, Area under rice, Annual Income Economic motivation, Level of aspiration, Rational decision making ability Innovativeness, Attitude towards fertiliser use Information source utilization Personal guidance on better farming, Extension participation Economic performance index, Irrigation index, Soil test utilization index and Knowledge about fertiliser use

3 4 2 Operationalisation and measurement of independent variables

Independent variables

1 Education

In this study education refers to the extent of formal or informal learning possessed by the farmer respondents, at the time of investigation It was measured by assigning scores for different levels of education as per the scoring system followed in the socio-economic status scale of Trivedi (1963) The categorisation of respondents and the corresponding scores assigned were as follows

Level of education	Score
Illiterate	0
Can read only	1
Can read and write	2
Primary school	3
Middle school	4
High school	5
Collegiate	6

2 Main occupation

The professional status of agriculture for a farmer respondent was measured by this variable It referred to whether agriculture was the respondent s primary occupation or not

The scoring procedure followed was

Agriculture as primary occupation	3
Agriculture as secondary occupation	1

3 Farm size

Farm size was defined in terms of the area of land owned and cultivated by a farmer which included both wet and garden land Wet land having cultivation more than once was multiplied by the number of times of cultivation so as to get a standardised estimate of the farm area

4 Area under rice

This variable refers to the area of land under rice cultivation by the farmer respondent Wet land having cultivation of rice more than once in an year was multiplied by the number of crops raised for calculating the total area under rice

5 Annual income

This indicated the total annual income expressed in rupees earned by a farmer and his family members from both farm and non farm enterprises put together

6 Economic motivation

Economic motivation referred to the extent to which an individual is oriented towards achievement of the maximum economic ends such as max_misation of farm profits

This was measured using Supe s (1969) scale with modification in the scoring procedure Instead of a five point continuum of response as developed by Supe a dichotomy of Yes or No response pattern was used in this study as done by Prasad (1983) The scale consisted of 6 statements of which the first five statements were positive while the last one was negative A score of 1 was assigned for the Yes response and 0 score for No response in the case of positive statements The scoring procedure was reversed in the case of negative statement The scores obtained on each statement were cumulated to obtain the total scores of a respondent on this variable The maximum score that could be obtained by a respondent was six and minimum zero

7 Level of aspiration

This was defined as the overall assessment of the farmer in relation to his concern for wishes for his future or for the fears and worries about the future in his own reality world

Self Anchoring Striving Scale developed by Cantrill (1969) was used in this study for measuring the level of aspiration A figure of ladder with 10 steps was shown to each respondent with the explanation that the top of the ladder represented the best possible life (Score 10) and the bottom one represented the worst possible life for an individual (Score 1) The respondent was then asked to indicate a step on the ladder where he stood for each of the three time spans - (a) at the present time (present) (b) five years before (past) and (c) five years after from now onwards (future) A modified procedure of arriving at the levels of aspiration of the past present and future as used by Prasad (1983) was followed to find the score of level of aspiration of the respondents The scores were given corresponding to the steps indicated by the respondent and the scores on the present past and future were summed up to get the level of aspiration score With a scoring procedure of 10 scores for each of the present past and future the total score ranged between 3 and 30

8 Rational decision making ability

In this study rationality in decision making is viewed as the ability of an individual to select those means which are justified of bearing rationality from the various means available at his disposal to reach an end

The rational decision making ability of a farmer was measured with the help of a Rationality Quotient (RQ) using the formula given by Supe (1969)

R Q was computed using the formula

$$R\,Q = \sum_{i=1}^{N} \frac{e_i}{p_i} \times w_i$$

where

N Number of decisions which are applicable to the situations of the farmer

$\sum_{i=1}^{N}$ Summation over each of the N decision of which any one is the i^{th} decision

e_i = Extent of rationality of i^{th} decision which can be less rational (1) Moderately rational (2) and Highly rational (3)

p_i = Potentiality of being rational in i^{th} decision (considered as 3 in all the decisions for the present study)

w Weight to be given to the th decision based on the differential complexity weights for decisions (considered as 1 for the present study)

The items developed by Supe (1969) were used with slight modifications to suit the purpose of the present study Only four items were included in the study with appropriate modifications to suit the nature of the crop The list of justifications for each decision was developed in consultation with subject matter specialists

The rationality quotient ranged from 1 33 to 4 00

9 Innovativeness

Innovativeness for the purpose of the study was defined as a socio-psychological orientation of an individual to get linked or closely associated with change adopting innovative ideas and practices Considering the difficulty of obtaining information on overt behaviour denoting innovativeness via the adoption of improved farm practices in this study it was viewed as a covert behaviour closely associated with change

This variable was quantified using the scale developed by Feaster (1968) as mod fied bv Prasad (1983) Eight statements were included for the present study with three response categories as Yes undecided and No For the first four statements a score of 2 was assigned to Yes response, a score of 1 for undecided and 0 score for No response The scoring procedure was reversed in the case of the last four statements The summation of the scores obtained by a farmer for all the eight statements indicated his innovativeness score The total score ranged from 0 to 16

10 Attitude towards fertiliser use

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

In this study attitude of farmers towards fertiliser use has been operationally defined as the degree of favourable or unfavourable mental disposition of a respondent towards use of fertilisers in farming as expressed by him to a set of statements with varing intensities of the stimulus statements

The scale developed by Choudhary and Prasad (1977) was used to measure attitude of farmers towards fertiliser use

The scale consisted of nine statements rated on a four point continuum ranging from strongly agree agree disagree and strongly disagree with weights 4 3 2 and 1 respectively for positive statements and the weights reversed for negative statements The scoring was done with the help of the method proposed by Eysenck and Crown (1949) According to this method the weight of Likert and scale value of Thurstone in Appendix-VIII (schedule) were combined in the form of products for each statement The total score of a respondent was the sum of such products for all the nine items

11 Exposure to information sources

This reflects an individual s contact with various sources of information i e his mere exposure to the various sources and not influence or internalisation of the message from those sources

This variable was quantified using a scale developed for the study The list of sources of information are given below

Sources	Frequency of exposure		
	Never 0	Occasionally 1	Regularly 2
A Official sources			
1 Agricultural Officer			
2 Agricultural Assistant			
3 University Scientist			
4 Bank Officials			
5 Fertiliser Dealers			
6 Co-operative Society officials			
7 Block Officials			
Others (specify)			
B Non official sources			
8 Convenors of group farming committees			
9 Progressive farmers			
10 Friends			
11 Neighbours			
12 Relatives			
Others (specify)			

C **Impersonal sources**

13 Newspaper

14 Other printed materials

15 Radio

16 Television/ Video cassetes

17 Exhibitions

18 Meetings/Seminars

Others (Specify)

The cumulative value of the scores obtained by a respondent on these items was considered as his extent of exposure to information sources

12 **Personal guidance on better farming**

Personal guidance was operationally defined as the technical guidance help and assistance obtained by a farmer from the different development offic als for efficient fertiliser use and increased crop production for the last one year

The scale developed by Singh (1981) was used with slight modifications to suit the present purpose of the study Five statements were used which were related to five activities viz (1) extent of discussion of problems related to fertiliser use with the extension worker (2) extent of visit to their crop by the extension worker (3) extent of advice received for proper use of fertilisers (4) extent of advice received for proper selection of fertilisers and (5) the level of assistance in identifying pests and diseases and their control They were rated on a four point continuum ranging from very much much very little and never with scores 4 3 2 and 1 respectively

The summation of the scores for different statements gave the total score on personal guidance for a respondent The maximum score a responent could obtain on this variable was 20 the minimum being zero

13 Extension participation

Extension participation is operationally defined as the extent of involvement and/or participation by a respondent in the various extension activities conducted in his locality

The scoring pattern developed is given below

Sl No	Extension activities	Frequency of participation		
		Whenever organised 2	Sometimes 1	Never 0
1	Group farming meetings			
2	Agricultural seminars			
3	General meetings discussions			
4	Exhibitions			
5	Demonstrations			
6	Campaigns			
7	Trainings			
8	Film shows			
9	Any other (specify)			

The summation of the scores for the different extension activities for a respondent gave his score on extension participation

14 Economic Performance Index

Economic Performance Index for this study was operationally defined as the ratio of the value of total output to total expenditure incurred on the rice crop by a farmer The procedure originally developed by Sankaraiah and Crouch (1977) as used by Rannorey (1979) was used for measuring this variable with slight modification The ratio of the total output to the total expenditure incurred was worked out as the Economic Performance Index (EPI)

The formula used was

$$\frac{\text{Total value of the rice produce}}{\text{Total cost of production of rice}} \times 100$$

The area under cultivation of rice during each season and the per hectare yield of rice for that particular season were first recorded The value for produce from each season and the corresponding cost of production of rice was worked out The ratio of the value of the produce to the cost of production multiplied by 100 gave the EPI for a particular season

The EPI for the two seasons were then summed up and the average was obtained The value thus obtained was taken as the Economic Performance Index (EPI) for an individual respondent

15 Irrigation Index

The extent to which the rice crop is being irrigated was measured by this variable This was quantified using a scoring procedure developed for the study Two dimensions viz availability of irrigation water and rice area covered under irrigation were considered for both the seasons

	Availability of irrigation water			Area irrigated (Per cent to total area)			
	Through out the season	Partially	Never	75% and above	50 00-74 99 %	25 00 49 99 %	Below 25 00 %
	3	2	0	4	3	2	1
1st season							
2nd season							

The scores obtained by a farmer for the availability of irrigation water and area under irrigation for a particular season were multiplied The average of the scores of both the seasons was obtained to form the Irrigation Index

16 Soil test utilisation

This variable was operationally defined in terms of the acceptance and use of soil test recommendation by the respondent in his application of fertilisers for rice

If a respondent has already tested his soil during the last year a score of 1 was assigned to him and 0 if the soil was not tested If he has adopted the soil test result and had applied fertilisers based on that a score of 1 was again assigned to him Thus a farmer respondent who had adopted soil test recommendation will get a score of 2 one who has tested his soil but not followed the recommendation will get a score of 1 and a farmer who had not conducted any soil test will be assigned a score of 0

17 Knowledge on fertiliser use

This variable refers to the extent of information possessed by a farmer on fertiliser recommendation of rice

The variable was measured using a knowledge test developed for the study The procedure by which the test was prepared is briefly discussed

Collection of items

The content of a knowledge test is composed of questions called items An item pool of questions was prepared by reviewing literature such as the Package of Practices Recommendations of Crops (1989) and consulting the subject matter specialists Thus initially 68 items on various aspects of use of fertiliser for rice were collected From this list initial selection of items was made observing criteria that (a) An item should promote thinking (b) It should differentiate well informed farmers from the poorly informed ones and (c) It should have some difficulty value Based on this 48 items were selected from the list for inclusion in the knowledge test (Appendix-VII) Items were converted into relevant question forms which were objective type necessitating the respondents to answer by Yes/No or to specify the name etc

Item Analysis

The 48 questions on fertiliser use were administered to a randomly selected sample of 48 rice farmers in Thrissur district which is a non sample area for the main study Item analysis yields two kinds of information item difficulty and item discrimination The index of item difficulty reveals how difficult an item is whereas the index of discrimination indicates the extent to which an item can discriminate the well informed respondents from the poorly informed ones

The scores obtained by the 48 respondents were arranged in the descending order of total scores from the highest to the lowest and the respondents were divided into three equal groups arranged in descending order based on the total scores obtained by them The three groups were G_1 G_2 and G_3 with 16 respondents in each group For item analysis the middle group namely G_2 was eliminated retaining only the terminal ones with high and low scores

The data pertaining to correct responses for all the items in respect of these two groups C_1 and C_3 are ... and the difficulty and discrimination ...

Calculation of Item Difficulty Index ( )

The index of item difficulty ... is expressed as percentage of the ... item correctly. The formula used for the ...

$$P_i = \frac{n_i}{N_i} \times 100$$

where

P_i - difficulty index expressed in percentage ... item

n_i - number of learners giving correct answer ... item

N_i - total number of learners to whom the i^{th} item was administered

Calculation of Discrimination Index

In this study to calculate the Discrimination Index the E 1/3 method was used. The formula of the method is given below

$$E\ 1/3 = \frac{(S ...)}{\ ...} \ \frac{(S3)}{}$$

where

S_1 and S_3 are the frequencies of correct answers in the Group G_1 and G_3 respectively

N is the total number of farmers in the sample of items analysed (48)

The item difficulty indices and discrimination indices of all the 48 items are furnished in Appendix-VII

The items having Pi values between 30 to 85 and discrimination index varying from 0 30 to 0 85 were finally selected as done by Geethakutty (1982) and accordingly 14 items were selected for inclusion in the knowledge test (Appendix-VIII)

Scoring procedure

The respondents were asked to answer the items which were in the form of correct or incorrect Yes/No or one word answer The scores for correct replies of all the 14 items of a particular respondent were summed up and this indicated his level of knowledge on fertiliser use for rice and the score range was from 0 to 14

Reliability of the knowledge test

The reliability of the developed knowledge test was estimated by the split half method All the 14 items were divided into two halves each having seven odd and even numbers and administered to 30 respondents The coefficient of correlation between the two sets of scores was computed and the obtained correlation coefficient value of 0 82 was found to be significant at 1 per cent level of significance

Content validity of the test

Utmost care was taken in the initial period itself to include in the universe of contents all the probable aspects related to fertiliser use for rice These items were further screened with the help of subject matter specialists so as to ensure the inclusion of items which can reflect the respondent s actual knowledge on use of fertiliser for rice Hence it was assumed that the test was considered to have validity

3 4 3 Relationship between the Composite Fertiliser Use Behaviour Index (CFUBI) and the farmers' characteristics

The CFUBI and the selected characteristics of the 300 farmers were first subjected to simple correlation Then Multiple Regression Analysis was worked out with the significantly correlated characteristics and CFUBI Lastly step down regression analysis was carried out to identify the best predictors of CFUBI

3 5 Identification of factors contributing to fertiliser use behaviour and constraints experienced by farmers

3 5 1 Identification of factors contributing to the fertiliser use behaviour as perceived by the farmers, extension personnel, scientists and input agencies

Through exhaustive review of literature discussion with the experts and pilor study conducted among various categories of respondents (40 farmers 20 scientists 20 extension personnel and 10 input agencies) in Thrissur district which formed a sample outside the main study sample 23 factors which were reported to have contribution to the fertiliser use behaviour of farmers were identified They were included in the final schedule for measuring their perceived importance by developing a perception index

Perception index

The different categories of the respondents were asked to assign a score for each factor listed out on a 0 to 10 point continuum 0 for the least contributing factor and 10 for the factor with highest contribution

0	1	2	3	4	5	6	7	8	9	10
Least										Highest

The score obtained by each contributing factor was worked out for different categories separately For each factor the frequency of response under the various points in the continuum were multiplied with the respective weights (scores) and added up to obtain a cumulative score for that contributing factor The obtained cumulative score of each factor was divided by its maximum obtainable cumulative score (3000 in the case of farmers and 400 in all the other three categories) which yielded the perception index of the particular factor

Based on the perception indices obtained by the factors the 23 contributing factors were ranked separately in the case of the four categories To test the agreement of ranking among the four categories Kendall s Coefficient of Concordance (W) was worked out The obtained W walue was highly significant (W - 0 712**) at 1 per cent level of significance which revealed that there was high degree of agreement among the four categories of respondents in the perception about the factors contributing to the FUB Hence the ranks for each factor assigned by the four categories were averaged based on which all the factors were again ranked (based on the average perception scores of the four categories put together) with regard to the factors listed out

3 5.2 Constraints experienced by the farmers in the fertiliser use of rice crop

Based on review of literature discussion with field extension workers farmers and on pilot study a list of possible general constraints faced by the rice farmers in fertiliser use was prepared At the data collection stage specific constraints in relation to the identified dimensions of major nutrients and organic manures were also gathered

To measure the importance of constraints in composite fertiliser use behaviour the following procedure was adopted The response to each constraint was obtained on a three point continuum viz most important important and least important with weights 3 2 and 1 respectively For each constraint the frequency of response under the various points were multiplied with the respective weights and summed up to get a summative score for the particular constraint after which the percentages were worked out The dimension wise frequencies of the reasons given for improper or low use of nitrogenous phosphatic and potassic fertilisers and organic manures were summed up and their averages were obtained which indicated the frequencies of the constraints in relation to composite fertiliser use behaviour

3 6 Procedure employed in data collection

Data collection was carried out using structured interview schedules which were prepared and pretested for the study The pilot study was carried out in Thrissur district The wordings and sequences were modified and items which were found not necessary were deleted in the light of the pilot study and the final schedules were prepared [Appendix VIII (a) and (b)] The interview schedule for the rice farmer consisted of four parts Part A was used to collect the information on various independent variables Part B was used to obtain the farmers perception about the factors contributing to fertiliser use behaviour Part C was used to collect data on the fertiliser use behaviour of farmers for the previous two seasons Part D consisted of a list of possible constraints experienced by the farmers in the use of fertilisers and manures

The questionnaire for the other three groups of respondents consisted of only one part which was used to gather information about their perception about the factors contributing to fertiliser use behaviour

The collection of data was carried out from November 1991 to March 1992

3 7 Statistical tools used in the study

The data collected were scored tabulated and analysed using suitable statistical methods The statistical tools used for the development of index have already been described in the procedure of index development The other statistical tools used alone are described here

1 Mean

The mean of the fertiliser use behaviour index and its components for the different zones and for the total sample were used to compare the fertiliser use behaviour of farmers in different NARP zones

2 Delinious Hodges Cumulative Root f method

Using the cumulative root f method the total sample of farmers under each zone were categorised into 4 classes Q_1 Q_2 Q_3 and Q_4 and assigned specific category names so as to represent Q_1 Q_2 Q_3 and Q_4 such that Q_1 very poor Q_2 poor Q_3 satisfactory and Q_4 good

3 Frequency and simple percentage

After grouping the respondents into four quarters frequency of farmers under each category and their percentages were worked out to find out the distribution of farmers under good satisfactory, poor and very poor groups in relation to fertiliser use behaviour

4 **Analysis of variance**

One way analysis of variance was used to test the significance of the differences between the farmers of different NARP zones with respect to their fertiliser use behaviour

5 **Critical difference**

Critical differences between the means of the different indices and components of different zones were worked out to know the statistical similiarity or dissimiliarity between the zones

6 **Coefficient of variation**

Coefficient of variation was worked out to show the homogeneity or consistency of the fertiliser use behaviour and its dimensions within each zone

7 **Kendall's Coefficient of Concordance (W)**

Kendall s coefficient of concordance W was computed to know whether the order of rankings obtained on the various factors contributing to FUB by the four different categories had a significant agreement or not

8 Pearson's product moment correlation

Correlation analysis was done to find the degree of linear relationship between behavioural characteristics of the farmers and their fertiliser use behaviour

9 Multiple Regression Analysis (MRA)

MRA was done (1) to find out the contribution of the significant behavioural characteristics to the fertiliser use behaviour and (2) to find out the contribution of components of fertiliser use behaviour of rice farmer towards yield of the crop

10 Step down Regression Analyis

Step down regression analysis was carried out to trace the variables contributing maximum variability to FUB and yield of the crop

11 Principal Component Analysis (PCA)

PCA was utilised to develop FUB index so that the importance of each fertiliser can be traced through the factor loadings Multidimensionality in a set of data can be transformed into unidimensionality through PCA The first

Principal Component is the normalised linear combination with maximum variance The utility of a component depends upon the variability it accounts for

The statistical analyses were carried out using the computer facility available at the College of Horticulture Vellanikkara

3 8 Hypotheses of the study

1 There will be no significant difference in the fertiliser use behaviour of the rice farmers in the different NARP zones of Kerala

2 There will be no significant difference in the use behaviour of the identified dimensions of fertiliser use by the farmers in the different NARP zones of Kerala

3 There will be no significant contribution of the identified dimensions of fertiliser use behaviour towards the yield of rice crop

4 There will be no significant relation between the selected personal socio psychological and socio-economic characteristics of the respondents and their fertiliser use behaviour

Results

CHAPTER IV

RESULTS

The results of the study are presented under the following heads

4 1 Fertiliser use behaviour of rice farmers

4 2 Dimensions of fertilizer use behaviour in predicting the yield of rice

4 3 Relationship between behavioural characteristics and fertilizer use behaviour of rice farmers

4 4 Perceived importance of technological and environmental factors affecting fertiliser use behaviour of rice farmers

4 5 Constraints identified by the farmers with reference to the fertiliser use behaviour

4 1 Fertiliser Use Behaviour of Rice Farmers

4 1 1 Distribution and comparison of rice farmers based on composite fertiliser use behaviour

The distribution of rice farmers under the four categories viz very poor poor satisfactory and good with respect to their Composite Fertiliser Use Behaviour Index (CFUBI) and the comparison of different NARP zones based on the CFUBI are presented in Tables 3 4 5

Table 3 presents the distribution of farmers under very poor poor satisfactory and good categories in relation to their composite fertiliser use behaviour and also use of nitrogenous phosphatic and potassic fertlizers and organic manures It could be observed from the table that 33 67 per cent of the farmers belonged to satisfactory level while 31 33 per cent was under good level of CFUBI 24 33 per cent of the farmers were grouped as 'poor' while 10 67 per cent of the farmers were considered as very poor (Fig 3)

From the data presented in Table 4 it was observed that there was variation between the NARP zones based on the composite fertilizer use behaviour of farmers The Central Zone had the highest percentage of farmers under good level of CFUBI (60 00 per cent) followed by the High Range Zone (53 33 per cent) The Northern Zone was found to have the lowest percentage of farmers under good CFUBI category Thirty five and forty per cent of the farmers in Northern Zone belonged to very poor and poor categories respectively There was significant variation among the NARP Zones with regard to the average CFUBI of the farmers (Fig 4)

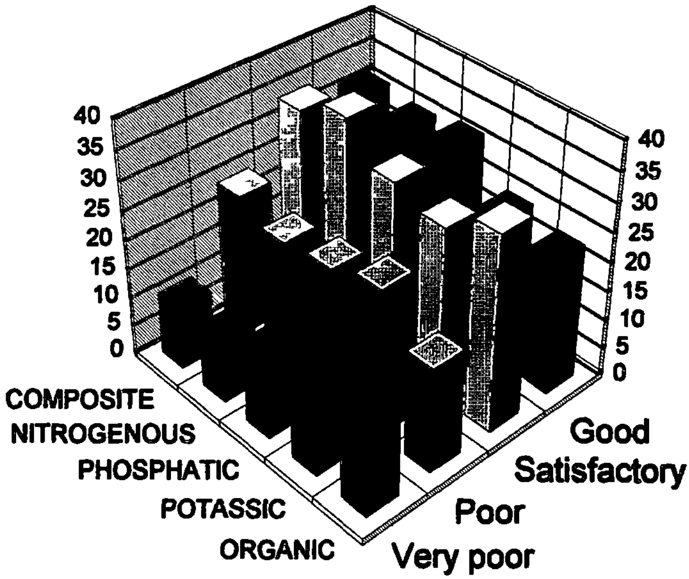

Fig.3 DISTRIBUTION OF FARMERS BASED ON USE OF DIFFERENT FERTILIZERS

Table 3 Distribution of farmers based on indices of composite fertiliser use behaviour and those of nitrogenous phosphatic and potassic fertilizers and organic manures

(n 300)

Sl No	Type of fertilizer use	Quartiles	Category	Frequency	Percentage
1	Composite fertiliser use behaviour	≤ 49 01	Very poor	32	10 67
		49 02 59 94	Poor	73	24 33
		59 95 71 66	Satisfactory	101	33 67
		> 1 66	Gooa	94	31 33
2	Use of nitrogenous fe tilizers	≤ 43 27	Very poor	33	11 00
		43 28 57 00	Poor	6	21 67
		57 01 74 65	Satisfactory	111	37 00
		≥ 74 65	Good	91	30 33
3	Use of phosphatic fertilisers	≤ 53 51	Very poor	43	14 33
		53 52 70 14	Poor	68	22 67
		70 15 80 54	Satisfactory	94	31 33
		> 80 54	Good	95	31 67
4	Use of potassic fertilisers	≤ 56 71	Very poor	64	21 33
		56 72 72 91	Poor	75	25 00
		72 92 86 10	Satisfactorv	87	29 00
		> 86 10	Good	74	24 67
5	Use of organic manures	< 35 87	Very poor	77	25 67
		35 88 63 28	Poo	54	18 00
		63 29 80 89	Satisfactory	100	33 33
		> 80 89	Good	69	23 00

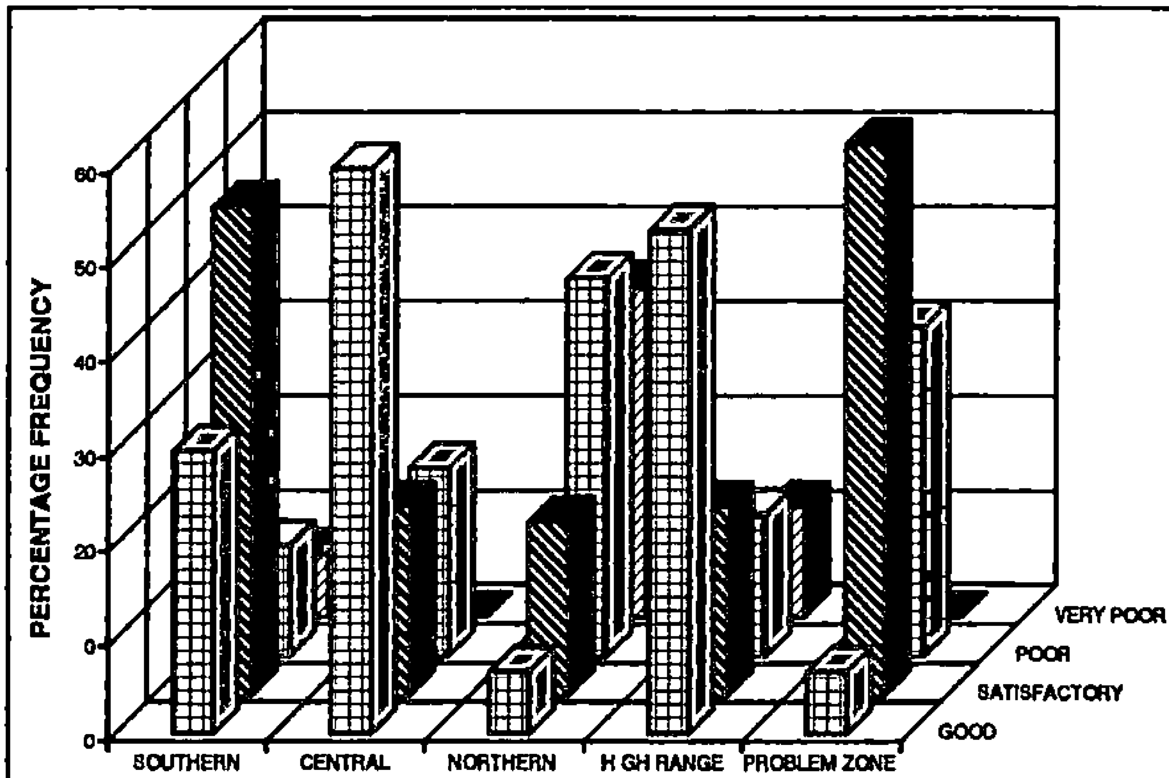

Fig.4 COMPARISON OF ZONES BASED ON COMPOSITE FERTILIZER USE BEHAVIOUR

Table 4 Distribution of farmers based on composite fertiliser use behaviour in the different NARP zones

(n 300)

Zone (n-60/ zone)	Categories							
	Very poor ≤ 49 01		Poor (49 02 59 94)		Satisfactory (59 95 71 66)		Good >71 66	
	F	%	F	%	F	%	F	%
SZ	4	6 67	7	11 67	31	51 67	18	30 00
CZ	0		12	20 00	12	20 00	36	60 00
NZ	21	35 00	24	40 00	11	18 33	4	6 67
HZ	7	11 67	9	15 00	12	20 00	32	53 33
PZ	0	-	21	35 00	35	58 33	4	6 67

χ^2 122 72**

** Significant at 1 per cent level of significance

SZ - Southern Zone CZ Central Zone NZ Northern Zone

HZ High Range Zone PZ Problem Zone (Special Zone on Problem Areas)

Table 5 presents the mean indices of fertiliser use and coefficient of variation (CV) of each zone The differences in CFUB indices of the various NARP zones were statistically significant among themselves (F = 23 68**)

From the results it is evident that the composite fertilizer use behaviour of rice farmers in one zone is significantly different from that in any other zone In other words the CFUBI of rice farmers in each zone is specific to that zone

Based on this the hypotheses that there would be no significant difference among the NARP zones with regard to the Composite Fertilizer Use Behaviour is rejected

From the results presented in Table 5 it could be observed that the Central Zone had a higher percentage of farmers under good CFUBI together with the highest mean value of CFUBI (70 255) The coefficient of variation of CFUBI of farmers in that zone also was relatively low (16 11) which indicated the relatively high homogeneity or uniformity existing among the farmers of the Central Zone with regard to the CFUBI High Zone was found to have the next higher percentage of farmers with good level of CFUBI and second highest mean value of CFUBI followed by Southern Zone Problem Zone and the Northern Zone in that order

Table 5 Comparison of NARP Zones based on the fertilizer use behaviour of farmers

Sl No	Type of fertiliser use	Zone (n 60/ zone)	Mean	C V	
1	Composite fertilizer use behaviour	CZ	70 255	16 11	
		HZ	67 605	22 60	
		SZ	66 284	16 91	CD 4 30
		PZ	62 110	10 39	F 23 628**
		NZ	51 041	27 60	
2	Use of nitrogenous fertilizers	PZ	76 565	7 92	
		CZ	69 108	14 62	
		HZ	61 912	24 42	CD 3 659
		NZ	46 913	32 02	F 63 646**
		SZ	41 279	51 79	
3	Use of phosphatic fertilizer	PZ	80 717	10 70	
		CZ	75 378	19 06	
		SZ	67 500	27 27	CD 6 655
		HZ	67 305	39 69	F 8 715**
		NZ	63 108	31 50	
4	Use of potassic fertilizer	PZ	86 615	7 83	
		CZ	76 453	20 80	
		SZ	72 127	18 57	CD 8 45
		HZ	61 822	54 98	F 67 918**
		NZ	21 697	150 57	
5	Use of organic manures	HZ	79 382	15 78	
		SZ	74 228	17 90	
		NZ	72 447	25 64	CD 7 006
		CZ	60 152	50 79	F 164 073**
		PZ	4 545	379 11	

** Significant at 1 per cent level of significance

4 1 1a Distribution and comparison of farmers based on nitrogenous fertiliser use behaviour

As evident from Table 3 largest percentage of farmers was found in the satisfactory category (37 00%) followed by 30 33 per cent of farmers under good level of nitrogenous fertiliser use Only 11 00 per cent of farmers were observed to have very poor nitrogenous fertiliser use while 21 67 per cent of them were categorised under poor category

Table 6 highlights the distribution of rice farmers in the five NARP zones under the four categories of nitrogenous fertilizer use behaviour The Problem Zone was found to have the highest percentage of farmers (81 67%) under good category followed by the Central Zone (25 00%) There was no farmer with very poor use behaviour of nitrogenous fertiliser in the Problem Zone while about 41 67 per cent of the farmers of Southern Zone was found to be very poor in their use behaviour of nitrogenous fertilisers (Fig 5)

The data in Table 5 indicated that the Problem Zone had the highest mean for nitrogenous fertiliser use (76 57) with the lowest coefficient of variation (7 92%) The next highest mean value for nitrogenous fertilizer use behaviour index was obtained by the Central Zone (69 108) with a C V of

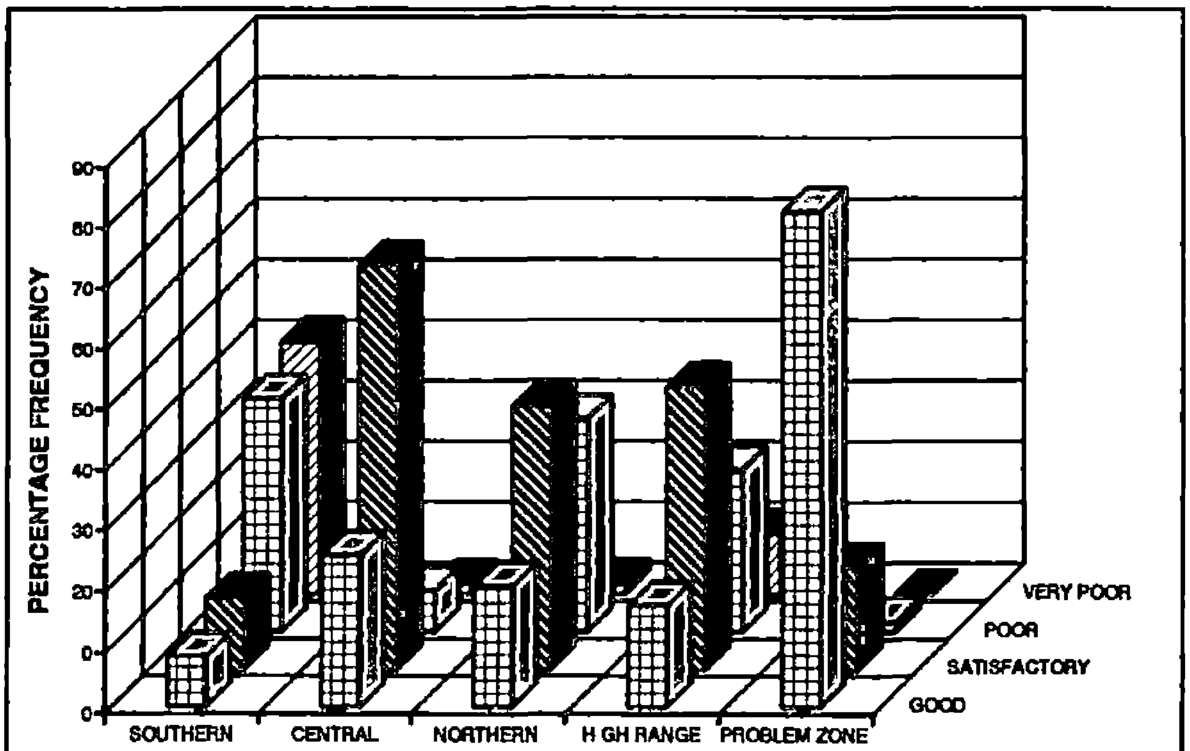

Fig 5 COMPARISON OF ZONES BASED ON USE OF NITROGENOUS FERTILIZERS

Table 6 Distribution of farmers based on the use of nitrogenous fertilisers in the different NARP Zones

Zone (n 60/ zone)	Categories							
	Very poor (≤ 43 27)		Poor (43 28 57 00)		Satisfactory (57 01 74 65)		Good (>74 65)	
	F	%	F	%	F	%	F	%
SZ	25	41 67	23	38 33	7	11 67	5	8 33
CZ	1	1 67	4	6 67	40	66 67	15	25 00
NZ	1	1 67	21	35 00	26	43 33	12	20 00
HZ	6	10 00	16	26 67	28	46 67	10	16 67
PZ	0		1	1 67	10	16 67	49	81 67

χ^2 219 54**

** Significant at 1 per cent level of significance

14 62 per cent The lowest mean and highest C V was observed in the case of Southern Zone (mean 41 28 and C V 51 79%)

The significant F value indicated that there was significant difference among the different NARP Zones with regard to the mean use behaviour of nitrogenous fertilisers The significant chi square indicated that the distribution of farmers into various categories according to fertiliser use is not independent of the choice of NARP Zone

Based on the above results the hypothesis that there would be no significant difference among the Zones with regard to nitrogenous fertiliser use behaviour was rejected

4 1 1b Distribution and comparison of farmers based on phosphatic fertilizer use behaviour

As revealed by Table 3 sixty per cent of the farmers were above the satisfactory level with regard to use of phosphatic fertilizers (31 33% under satisfactory and 31 67% under good category) Over 14 00 per cent of the farmers was grouped under very poor category while 22 67 per cent belonged to poor category with regard to phosphatic fertiliser use

Table 7 presents the zone-wise comparison of phosphatic fertiliser use from which it is seen that the

Table 7 Distribution of farmers based on the use of phosphatic fertilisers in the different NARP Zone

Zone (n-60/ zone)	Very poor (≤ 53 51)		Poor (53 52 70 14)		Satisfactory (70 15 80 54)		Good (>85 54)	
	F	%	F	%	F	%	F	%
SZ	13	21 67	20	33 33	12	20 00	15	25 00
CZ	2	3 33	17	28 33	21	35 00	20	33 33
NZ	18	30 00	21	35 00	12	20 00	9	15 00
HZ	9	15 00	7	11 67	26	43 00	18	30 00
PZ	1	1 67	3	5 00	23	38 33	33	55 00

χ^2 - 231 56**

** Significant at 1 per cent level of significance

Problem Zone had the highest percentage of farmers with good use behaviour (55 00%) followed by Central Zone (33 33%) The Northern Zone had only 15 per cent of the farmers with good phosphatic fertilizer use behaviour (Fig 6)

The χ^2 value of 231 56 which was significant revealed the there was significant association between the various NARP Zones and levels of fertiliser use behaviour From the results in Table 5 it was further noticed that the Problem Zone had the highest mean value (80 71) for phosphatic fertiliser use behaviour index with the lowest coefficient of variation indicating higher rate and degree of uniformity among the farmers in the adoption of practices within the Zone This was followed by the Central Zone (mean 75 378 and C V 19 06%) The Zone with lowest mean value for phosphatic fertiliser use behaviour was the Northern Zone

4 1 1c Distribution and comparison of farmers based on potassic fertiliser use

A perusal of Table 3 with regard to potassic fertiliser use indicates that the farmers were almost equally distributed among the four different categories in relation to potassic fertiliser use behaviour However the highest percentage (29 00%) was under satisfactory group followed by one fourth of the respondents under poor use behaviour A

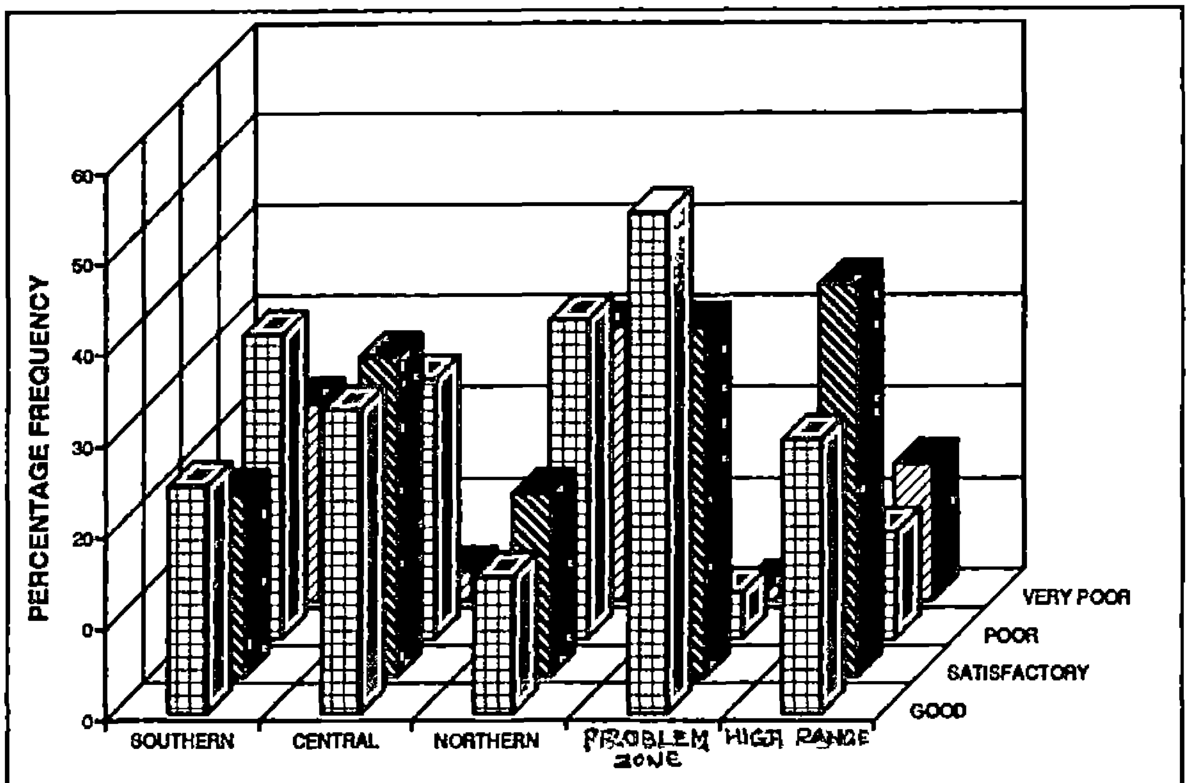

Fig 6 COMPARISON OF ZONES BASED ON USE OF PHOSPHATIC FERTILIZERS

glance at Table 8 makes it very clear that the Problem Zone had the highest percentage of farmers (63 33%) with good potassic fertiliser use behaviour whereas Northern Zone had no farmers under that category It was noticed that 66 67 per cent of the farmers in the Northern Zone were in the very poor use behaviour category (Fig 7)

Table 5 presents the mean and coefficient of variation of indices of potassic fertilizer use behaviour of the rice farmers The Problem Zone stood first with highest mean (86 615) and lowest C V (7 83%) while the Northern Zone had a mean value (21 697) and highest C V (150 57%) This showed that there was relatively poorer use and lesser consistency in the use of potassic fertiliser among the farmers of the Northern Zone The high significant value of F (Table 5) and χ^2 indicated that there was significant differences among the zones with regard to the mean potassic fertilizer use and the distribution of farmers in the different categories

Based on the above observations the hypothesis that there would be no significant difference among the zones with regard to the use behaviour of potassic fertilizer was rejected

4 1 1d Organic manure use behaviour

A perusal of Table 3 brings out the fact that 33 33

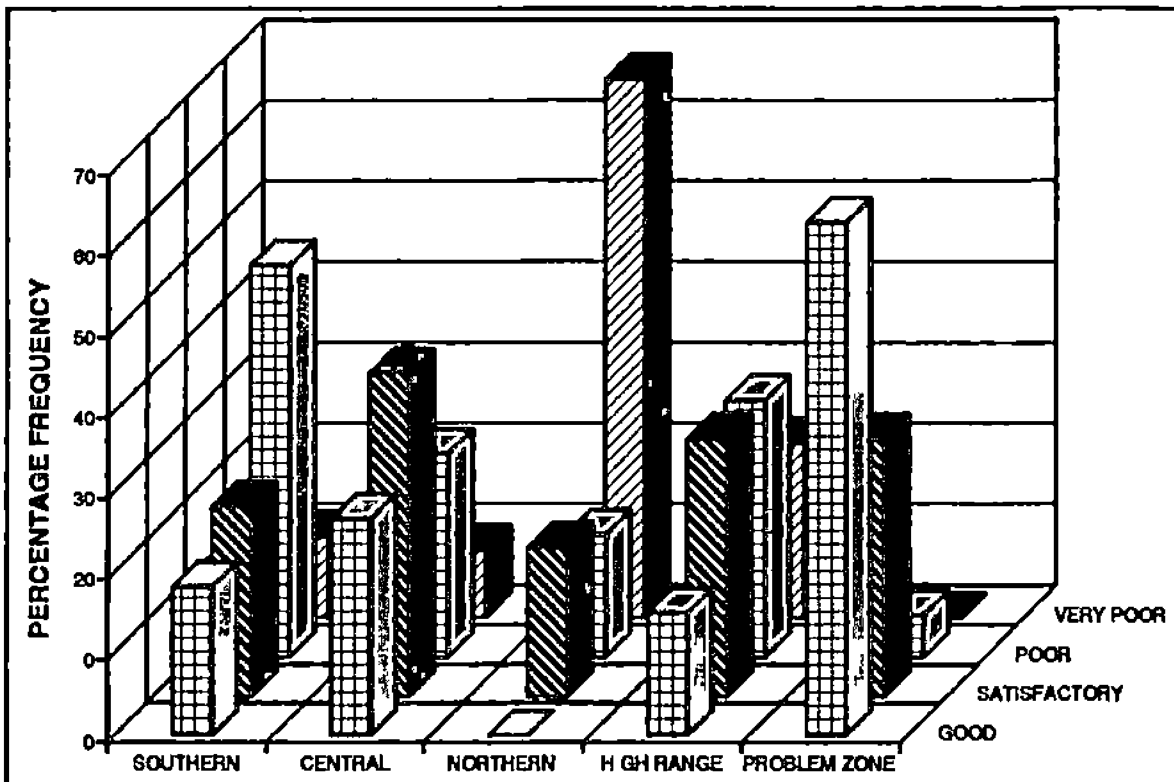

Fig 7 COMPARISON OF ZONES BASED ON USE OF POTASSIC FERTILIZERS

Table 8 Distribution of farmers according to the use of potassic fertilisers in the different NARP Zones

Zone (n-60/ zone)	Categories							
	Very poor (≤ 56 71)		Poor (56 72 72 91)		Satisfactory (72 92-86 10)		Good (>86 10)	
	F	%	F	%	F	%	F	%
SZ	6	10 00	29	48 33	14	23 33	11	18 33
CZ	5	8 30	15	25 00	24	40 00	16	26 67
NZ	40	66 67	9	15 00	11	18 33	0	
HZ	13	21 67	19	31 67	19	31 67	9	15 00
PZ	0		3	5 00	19	31 67	38	63 33

x^2 165 42**

** Significant at 1 per cent level of significance

per cent of the farmers were having satisfactory level of organic manure use while only 23 00 per cent of the farmers were found to have good level of organic manure use More than one fourth of the farmers were with very poor use behaviour

The data in Table 9 reveals that the High Range zone had the highest percentage of farmers with good level of use of organic manure (55 00%) followed by Central zone (26 67%) A large majority (93 33%) of the farmers in the Problem Zone were with very poor organic use behaviour (Fig 8)

A perusal of Table 5 also indicated that the High Range Zone had the highest mean (79 38) for organic manure use behaviour with lowest C V (15 78%) while the Problem Zone had the lowest mean (4 55) with the highest C V of 379 11 per cent

4 1 2a Dimension-wise analysis of nitrogenous fertilizer use behaviour

Table 10 depicts the distribution of farmers based on the dimensions of nitrogenous fertilizer use behaviour

a Quantity

Based on the quantity of nitrogenous fertiliser used 15 67 per cent of the farmers were found under good

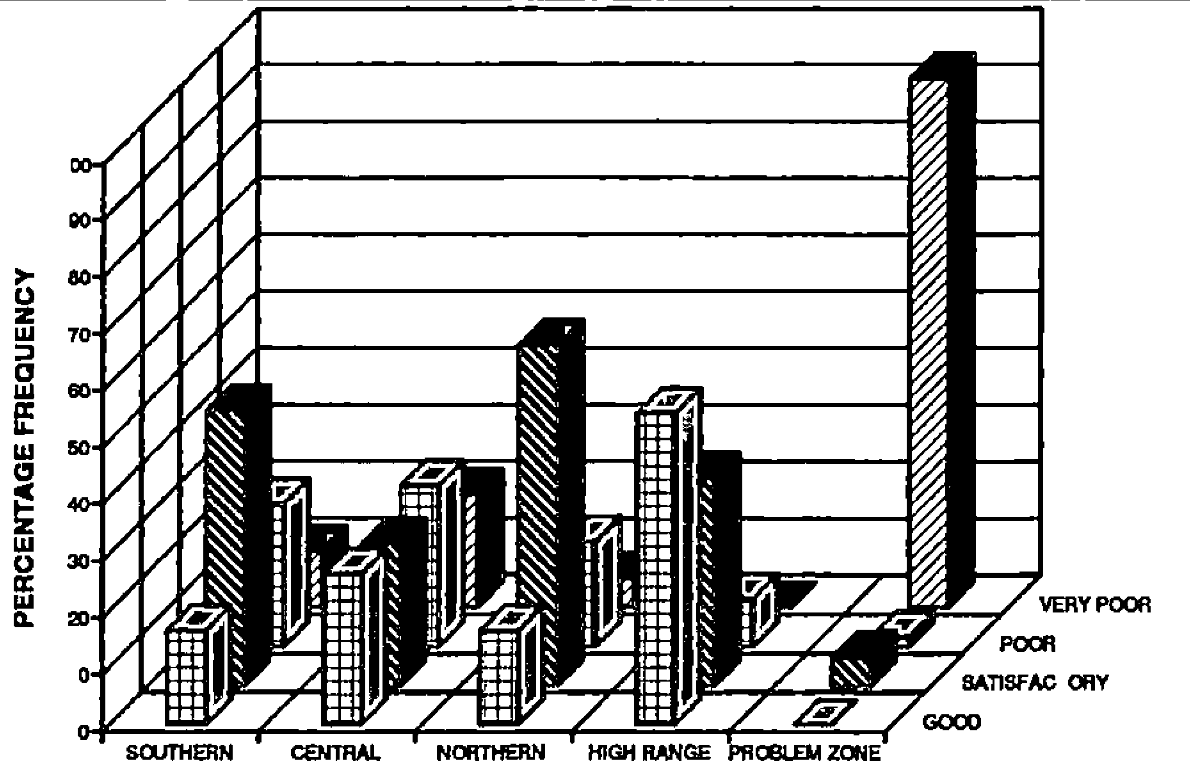

Fig 8 COMPARISON OF ZONES BASED ON USE OF ORGANIC MANURES

Table 9 Dıstrıbutıon of farmers based on the use of organıc manures ın the dıfferent NARP Zones

Zone (n-60/ zone)	Categorıes							
	Very poor (≤ 35 87)		Poor (35 88 63 28)		Satısfactory (63 29 80 89)		Good (>80 89)	
	F	%	F	%	F	%	F	%
SZ	6	10 00	15	25 00	29	48 33	10	16 67
CZ	12	20 00	17	28 33	15	25 00	16	26 67
NZ	3	5 00	11	18 33	36	60 00	10	16 67
HZ	0		5	8 33	22	36 67	33	55 00
PZ	56	93 33	1	1 66	3	5 00	0	

χ^2 231 27**

** Sıgnıfıcant at 1 per cent level of sıgnıfıcance

Table 10 Distribution of farmers based on the dimensions of nitrogenous fertilizer use behaviour

(n 300)

Sl No	Dimension	Categories	F	%
1	Quantity	Very poor (≤ 0 32)	62	20 67
		Poor (0 33 0 56)	69	23 00
		Satisfactory (0 57 0 81)	122	40 67
		Good (> 0 82)	47	15 67
2	Time of application	Very poor (≤ 0 57)	37	12 33
		Poor (0 58 0 77)	55	18 33
		Satisfactory 0 78 0 92)	99	33 00
		Good (≥ 0 93)	109	36 33
3	Split application	Very poor (≤ 0 40)	74	24 67
		Poor (0 41 0 69)	66	22 00
		Satisfactory (0 70 0 92)	60	20 00
		Good (> 0 93)	100	33 33
4	Type of fertilizer	Very poor (< 0 49)	20	6 67
		Poor (0 50 0 75)	86	28 67
		Satisfactory (0 76 0 92)	153	51 00
		Good (> 0 93)	41	13 67
5	Method of application	Very poor (≤ 0 26)	279	93 00
		Poor (0 27 0 47)	14	4 67
		Satisfactory (0 48 0 67)	7	2 33
		Good (≥ 0 68)	0	
6	Related management practices	Very poor (< 0 38)	26	8 67
		Poor (0 39 0 55)	102	34 00
		Satisfactory (0 56 0 75)	136	45 33
		Good (0 76)	36	12 00

category while 40 67 per cent of the farmers were in satisfactory category More than 20 per cent of farmers came under poor and very poor categories respectively (Fig 9)

Table 11 presents the distribution of farmers in the different NARP zones under the four categories in relation to the different dimensions of nitrogenous fertilizers

It could be observed from the Table that 38 33 per cent of the farmers in the Problem Zone were in the category of good with respect to the use of recommended quantity of nitrogenous fertilizers while farmers in the Southern Zone and Northern Zone were low in this aspect with only 5 00 and 6 67 per cent under the good category The high significant value of X^2 (241 33) indicated the significant region specificity of the se of quartity of nitrogenous fertilizer by the farmers

Table 12 depicts the comparison of NARP zones based on the mean and C V values of the various dimensions of nitrogenous fertilizer use In the case of the quantity of application of nitrogenous fertilizers the Problem Zone had the highest mean (0 824) with lowest C V (12 97%) followed by the Central Zone The lowest mean (0 318) and highest C V (81 76%) was observed in the case of Southern Zone High and

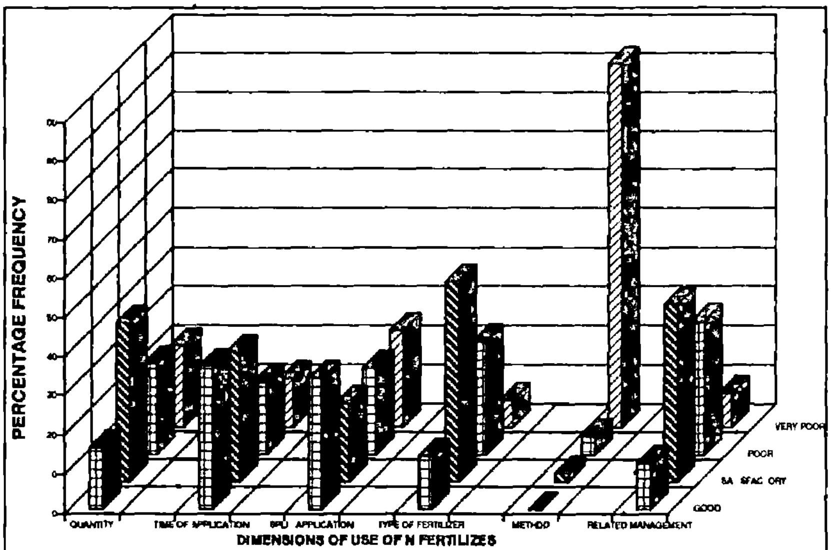

Fig 9 DISTRIBUTION OF FARMERS BASED ON DIMENSIONS OF USE OF N FERTILIZERS

Table 11 Zone wise distribution of farmers into various categories on the basis of the dimensions of nitrogenous fertilizer use behaviour

Sl No	Dimension	Zone (n 60/ zone)	Categories								
			Very poor		Poor		Satisfactory		Good		
			F	%	F	%	F	%	F	%	
			(≤ 0 32)		(0 33 0 56)		(0 57 0 81)		(≥0 82)		
1	Quantity applied	SZ	36	60 00	17	28 00	4	6 67	3	5 00	
		CZ	3	5 00	2	3 33	45	75 00	10	16 67	
		NZ	16	26 67	32	53 33	8	13 33	4	6 67	
		HZ	7	11 67	16	26 67	30	50 00	7	11 67	χ^2 241 33**
		PZ	0		2	3 33	35	58 33	23	38 33	
			(≤ 0 57)		(0 58 0 77)		(0 78 0 92)		(>0 93)		
2	Time of application	SZ	16	26 67	15	25 00	13	21 67	16	26 67	
		CZ	12	20 00	22	36 60	9	15 00	17	28 33	
		NZ	3	5 00	10	16 67	25	41 67	22	36 67	
		HZ	5	8 33	7	11 67	18	30 00	30	50 00	χ^2 110 33**
		PZ	1	1 67	1	1 67	34	56 67	24	40 00	
			(≤ 0 40)		(0 41 0 69)		(0 70 0 90)		(≥0 91)		
3	Split application	SZ	32	53 33	18	30 00	4	6 67	6	10 00	
		CZ	1	1 67	7	11 67	27	45 00	25	41 67	
		NZ	28	46 67	21	35 00	9	15 00	2	3 33	
		HZ	12	20 00	19	31 67	6	10 00	23	38 33	χ^2 187 86**
		PZ	1	1 67	1	1 67	14	23 33	44	73 33	
			(≤ 0 49)		(0 50 0 75)		(0 76 0 92)		(≥0 93)		
4	Type of fertilizer	SZ	13	21 67	16	26 67	4	6 67	6	10 00	
		CZ	1	1 67	13	21 67	27	45 00	25	41 67	
		NZ	5	8 33	46	76 67	9	15 00	2	3 33	
		HZ	1	1 67	10	16 67	6	10 00	23	38 33	χ^2 747 33**
		PZ	0		1	1 67	14	23 33	44	73 33	

Contd

Table 11 (Contd)

Sl No	Dimension	Zone (n 60/ zone)	Categories									
			Very poor		Poor		Satisfactory		Good			
			F	%	F	%	F	%	F	%		
			(≤ 0 26)		(0 27 0 47)		(0 48 0 67)		(≥0 68)			
5	Method of application	SZ	59	98 33	0		1	1 67	0			
		CZ	53	88 33	3	5 00	4	6 67	0			
		NZ	60	100 00	0		0		0			
		HZ	55	91 67	5	8 33	0		0		χ^2	166 93**
		PZ	52	86 67	6	10 00	2	3 33	0			
			(≤0 38)		(0 39 0 55)		(0 56 0 75)		(≥0 76)			
6	Related management practices	SZ	10	16 67	21	35 00	25	41 67	4	6 67		
		CZ	0		24	40 00	25	41 67	11	18 33		
		NZ	9	15 00	28	46 67	22	36 67	1	1 67		
		HZ	7	11 67	25	41 67	23	38 33	5	8 33	χ^2	154 533**
		PZ	0		4	6 67	41	68 33	15	25 00		

** Significant at 1 per cent level of significance

1	Quantity	PZ	0 824	12 13	
		CZ	0 731	12 97	
		HZ	0 607	32 95	CD 0 0688
		NZ	0 448	46 88	F 68 816**
		SZ	0 318	81 76	
2	Time of applicat on	PZ	0 910	9 89	
		HZ	0 859	23 28	
		CZ	0 839	19 07	CD 0 0816
		NZ	0 685	39 42	F 13 219**
		SZ	0 675	48 89	
3	Split application	PZ	0 948	11 60	
		CZ	0 852	18 78	
		HZ	0 725	35 86	CD 0 0792
		NZ	0 504	45 63	F 58 781**
		SZ	0 440	65 90	
4	Type of fertilizer	PZ	0 842	5 93	
		HZ	0 802	16 95	
		CZ	0 795	10 06	CD 0 0025
		SZ	0 681	49 93	F 12 421**
		NZ	0 634	31 55	
5	Method of application	PZ	0 053	264 15	
		CZ	0 053	264 15	
		HZ	0 040	250 00	CD 0 0375
		SZ	0 008	750 00	F 68 816**
		NZ	0 005	600 00	
6	Related management practices	PZ	0 6 8	14 75	
		CZ	0 602	21 60	
		HZ	0 544	29 41	CD 0 059
		SZ	0 494	40 58	F 15 078**
		NZ	0 478	33 47	

significant F value indicated significant difference among zones

b Time of application

Regarding the time of application of nitrogenous fertilizers 36 33 per cent of the farmers were found under good and satisfactory use categories respectively while 18 33 and 12 33 per cent of the farmers came under the poor and very poor categories respectively (Table 10 and Fig 9)

From the Table 11 it could be noticed that the High Range Zone was having the highest per cent of farmers (50 00%) under good level of use with regard to the time of application followed by Problem Zone (40 00%) High significant χ^2 value (110 33**) was also observed

The Problem Zone had the highest mean (0 910) and lowest C V (9 89%) while the Southern Zone was lagging behind with a lowest mean value of 0 675 and a high C V or 48 89 per cent

Significant value of F (13 229) observed in this comparison indicated that there were significant differences among the zones with regard to the time of application of nitrogenous fertilisers c Split application

With respect to the split application of nitrogenous fertilizers the distribution of farmers observed was as 33 33 per cent under good 20 00 per cent under satisfactory 22 00 per cent under poor and 24 67 per cent under very poor categories (Fig 9)

The Problem Zone was observed to have 73 33 per cent of farmers under good category regarding use of split application followed by the Central Zone The Northern Zone was the one with lowest per cent of farmers under good category with respect to use of split application (3 33%) High χ^2 value observed is an evidence for the high association between different zones and the use of split application

The comparison of zones using mean and C V also indicated that the Problem Zone had the highest mean (0 948) and a low C V (11 60%) The Southern Zone had the highest C V and lowest mean for this dimension (65 90% and 0 440 respectively)

The significant F value (58 781) indicated that these was significant difference among the zones with regard to the split applications of nitrogenous fertilizers d Type of fertilizers used

In the case of type of fertilisers used only 13 67 per cent of the farmers came under the category of good use while more than 50 00 per cent of the farmers were found under the satisfactory level 28 67 and 6 67 per cent of the farmers were in poor and very poor categories respectively (Table 10 and Fig 9)

The Problem Zone had highest percentage of farmers with good level of use in respect of type of fertilisers (73 33%) followed by the Central Zone (41 67%) The significant χ^2 indicated that the distribution of farmers under different categories in the different zones were not identical The significant chi square value is an indication of the region specificity of this practice

The Problem Zone had the highest mean while the Northern Zone had the lowest mean (0 842 and 0 634 respectively) The significant value of F indicated significant differences among zones

e Method of application

The results in Table 10 indicate that ninety three per cent of the farmers were in the very poor category with regard to the method of application of nitrogenous fertilisers There were no farmers under the good level of use of method of application Only 2 33 per cent of farmers had satisfactory level under the method of application (Fig 9)

Table 12 indicates that in all the 5 NARP zones for the method of application of nitiogenous fertilizers the mean use was very low and the C V values very high Among the five zones the Problem Zone and the Central Zone were better with mean values of 0 053 and C V of 264 15 per cent

The significantly high χ^2 value and significant F value (68 82) indicated the region specificity and the heterogenity among the zones with regard to the method of application of nitrogenous fertilizers

f Related management practices

A perusal of Table 10 reveals that the majority of the farmers were in the satisfactory and good categories with respect to the related management practices (45 33 and 12 00% respectively) while 34 00 and 8 67 per cent of farmers were found to be in poor and very poor categories respectively (Fig 9)

Table 11 further points out that among the NARP Zones the Problem Zone had the highest per cent (25 00%) of farmers under good level of use the owest being the Northern Zone The results in Table 12 also indicate that the Problem Zone had the highest mean and lowest C V values (0 678 and 14 75%) while the Northern Zone had the lowest mean (0 478) and high C V value (33 47%) High F value obtained indicates the significant differences among the zones with regard to the use of related management practices

Based on the significant F values obtained for all the six dimensions of nitrogenous fertilizer use behaviour the hypothesis that there would be no significant difference among the zones with regard to the use behaviour of different dimensions of fertiliser use was rejected

4 1 2b Dimension-wise analysis of phosphatic fertilizer use behaviour

The distribut on of farmers based on the dimensions of phosphatic fertilizer use behaviour is presented in Table 13 The zone wise comparison of these dimensions could be obtained from Tables 14 and 15

a Quantity

It was found that 16 00 and 47 33 per cent of the farmers were in good and satisfactory categories respectively with regard to quantity of phosphatic fertilisers

Table 13 Dıstrıbutıon of farmers based on the dımensıons of phosphatıc fertılızer use behavıour

(n 300)

Sl No	Dımensıon	Categorıes	F	%
1	Quantıty	Very poor (≤0 43)	49	16 33
		Poor (0 44-0 67)	61	20 33
		Satısfactory (0 68 0 92)	142	47 33
		Good (≥0 93)	48	16 00
2	Tıme of applıcatıon	Very poor (≤0 45)	44	14 67
		Poor (0 46-0 71)	74	24 67
		Satısfactory (0 72 0 94)	71	23 67
		Good (≥0 95)	111	37 00
3	Type of fertılıser	Very poor (≤0 41)	15	5 00
		Poor (0 42 0 61)	65	21 67
		Satısfactory (0 62-0 83)	178	59 33
		Good (≥0 84)	42	14 00
4	Related management practıces	Very poor (≤0 42)	25	8 33
		Poor (0 43 0 61)	84	28 00
		Satısfactory (0 62 0 83)	171	57 00
		Good (≥0 84)	20	6 67

Table 14 Zone wise distribution of farmers based on the dimensions of phosphatic fertilizer use

Sl No	Dimension	Zone (n 60/ zone)	Very poor F	Very poor %	Poor F	Poor %	Satisfactory F	Satisfactory %	Good F	Good %	
			($\leq$0 32)		(0 33 0 56)		(0 57 0 81)		($\geq$0 82)		
1	Quantity applied	SZ	13	21 67	25	41 67	10	16 67	12	20 00	
		CZ	9	15 00	11	18 33	32	53 33	8	13 33	
		NZ	13	21 67	17	28 33	24	40 00	6	10 00	
		HZ	13	21 67	6	10 00	32	53 33	9	15 00	χ^2 155 38**
		PZ	1	1 67	2	3 33	44	73 33	13	21 67	
			($\leq$0 45)		(0 46 0 71)		(0 72 0 94)		($\geq$0 95)		
2	Time of application	SZ	13	21 67	17	28 33	11	18 33	19	31 67	
		CZ	4	6 67	10	16 67	20	33 33	26	43 33	
		NZ	14	23 33	24	40 00	7	11 67	15	25 00	
		HZ	12	20 00	11	18 33	10	16 67	27	45 00	χ^2 68 13**
		PZ	1	1 67	12	20 00	23	38 33	24	40 00	
			($\leq$0 41)		(0 42 0 61)		(0 62 0 83)		($\geq$0 84)		
3	Type of fertilizer applied	SZ	2	3 33	8	13 33	23	38 33	27	45 00	
		CZ	1	1 67	28	46 67	30	50 00	1	1 67	
		NZ	5	8 33	20	33 33	29	48 33	6	10 00	
		HZ	7	11 67	1	1 67	47	78 33	5	8 33	χ^2 304 8**
		PZ	0		8	13 33	49	81 67	3	5 00	
			($\leq$0 42)		(0 43 0 61)		(0 62 0 84)		($\geq$0 85)		
4	Related management practices	SZ	4	6 67	21	35 00	34	56 67	1	1 67	
		CZ	2	3 33	24	40 00	27	45 00	7	11 67	
		NZ	9	15 00	26	43 33	25	41 67	0		
		HZ	9	15 00	10	16 67	39	65 00	2	3 33	χ^2 244 44**
		PZ	1	1 67	3	5 00	46	76 67	10	16 67	

** Significant at 1 per cent level of significance

Table 15 Comparison of NARP Zones based on the dimensions of phosphatic fertiliser use

Sl No	Dimensions	Zone (n 60/ zone)	Mean	C V	
1	Quantity	PZ	0 818	14 67	
		CZ	0 707	29 70	
		HZ	0 654	42 81	CD 0 084
		NZ	0 624	40 00	F 7 97*
		SZ	0 604	44 70	
2	Time of application	CZ	0 853	22 27	
		PZ	0 837	17 92	
		HZ	0 724	41 16	CD 0 089
		NZ	0 724	45 58	F 6 933**
		SZ	0 714	37 82	
3	Type of fertilisers	SZ	0 813	27 06	
		PZ	0 670	8 96	
		HZ	0 620	40 32	CD 0 0640
		NZ	0 617	30 79	F 13 595**
		CZ	0 610	18 03	
4	Related management practices	PZ	0 817	15 91	
		CZ	0 747	29 45	
		SZ	0 708	31 07	CD 0 0933
		HZ	0 570	57 89	F 50 875**
		NZ	0 214	158 88	

* Significant 5 per cent level of significance

** Significant at 1 per cent level of significance

used Only 20 33 and 16 33 per cent of farmers were found in the poor and very poor categories respectively (Table 13 and Fig 10)

Table 14 makes it clear that the Problem Zone had the highest percentage of farmers with good category of use (21 67%) while the Northern Zone had the lowest (10 00%) This is further corroborated by data in Table 15 wherein it is shown that the Problem Zone has the highest mean use level with the lowest C V (14 67%) The F value (7 97) was also significant

b Time of application

A perusal of Table 13 reveals that 37 00 and 23 67 per cent of the farmers were in good and satisfactory categories respectively while 24 67 and 14 67 per cent were in poor and very poor categories in relation to the time of application of phosphatic fertilizers (Fig 10)

Among the different NARP Zones the High Range Zone had the highest percentage of farmers under good category (45 00%) followed by Central Zone (43 33%) and Problem Zone (40 00%) High and significant chi square value of 68 13 also established the significant association between the zonal distribution of farmers and the time of application of phosphatic fertilisers among the farmers (Table 14)

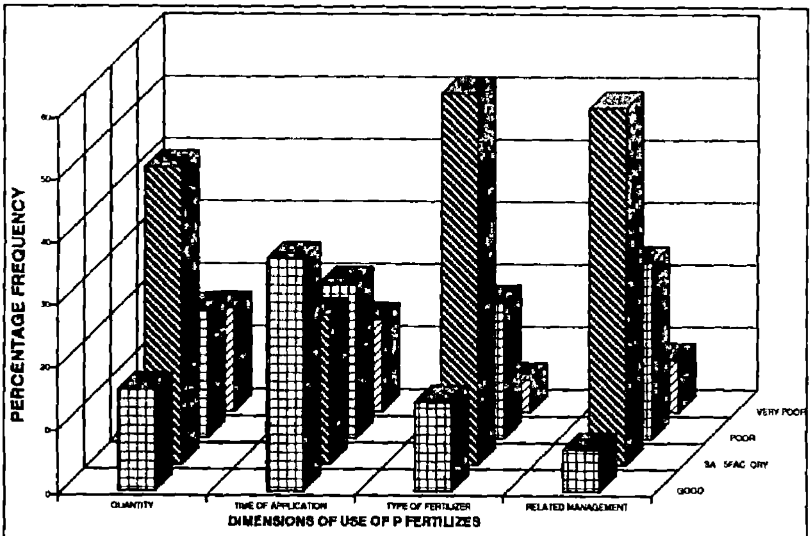

Fig 10 DISTRIBUTION OF FARMERS BASED ON DIMENSIONS OF PHOSPHATIC FERTILIZER USE

Table 15 indicates that the Central Zone had the highest mean value of 0 853 and C V of 22 27 per cent followed by Problem Zone with a mean value of 0 837 and the lowest C V (17 92%) The F value was also found to be significant

c Type of fertilizer

With respect to the type of fertilisers used it could be observed that 14 00 and 59 33 per cent of the farmers were found to be in good and satisfactory categories while 21 67 and 5 00 per cent in poor and very poor categories (Table 13 and Fig 10)

The data in Table 14 also indicate that in the Southern Zone 45 00 and 38 33 per cent of farmers were in good and satisfactory categories respectively with respect to the type of phosphatic fertilisers used The high and significant χ^2 value obtained indicated the significant association between locational variation of farmers and the component of phosphatic fertilizer use behaviour by the farmers

d Related management practices

Table 13 indicates that only 6 67 per cent of the farmers were under good level of use while 57 00 per cent had satisfactory level regarding the use of related management practices of phosphatic fertiliser application It was observed that 28 00 and 8 33 per cent of farmers were in poor and very poor categories (Fig 10)

On comparing the NARP Zones (Table 14) it could be observed that the Northern Zone had no farmer under good use level of related management practices The Problem Zone had 76 67 and 16 67 per cent of farmers under satisfactory and good categories respectively This was further established by the data in Table 15 which indicates that the Problem Zone had the highest mean value of 0 817 and lowest C V of 15 91 per cent while the Northern Zone had the lowest mean of 0 214 and highest C V of 158 88 per cent High F value (50 875) indicated the significant difference existing among the zones with regard to the use of these practices

4 1 2 c Dimension-wise analysis of potassic fertilizer use behaviour

Table 16 outlines the distribution of farmers in the different NARP Zones based on the various dimensions of potassic fertiliser use while Tables 17 and 18 compare the different zones based on the use behaviour of farmers with respect to various dimensions

Table 16 Dıstrıbutıon of farmers based on the dımensıons of potassıc fertılızer use

(n 300)

Sl No	Dımensıon	Categories	F	%
1	Quantıty	Very poor (≤0 39)	72	24 00
		Poor (0 40 0 69)	38	12 67
		Satısfactory (0 70 0 84)	129	43 00
		Good (≥0 85)	61	20 33
2	Tıme of applıcatıon	Very poor (≤0 43)	71	23 67
		Poor (0 44 0 63)	16	5 33
		Satısfactory (0 64 0 89)	88	29 33
		Good (≥0 90)	125	41 67
3	Splıt applıcatıon	Very poor (≤0 34)	70	23 33
		Poor (0 35 0 62)	97	32 33
		Satısfactory (0 63 0 94)	23	7 67
		Good (≥0 95)	110	36 67
4	Type of fertılızer	Very poor (≤0 56)	66	22 00
		Poor (0 57 0 80)	57	19 00
		Satısfactory (0 81 0 98)	27	9 00
		Good (≥0 99)	150	50 00
5	Related management practıces	Very poor (≤0 39)	74	24 67
		Poor (0 40 0 67)	69	23 00
		Satısfactory (0 68 0 82)	94	31 33
		Good ≥0 83)	63	21 00

Table 17 Zonewise distribution of farmers based on the dimensions of potassic fertilizer use

Sl No	Dimension	Zone (n 60/ zone)	Very poor F	Very poor %	Poor F	Poor %	Satisfactory F	Satisfactory %	Good F	Good %	
			(≤0 39)		(0 40 0 69)		(0 70 0 84)		(≥0 85)		
1	Quantity applied	SZ	5	8 33	14	23 33	26	43 33	15	25 00	
		CZ	7	11 67	7	11 67	27	45 10	19	31 67	
		NZ	43	71 67	3	5 00	11	18 33	3	5 00	
		HZ	14	23 33	13	21 67	26	43 33	7	11 67	χ^2 128 533**
		PZ	3	5 00	1	1 67	39	65 00	17	28 33	
			(≤0 43)		(0 44 0 63)		(0 64 0 89)		(≥0 90)		
2	Time of application	SZ	14	23 33	5	8 33	20	33 33	21	35 00	
		CZ	2	3 33	7	11 67	13	21 67	38	63 33	
		NZ	42	70 00	2	3 33	8	13 33	8	13 33	χ^2 144 823**
		HZ	13	21 67	1	1 67	17	28 33	29	48 33	
		PZ	0		1	1 67	30	50 00	29	48 33	
			(≤ 0 34)		(0 35 0 62)		(0 63 0 94)		(≥0 95)		
3	Split application	SZ	3	5 00	32	53 33	4	6 67	21	35 00	
		CZ	2	3 33	36	60 00	5	8 33	17	28 33	
		NZ	42	70 00	14	23 33	2	3 33	2	3 33	χ^2 134 71**
		HZ	23	38 33	7	11 67	4	6 67	26	43 33	
		PZ	0		8	13 33	8	13 33	44	73 33	
			(≤0 56)		(0 57 0 80)		(0 81 0 98)		(>0 99)		
4	Type of fertilizer	SZ	1	1 67	13	21 66	1	1 67	45	75 00	
		CZ	1	1 67	18	30 00	10	16 67	31	51 67	
		NZ	47	78 33	6	10 00	2	3 33	5	8 33	χ^2 213 41**
		HZ	17	28 33	13	21 67	3	5 00	27	45 00	
		PZ	0		7	11 67	11	18 33	42	70 00	
			≤0 49)		(0 50 0 67)		(0 68 0 82)		(≥0 83)		
5	Related management practices	SZ	9	15 00	18	30 00	27	45 00	6	10 00	
		CZ	3	5 00	18	30 00	22	36 67	17	28 33	
		NZ	44	73 33	10	16 67	4	6 67	2	3 33	χ^2 156 70**
		HZ	18	30 00	4	6 67	18	30 00	20	33 33	
		PZ	0		2	3 33	32	53 33	26	43 33	

Table 18 Comparison of NARP Zones based on the dimensions of potassic fertiliser use

Sl No	Dimensions	Zones (n 60/ zone)	Mean	C V	
1	Quantity	PZ	0 817	15 91	
		CZ	0 747	29 45	
		SZ	0 708	31 07	CD 0 0933
		HZ	0 570	57 89	F 50 875**
		NZ	0 214	158 88	
2	Time of application	PZ	0 910	6 89	
		CZ	0 886	21 44	
		SZ	0 717	37 66	CD 0 1049
		HZ	0 716	54 47	F 47 676**
		NZ	0 260	153 846	
3	Split application	PZ	0 912	19 74	
		SZ	0 67	38 41	
		CZ	0 655	38 16	CD 0 1006
		HZ	0 628	63 69	F 54 005**
		NZ	0 179	156 42	
4	Type of fertilizer	PZ	0 956	7 32	
		SZ	0 920	18 48	
		CZ	0 879	20 48	CD 0 0946
		HZ	0 684	57 02	F 77 026**
		NZ	0 232	155 17	
5	Related management practices	PZ	0 795	12 58	
		CZ	0 696	24 43	
		S	0 672	26 79	CD 0 0808
		HZ	0 528	56 8	F 61 988**
		NZ	0 204	151 92	

** Significan at 1 per cent level of significance a Quantity applied

It could be observed from Table 16 that about 43 00 per cent of the farmers were found in the satisfactory category while only 20 33 per cent in good category with regard to the quantity of potassic fertiliser used (Fig 11)

Among the five NARP Zones the Central Zone had 31 67 per cent of farmers under good category while the Northern Zone had only 5 00 per cent under this category with respect to the quantity of potassic fertilizers applied High X^2 value indicates the significant association between each zone and the potassic fertiliser use behaviour of farmers (Table 17) But in comparison using mean and C V the Problem Zone had the highest mean value (0 817) and the lowest C V value (15 91%) The Central Zone had a mean value of 0 747 and C V value of 29 45 per cent The lowest mean (0 214) and highest C V (158 88%) were observed in the Northern Zone

The significant difference among the zones were indicated by the significant F value (50 875)

b Time of application

Table 16 reveals that 41 67 and 29 33 per cent of farmers were under good and satisfactory levels of use respectively in relation to time of application of potassic fertilisers while 5 33 and 23 67 per cent were in poor and very poor categories (Fig 11)

The Central Zone had a large number of farmers under good category (63 33%) followed by the Problem Zone and High Range Zone (each with 48 33%) However on comparing mean and C V values the Problem Zone stood first with mean value of 0 910 and C V of 6 89 per cent while the Central Zone had a mean value of 0 886 and C V value of 21 44 per cent A mean value of 0 260 and C V of 153 85 per cent was observed in the case of the Northern Zone with regard to the time of application of potassic fertilisers Significant F value indicated the significant difference among the zones

c Split applications

Only 36 67 and 7 67 per cent of farmers were found to be in good and satisfactory groups regarding the split application of potassic fertilizer (Table 16 and Fig 11) A perusal of the Tables 17 and 18 indicates superior position of the Problem Zone with respect to split application As much as 73 33 per cent of farmers were under good category (mean 0 912 and C V 19 74%) while only 3 33 per cent of farmers in the Northern Zone came under good category (mean 0 179 and C V 156 42%) High and significant F value establishes the

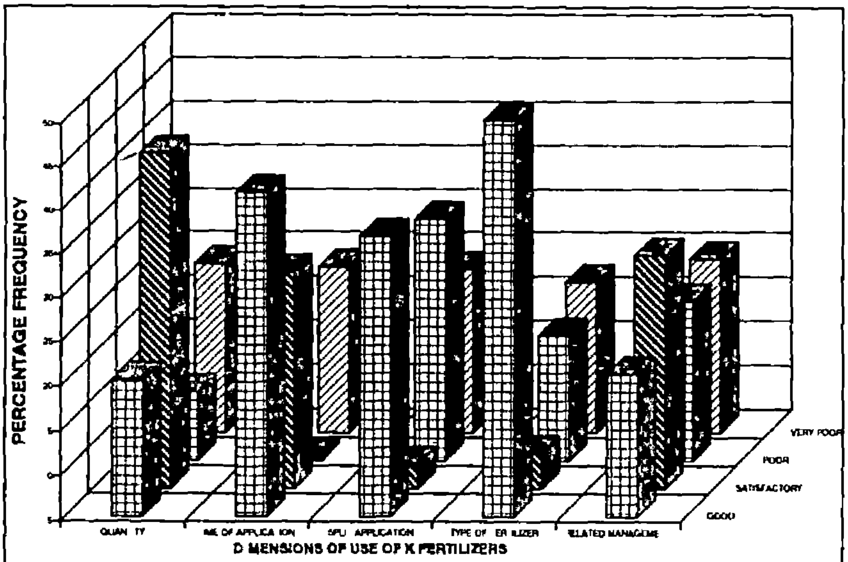

Fig 11 DISTRIBUTION OF FARMERS BASED ON DIMENSIONS OF POTASSIC FERTILIZER USE

significant difference among the NARP Zones with respect to the split application of potassic fertilizers

d Type of fertiliser

One-half of the number of respondents were found to be in good level of use with regard to the type of potassic fertilisers (Table 16 and Fig 11)

Three fourth of the farmers were distributed under good category in the case of Southern Zone while only 8 33 per cent came under this category in the Northern Zone with respect to the type of potassic fertilizers used

The Problem Zone had the highest mean and lowest C V values (0 956 and 7 32%) with regard to the type of potassic fertilizers used The Northern Zone had a mean value of 0 232 and C V of 155 17 per cent

Significant differences among the regions were indicated by the significant F value obtained

e Related management practices

As much as 21 00 and 31 33 per cent of farmers were found distributed under good and satisfactory groups respectively with regard to the use of related management practices in respect of potassic fertiliser use (Fig 11)

Among the zones the Problem Zone had the highest percentage of farmers under good category with respect to use of related management practices (43 33%)

The result in Table 18 also revealed that the Problem Zone stood first with respect to use of this dimension with a mean of 0 795 and C V of 12 58 per cent while Northern Zone was at the bottom

A significant F value noticed in the case of this dimension also indicated substantial differences among the regions with regard to the use of related management practices of potassic fertilisers

Based on the F values obtained for all the five dimensions of the potassic fertiliser use behaviour the hypothesis that there is no significant difference among the zones with respect to the different dimensions of fertilizer use is rejected

4 1 2 d Dimension wise analysis of organic manure use behaviour

Table 19 presents the distribution of farmers based on the dimensions of organic manure use Tables 20 and 21 compare the organic manure use behaviour in the different NARP Zones

Table 19 Distribution of farmers based on the dimensions of organic manure use

(n 300)

Sl No	Dimension	Categories	F	%
1	Quantity applied	Very poor (≤0 42)	98	32 67
		Poor (0 43 0 67)	81	27 00
		Satisfactory (0 68-0 83)	67	22 33
		Good (≥0 84)	54	18 00
2	Time of application	Very poor (≤0 42)	73	24 33
		Poor (0 43 0 78)	43	14 33
		Satisfactory (0 79 0 95)	62	20 67
		Good (≥0 96)	122	40 67
3	Related management practices	Very poor (≤0 43)	85	28 33
		Poor (0 44 0 69)	112	37 33
		Satisfactory (0 70 0 81)	74	24 67
		Good (≥0 82)	29	9 67

Table 20 Distribution of farmers in the NARP Zones based on the dimensions of use of organic manures

Sl No	Dimension	Zones (n 60/ zone)	Categories									
			Very poor		Poor		Satisfactory		Good			
			F	%	F	%	F	%	F	%		
			(≤0 42)		(0 43 0 67)		(0 68-0 83)		(≥0 84)			
1	Quantity applied	SZ	1	1 67	18	30 00	24	40 00	17	28 33		
		CZ	23	38 33	23	38 33	8	13 33	6	10 00		
		NZ	9	15 00	32	53 33	12	20 00	7	11 67	χ^2	152 63**
		HZ	7	11 67	6	10 00	23	38 33	24	40 00		
		PZ	58	96 67	2	3 33	0		0			
			(≤0 42)		(0 43 0 78)		(0 79 0 95)		(≥0 96)			
2	Time of application	SZ	3	5 00	12	20 00	5	8 33	40	66 67		
		CZ	12	20 00	11	18 33	21	35 00	16	26 67		
		NZ	2	3 33	7	11 67	19	31 67	32	53 33	χ^2	206 66**
		HZ	0		13	21 67	16	26 67	31	51 67		
		PZ	56	93 33	0		1	1 67	3	5 00		
			(≤0 43)		(0 44 0 69)		(0 70 0 81		(≥0 82)			
3	Related management practices	SZ	1	1 67	20	33 33	22	36 67	17	28 33		
		CZ	12	20 00	16	26 67	25	41 67	7	11 67		
		NZ	10	16 67	48	80 00	1	1 67	1	1 67	χ^2	242 17**
		HZ	6	10 00	28	46 67	24	40 00	2	3 33		
		PZ	56	93 33	0		2	3 33	2	3 33		

** Significant at 1 per cent level of significance

Table 21 Comparison of NARP Zones based on the dimensions of organic manure use

Sl No	Dimensions	Zones (n-60/ zone)	Mean	C V	
1	Quantity applied	HZ	0 705	28 37	
		SZ	0 614	35 83	
		NZ	0 609	36 12	CD-0 0784
		CZ	0 532	56 39	** F 114 015
		PZ	0 029	379 30	
2	Time of application	HZ	0 933	11 71	
		SZ	0 917	19 63	
		NZ	0 877	22 81	CD-0 0839
		CZ	0 690	52 17	** F 148 352
		PZ	0 063	380 95	
3	Related management practices	HZ	0 711	30 94	
		SZ	0 695	139 57	
		NZ	0 663	21 21	CD 0 1720
		CZ	0 593	52 28	** F 19 796
		PZ	0 056	375 00	

** = Significant at 1 per cent level of significance a Quantity

It could be seen from Table 19 that 18 00 and 22 33 per cent of farmers respectively were in good and satisfactory categories while 27 00 and 32 67 per cent respectively were under poor and very poor categories with respect to the quantity of organic manure used (Fig 12)

When the NARP Zones are compared (Table 20) it is seen that the High Range Zone had 40 00 and 38 33 per cent of farmers respectively under good and satisfactory level of organic manure use A large majority (96 67%) of farmers in the Problem Zone were in very poor category with the rest distributed under the poor category with respect to the quantity of organic manure used

Table 21 indicates that with respect to the quantity of organic manure the High Range Zone had the highest mean and lowest C V (0 705 and 28 37%) High and significant value of F indicated significant differences among the zones

b Time of application

It can be seen from the Table 19 that 40 67 and 20 67 per cent of the farmers were under categories of good and satisfactory use behaviour respectively in respect of the time of application of organic manure However 14 33 and

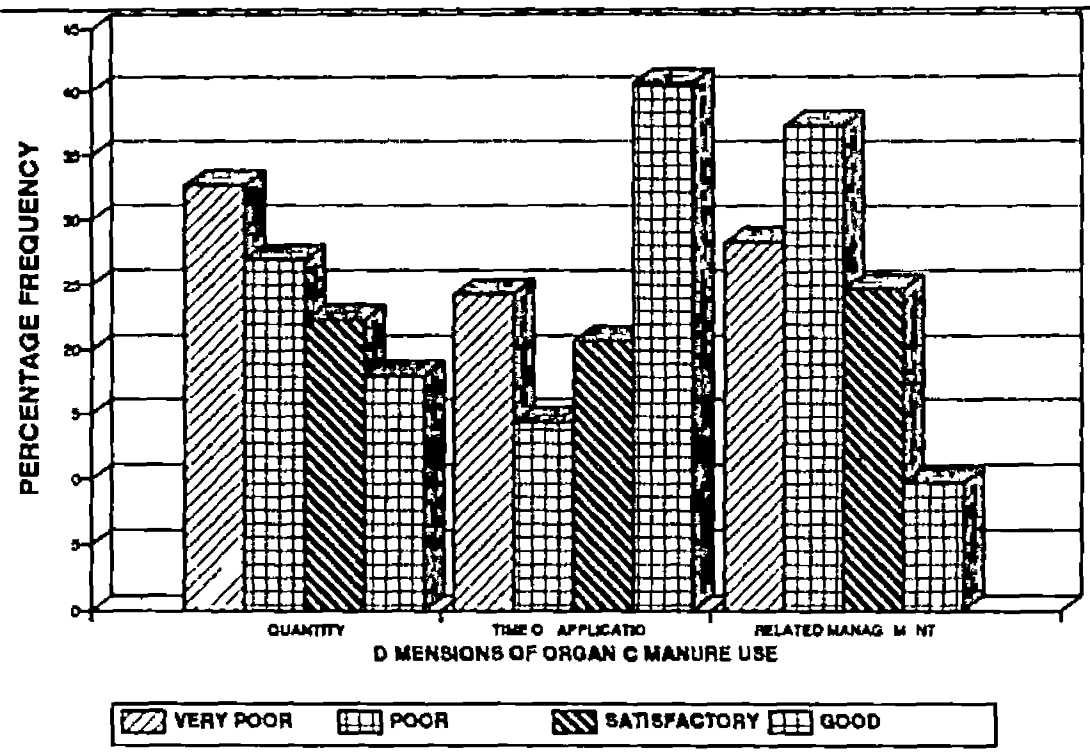

Fig 12 DISTRIBUTION OF FARMERS BASED ON DIMENSIONS OF ORGANIC MANURE USE

24 33 per cent of the farmers were found to be in poor and very poor categories (Fig 12)

The data in Table 20 show that 66 67 53 33 and 51 67 per cent of farmers of the Southern Zone Northern Zone and High Range Zone respectively were under good category with respect to the time of application of organic manure A large number of farmers in the Problem Zone (93 30%) were under very poor category

It has been found that High Range Zone had the highest mean and lowest C V (0 939 and 11 71%) while the Problem Zone had the lowest mean and high C V (0 029 and 379 30%) in respect of time of application The significant F value indicated significant difference among the zones with regard to the time of application of organic manure (Table 21)

c Related management practices

Only 9 67 and 24 67 per cent of the farmers were found under good and satisfactory categories regarding the use of related management practices in respect of organic manure It was found that 37 33 and 28 33 per cent of farmers were under poor and very poor categories respectively (Table 19 and Fig 12)

Table 20 reveals that in the Southern Zone 28 33 and

36 67 per cent of farmers were distributed under good and satisfactory categories respectively In the Central Zone 11 67 and 41 67 per cent of the farmers were in good and satisfactory categories respectively Eighty per cent of the farmers in the Northern Zone were found to be in the poor use category while in the Problem Zone 93 33 per cent of the farmers were observed to be under very poor category

Among the zones the High Range Zone had the highest mean and lowest C V (0 711 and 30 94%) while the Problem Zone had the lowest mean and highest C V (0 056 and 375 00%) The high and significant value of F establishes the significant d fference existing among the different zones (Table 21)

4 1 3 Principal Component Analysis of Fertilizer Use Behaviour

4 1 3 1 Factor Loadings of Composite Fertiliser Use Behaviour Index (CFUBI)

Table 22 depicts the results of the Principal Component Analysis (PCA) of CFUBI generated from the data on fertiliser use behaviour The results show that more than fifty per cent (53 80%) of variability in fertiliser use behaviour could be explained by the first principal component of the data on the fertiliser use behaviour indices The

Table 22 Factor loadings of composite fertilizer use behaviour index

Item	P I	P II	P III	P IV
N index	0 633	0 008	0 711	0 306
P index	0 474	0 174	0 516	0 693
K index	0 895	0 397	-0 206	0 019
OM index	0 605	0 789	0 102	0 035
Percentage variability explained	53 796	27 127	12 86	6 214

N index index of nitrogenous fertilizer use

P index index of phosphatic fertilizer use

K index – index of potassic fertilizer use

OM index index of organic manure use

I and II Principal Components together could explain more than 80 00 per cent of variability

As revealed from the Table the four Principal Components together could explain complete variability The highest contribution or effect towards the variability in the principal component I was through the K index (0 895) followed by N index (0 633) and OM index (-0 605) In the case of principal component II the highest contribution was through OM index (0 781) followed by K index (0 789)

4 1 3 2 Factor Loadings of the Nitrogenous Fertiliser Use Behaviour

The results in Table 23 reveal that the principal component I of the various dimensions of the N index could explain 67 70 per cent variability in the use behaviour of nitrogenous fertilizer Among the six dimensions the split application of nitrogenous fertilisers had the highest factor loading (0 924) followed by quantity of nitrogenous fertilisers (0 865) and time of application (0 810)

The three principal components of the N index when combined could explain about 87 per cent of variability in the use behaviour of nitrogenous fertilizers

Table 23 Factor loadings of nitrogenous fertilizer use behaviour index

Sl No	Dimensions	P I	P II	P III
1	Qa (N)	0 865	-0 379	0 16
2	Ta (N)	0 810	0 429	0 350
3	Ns (N)	0 924	-0 239	0 103
4	Tf (N)	0 689	0 95	0 474
5	Ma (N)	0 249	-0 056	0 058
6	Rm (N)	0 775	0 244	0 067
Percentage variability explained		67 760	12 964	6 685

Qa (N) Quantity of nitrogenous fertilizers

Ta (N) - Time of application of nitrogenous fertilizers

Ns (N) Number of split applications of nitrogenous fertilizers

Tf (N) Tvpe of nitrogenous fertilizers applied

Ma (N) Method of nitrogenous fertilizers applied

Rm (N) Related management practices of nitrogenous fertilizer application

4 1 3 3 Factor loadings of phosphatic fertiliser use behaviour

Table 24 presents the factor loadings of P index Only one principal component of this factor was extracted on the data on the various dimensions of the P index which could explain about 60 per cent of the variation in phosphatic fertilizer use Among the four dimensions the highest contribution was explained through the time of application of phosphatic fertilisers (0 854) followed by the related management practices (0 808)

4 1 4 4 Factor loadings of potassic fertiliser use behaviour

A perusal of Table 25 reveals that of the two components extracted the first principal component of the K index alone could explain more than 85 per cent (85 53%) variability in the potassic fertiliser use behaviour It is interesting to observe that all the dimensions of this index were more or less of the same magnitude in explaining the variability the maximum being through the related management practices (0 946) Time of application and type of fertilizer had the same contribution (0 934) followed by quantity of potassic fertilisers (0 920) and split application (0 895) Split application had the main effect through the principal

Table 24 Factor loadings of phosphatic fertilizer use behaviour index

Sl No	Dimension	P I
1	Qa (P)	0 787
2	Ta (P)	0 854
3	Tf (P)	0 550
4	Rm (P)	0 808
	Percentage of variability explained	60 71

Qa (P) Quantity of phosphatic fertilisers

Ta (P) = Time of application of phosphatic fertilisers

Tf (P) Type of phosphatic fertilisers

Rm (P) = Related management practices of phosphatic fertil ser application

Table 25 Factor loadings of the index of potassic fertilizer use behaviour

Sl No	Dimension	P I	P II
1	Qa (K)	0 920	-0 016
2	Ta (K)	0 934	0 150
3	Ns (K)	0 895	0 436
4	Tf (K)	0 934	0 203
5	Rm (K)	0 946	0 055
	Percentage variability explained	85 525	5 632

Qa (K) - Quartity of potassic fertilisers

Ta (K) - Time of application of potassic fertilisers

Ns (K) Number of split applications of potassic fertilisers

Tf (K) Type of potassic fertilisers

Rm (K) = Relatal management practices of potassic fertiliser application component Ii in explaining about 5 63 per cent variability in potassic fertiliser use behaviour

4 2 5 Factor loadings of organic manure use behaviour

Table 26 reveals that the first principal component alone could explain 72 per cent variability Among the three dimensions considered for the index the related management practices had highest effect on the variability followed by the time of application rather than the quantity of organic manure used by the farmer

4 2 Dimensions of fertilizer use behaviour in predicting the yield of rice

Multiple Linear Regression Analysis (MRA) was employed to understand the nature of variation in yield as revealed by the different dimensions Step down Regression Analysis was also used to identify the best sub set of dimensions in the prediction of yield

Table 27 outlines the results of the Multiple linear regression analysis of the CFUBI of farmers It could be observed from the Table that the 18 dimensions together were able to explain about 48 per cent of variability in yield (R^2 - 0 482) Out of the 18 dimensions of the CFUBI six dimensions were found to contribute significantly in

Table 26 Factor loadings of the index of organic manure use behaviour

Sl No	Dimension	P I
1	Qa (OM)	0 755
2	Ta (OM)	0 841
3	Rm (OM)	0 892
	Percentage variability explained	72 274

Qa (OM) Quantity of organic manures

Ta (OM) Time of application of organic manures

Rm (OM) – Related management practices of organic manure application

Table 27 Results of multiple linear regression analysis of the dimensions of CFUBI and AYI

(n - 300)

Variable symbol	Dimension	Regression coefficient	Standard partial regression coefficient	t value
V_1	Qa (N)	0 00018	0 00308	-0 039
V_2	Ta (N)	0 012/6	0 05019	-0 679
V_3	Ns (N)	0 04877	0 2603	2 817**
V_4	Tf (N)	0 01426	0 02128	0 307
V_5	Ma (N)	0 05743	0 04336	0 943
V_6	Rm (N)	0 07315	0 09369	0 928
V_7	Qa (P)	0 04203	0 11766	2 00**
V_8	Ta (P)	0 07823	0 23140	3 258**
V_9	Tf (P)	0 01399	0 01937	0 316
V_{10}	Rm (P)	-0 00154	-0 02145	0 212
V_{11}	Qa (K)	0 04983	0 19122	1 959*
V_{12}	Ta (K)	0 00168	0 17849	0 153
V_{13}	Ns (K)	0 07646	0 20495	1 774*
V_{14}	Tf (K)	0 00221	0 02317	0 282
V_{15}	Rm (K)	0 01858	0 04047	0 273
V_{16}	Qa (OM)	0 04632	0 28723	3 577**
V_{17}	Ta (OM)	0 00230	0 10606	1 200
V_{18}	Rm (OM)	0 1559	0 07517	1 403

Intercept 0 203360

* Significant at 5 per cent level of significance
** - Significant at 1 per cent level of significance

F 14 52** R^2 0 482 $\bar{R}^2$ 0 449

explaining the variability in yield as revealed by the significant t values

Table 28 presents the results of step down regression analysis using the variables which were found significant in contributing to CFUBI It could be seen that all the six dimensions had significant contribution in explaining the variability in yield The six dimensions taken together were able to explain 45 2 per cent variability in yield (R^2 = 0 452)

The results indicate that the variables important in predicting yield of rice were split application of nitrogenous fertilizers quantity of phosphatic fertiliser time of application of phosphatic fertilizer quantity of potassic fertilizer split application of potassic fertilizer and quantity of organic manure

The equation obtained was

$$Y = 0\ 277024 + 0\ 0616_{V3} + 0\ 0516_{V7} + 0\ 0972_{V8}$$
$$0\ 0612_{V11} + 0\ 0723_{V13} + 0\ 0524_{V16}$$
$$(R^2\quad 0\ 452)$$

where

Y Average Yield Index (AYI)

V_3 split application of nitrogenous fertilizer

V_7 – quantity of phosphatic fertilizer

Table 28 Step down regression analysis of the dimensions of composite fertiliser use behaviour with AYI

(n - 300)

Dimension No	Dimension	Regression coeffi-cient	Standard partial regression coefficient	t value
V_3	Ns (N)	0 0616	0 2835	2 921**
V_7	Qa (P)	0 0516	0 14447	2 753**
V_8	Ta (P)	0 0972	0 28752	5 461**
V_{11}	Qa (K)	0 0612	0 23500	2 885**
V_{13}	Ns (K)	0 0723	0 24122	2 394**
V_{16}	Qa (OM)	0 0524	0 32499	7 070**

Intercept = 0 277024

F 41 09** R^2 = 0 452 $\bar{R}^2$ - 0 431

** Significant at 1 per cent level of significance

V_8 time of application of phosphatic fertilizer

V_{11} = quantity of potassic fertilizer

V_{13} = split application of potassic fertilizer and

V_{16} - quantity of organic manure

It could be inferred from the equation that a unit increase in the use of split application of nitrogenous fertiliser quantity of phosphatic fertiliser time of application of phosphatic fertilizer quantity of potassic fertilisers split application of K fertilizer and quantity of organic manure may result in an increase in the magnitude of 0 0616, 0 0516 0 0972 0 0612 0 0723 and 0 0524 units in the Average Yield Index (AYI) rice The index ranges from zero to one

4 3 Relationship between behavioural characteristics and fertilizer use behaviour of rice farmers

The relationship of the behavioural characteristics of rice farmers with their fertilizer use behaviour was established in this study first by simple correlation analysis and then using multiple regression analysis

The findings of the simple correlation analysis are presented in Table 29 Out of the [illegible] independent variables which were correlated with the dependent variable 11 variables were found to be significantly correlated with CFUBI

Table 29 Simple correlation analysis of composite fertiliser use behaviour with the behavioural characteristics of farmers

(n - 300)

Variable No	Variable	r value
X_1	Education	0 231*
X_2	Main occupation	0 428**
X_3	Farm size	0 151
X_4	Area under rice	0 114
X_5	Annual income	0 166
X_6	Economic motivation	0 633**
X_7	Level of aspiration	0 833**
X_8	Rational decision making ability	0 783**
X_9	Innovativeness	0 023
X_{10}	Attitude towards fertiliser use	0 889**
X_{11}	Information source utilisation index	0 810**
X_{12}	Personal guidance on fertiliser use	0 104
X_{13}	Extension participation	0 0382**
X_{14}	Economic performance index	0 187**
X_{15}	Irrigation index	0 085
X_{16}	Soil test utilisation index	0 375**
X_{17}	Knowledge of fertiliser use	0 363**

* Significant at 5 per cent level of significance

** Significant at 1 per cent level of significance

at 5 per cent level of significance Out of the eleven variables, 10 variables had significant correlation with the dependent variable at 1 per cent level of significance The variables were main occupation economic motivation level of aspiration rational decision making ability attitude towards fertilizer use, information source utilization extension participation, economic performance index, soil test utilization index, and knowledge about fertilizer Multiple Regression Analysis was carried out using these 10 variables

The findings of the multiple regression analysis are presented in Table 30 The F value (189 34) obtained was significant indicating that all the variables together contributed significantly to the variation in the fertiliser use behaviour of farmers The coefficient of multiple determination (R^2) was 0 868 which revealed that 86 8 per cent of the variation in FUB was explained by those 10 variables

Out of the ten variables four variables did not show significant regression coefficients in the multiple linear regression analysis They were economic motivation soil test utilization index and knowledge about fertilizer use and extension participation The significant variables only were selected and less significant variables were eliminated to get a linear regression equation of significant contributor variables

Table 30 Multiple regression analysis of CFUBI with the behavioural characteristics of rice farmers

(n = 300)

Variable No	Variable	Regression coefficient	Standard partial regression coefficient	t value
X_2	Main occupation	1 3049	0 08463	3 567**
X_6	Economic performance index	0 0053	-0 00058	-0 019
X_7	Level of aspiration	0 4357	0 18682	4 728**
X_8	Rational decision making ability	5 6358	0 20454	5 764**
X_{10}	Attitude towards fertiliser use	0 1976	0 41881	9 322**
X_{11}	Information source utilisation index	0 5793	0 17931	4 862**
X_{13}	Extension participation	0 2151	0 04213	1 799
X_{14}	Economic performance index	-0 0585	-0 07498	2 781**
X_{16}	Soil test utilisation index	0 7678	0 03590	1 419
X_{17}	Knowledge about fertiliser use	0 0580	0 02229	0 926

Intercept - 3 9549

R^2 - 0 868 F 189 34**

** Significant at 1 per cent level of significance

Then using the six significantly contributing variables reduced regression equation was constructed which resulted in a coefficient of multiple determination of 0 862 with F value of 312 43

Among the six variables attitude towards fertilizer use was found to have maximum contribution in explaining the variation in the fertiliser use behaviour (Table 31)

The reduced regression equation predicting the fertiliser use behaviour index was as follows

$$Y = 0\ 03?428 + 1\ 294^{**}{}_{x2} + 0\ 4634^{**}{}_{x7} + 5\ 6576^{**}{}_{x8} + 0\ 2060^{**}{}_{x10} + 0\ 5971^{**}{}_{x11} - 0\ 0530^{**}{}_{x14}$$

$$(R^2\ \ 0\ 862)$$

where

Y - Fertiliser use behaviour index

x_2 - main occupation

x_7 = level of aspiration

x_8 = rational decision making ability

x_{10} - attitude towards fertiliser use

x_{11} information source utilization and

x_{14} economic performance index

From the equation it could be observed that an increase in the main occupation of the farmer being agriculture would lead to an increase in the FUB index by

Table 31 Step down regression analysis of CFUBI with the behavioural characteristics of farmers

(n - 300)

Variable No	Variable	Regression coeffi- cient	Standard partial regression coefficient	t value
X_2	Main occupation	1 294	0 08395	3 537**
X_7	Level of aspiration	0 4634	0 19869	5 237**
X_8	Rational decision making ability	5 6576	0 20534	5 911**
X_{10}	Attitude towards fertiliser use	0 2060	0 43656	9 970**
X_{11}	Information source utilisation index	0 5971	0 18481	5 010**
X_{14}	Economic performance index	-0 0530	-0 068084	-2 568**

Intercept = 3 3428

R^2 0 862 F - 312 43**

** Significant at 1 per cent level of significance

1 294 units, <u>ceteris paribus</u> Similarly a unit increase in level of aspirat on rational decision making ability attitude towards fertilizer use and information source utilization would lead to an increase in the CFUBI by 0 4634 5 6576 0 2060 and 0 5971 units respectively It was also revealed that a unit increase in economic performance would lead to a decrease in CFUBI by 0 0530 units

4 4 Perceived importance of technological and environmental factors affecting fertilizer use behaviour of rice farmers

Table 32 presents the perceived importance of the different technological and environmental factors in influencing the CFUBI of rice farmers as perceived by farmers fertilizer dealers scientists and ag icultural extension personnel

Among the 23 factors the perceived appearance of the of the crop stand was identified by the farmers as the most important, followed by availability of desired fertiliser on time group farming activities in the locality irrigation facilities and extension guidance in the order of decreasing importance

The scienti s have ranked labour availability in the locality as the mos important factor followed by price of

Table 32 Perceived importance of technological and situational factors affecting fertilise use behaviour of farmers by farmers scientists extension workers and input dealers

Sl No	Factors	Farmers (n 300)		Scientists (n 40)		Extension workers (n 40)		Input dealers (n 40)	
		Perception index	Rank	Perception index	Rank	Perception index	Rank	Perception index	Ran
1	Variety grown	0 401	19	0 705	2	0 787	1	0 40	16
2	Irrigation facilities	0 813	4	0 695	5	0 740	3	0 68	5
3	Drainage facilities	0 687	7	0 618	7	0 673	8	0 76	3
4	Price of fertilisers	0 497	15	0 515	17	0 433	16	0 42	14
5	Availability of fertiliser subsidy	0 596	12	0 545	11	0 440	15	0 30	20
6	Availability of rain	0 651	10	0 701	4	0 121	4	0 67	7
7	Availability of credit	0 305	21	0 492	19	0 201	22	0 30	20
8	Soil type	0 302	22	0 445	21	0 325	20	0 30	20
9	Crop season	0 451	17	0 361	23	0 402	19	0 84	2
10	Cropping intensity	0 540	13	0 525	14	0 313	21	0 36	18
11	Cropping pattern	0 376	20	0 531	13	0 160	23	0 18	22
12	Availability of desired ferti lizer on lime	0 856	2	0 535	12	0 580	12	0 48	13
13	Availability of organic manure	0 671	8	0 520	15	0 567	13	0 64	6
14	Fertiliser use behaviour of neighbours and friends	0 604	11	0 515	17	0 421	18	0 74	4
15	Price of produce	0 670	9	0 705	2	0 702	6	0 62	7
16	Extension guidance	0 729	5	0 564	10	0 427	17	0 50	11

Contd

Table 32 (Contd)

Sl No	Factors	Farmers (n 300)		Scientists (n 40)		Extension workers (n 40)		Input dealers (n 40)	
		Perception index	Rank	Perception index	Rank	Perception index	Rank	Perception index	Rank
17	Availability of information	0 695	6	0 587	9	0 601	11	0 60	9
18	Promotional efforts by input dealers	0 451	17	0 475	20	0 441	15	0 54	10
19	Group farming activities in the locality	0 841	3	0 385	22	0 638	10	0 40	16
20	Perceived appearence of the crops stand	0 860	1	0 605	8	0 647	9	0 88	1
21	Yield obtained during the previous season	0 533	14	0 685	6	0 713	5	0 48	13
22	Labour availability	0 453	16	0 825	1	0 787	1	0 40	16
23	Soil test facilities	0 318	23	0 515	17	0 533	14	0 14	23

produce variety grown availability of rain irrigation facilities and yield obtained during the previous season in that order

The perception of the factors by the extension personnel was in the descending order of importance as variety grown labour availability irrigation facilities availability of rain yield obtained in the previous season and price of produce

The input dealers had ranked the factors in the following order of importance as perceived appearance of the crop stand crop season drainage facilities fertiliser use bahaviour of neighbours and friends irrigation facilities and availability of organic manure

The factors commonly agreed to by the different categories of respondents as important in affecting CFUBI of rice farmers are presented in Table 33 The factors were in the following order - irrigation facilities (I) perceived appearance of crop stand (II) drainage facilities (III) price of produce (III) availability of rain (III) and labour availability (VI)

Table 33 Perceived importance of technological and situational factors ordered based on the Kendall s coefficient of concordance (W)

Sl No	Factors	Rank total	Obtained rank
1	Irrigation facilities	17	I
2	Perceived crop stand	19	II
3	Drainage facilities	25	III
4	Price of produce	25	III
5	Availability of rain	25	III
6	Labour availability	34	VI
7	Availability of information	35	VII
8	Yield obtained in the previous season	38	VIII
9	Availability of desired fertiliser on time	39	IX
10	Variety grown	39	IX
11	Availability of organic manure	42	XI
12	Extension guidance	43	XII
13	Fertiliser use behaviour of neighbours and friends	50	XIII
14	Group farming activities in the locality	51	XIV
15	Availability of fertiliser subsidy	58	XV
16	Crop season	61	XVI
17	Promotional efforts of fertiliser agency	62	XVII
18	Price of fertiliser	62	XVII
19	Cropping intensity	66	XIX
20	Soil testing facilities	77	XX
21	Cropping pattern	78	XXI
22	Availability of credit	82	XXII
23	Soil type	83	XXIII

4 5 Constraints identified by the farmers with reference to the fertiliser use behaviour

Tables 34 to 40 present the constraints identified by the rice farmers in relation to their fertiliser use behaviour The constraints in general as well as in relation to each dimension are presented

4 5.1 Quantity of fertiliser applied and related constraints

Table 34 outlines the major constraints experienced by rice farmers in using the recommended quantity of fertilisers It could be noticed that lack of knowledge about recommended quantity high cost of fertiliser delay in obtaining soil test results and lack of guidance were the common constraints in the use of the recommended quantity of the major nutrients and manure But with respect to the use of recommended quantity of nitrogenous fertilisers the farmers had pointed out the high incidence of pests and diseases increased percentage of chaffy grains increased lodging tendency and poor straw quality as the major constraints In relation to the use of recommended quantity of organic manure the major constraints were non availability lack of knowledge about green manure crops and problem of adulteration (adding inert materials waste etc)

Table 34 Constraints in the use of recommended quantity of fertilisers and manures

(n-300)

Sl No	Constraint	Frequency	Percentage
1	Lack of knowledge about the recommended quantity (G)	279	93 00
2	High cost of fertilisers (G)	270	90 00
3	Non-availability of organic manure (OM)	268	89 33
4	Lack of knowledge about green manure crops (OM)	260	86 67
5	High insidence of pests and diseases (N)	240	80 00
6	Non-availability or delay in obtaining soil test results (G)	200	66 67
7	Poor guidance	189	63 00
8	Increased lodging tendency (N)	140	63 00
9	Increased percentage of chaff grains (N)	120	40 00
10	Poor straw quality (N)	90	30 00
11	Problems of adulteration (OM)	76	25 83

G General for all nutrients

N - For nitrogenous fertilisers

OM For organic manure

4 5 2 Time of application

Table 35 presents the major constraints expressed by the farmers in relation to time of application Lack of knowledge about correct time of application lack of conviction about the need for applying fertiliser and manures in the correct time lack of irrigation water or drought condition flooded/water logged situation scarcity of labourers in time and non-availability of fertiliser in time were some of the major constraints expressed by the farmers in common But with regard to the timely application of nitrogenous fertilisers the other reasons pointed out were incidence of pests and diseases and increased weed growth In relation to time of application of organic manure the other major constraints were non-availability of manure in time and increased weed growth

4 5 3 Split application

It could be noticed from Table 36 that the major constraints for poor use behaviour of the split application of nitrogenous and potassic fertilizers were the same Lack of knowledge about the recommendat on of split application lack of conviction about the relative advantage of split application lack of drainage/water stagnation non availability of labourers and high wage rate of labourers

Table 35 Constraints in the time of application of fertilisers and manures

(n-300)

Sl No	Constraint	Frequency	Percentage
1	Lack of knowledge about recommended time of application (G)	272	90 67
2	Scarcity of labour	220	73 33
3	Lack of conviction about the need of timely application (G)	196	65 33
4	Lack of irrigation water and rain (G)	196	65 32
5	Water stagnation problem and heavy rain (G)	192	64 00
6	Non-availability of desired fertilisers on time (G)	192	64 00
7	Non-availability of organic manure (OM)	188	62 67
8	High incidence of pests and diseases (N)	150	50 00
9	Increased weed growth (OM)	123	42 00
10	Lack of time (G)	15 33	45

G - General for all nutrients

N - For nitrogenous fertilisers

OM For organic manure

Table 36 Constraints in the split application of fertilisers (N and K)

(n–300)

Sl No	Constraint	Frequency	Percentage
1	Lack of knowledge about the recommendation on split application practice	202	67 33
2	High wage rate of labourers	202	67 33
3	Lack of conviction about the relative advantage of split application	198	66 00
4	Lack of drainage facilities/ incidence of water stagnation	198	66 00
5	Non-availability and delay in obtaining soil test results	198	66 00
6	Non availability of labour in time	181	61 67
7	Non availability of desired fertiliser in time	166	55 33
8	Non-availability of fertiliser packets of convenient size	1[illegible]2	47 33
9	Poor storage facilities for fertilisers	140	46 67
10	Increased weed growth in the case of N fertilisers	136	45 33
11	Lack of time	46	15 33

were the major constraints as reported by the farmers The main constraint in the split application of nitrogenous fertiliser use was the resulting increased and frequent weed growth

4.5 4 Method of application

Table 37 highlights the important constraints in relation to method of application of nitrogenous fertilisers Lack of knowledge about the specific methods of application lack of conviction about the need lack of knowledge about the methods non-availability of the materials required and perceived impracticability of the recommendation were the major reasons for poor use behaviour of the methods of application of nitrogenous fertilisers as perceived by the rice farmers

4 5 5 Type of fertilisers

The major constraints related to the type of fertilisers used are presented in Table 38 Lack of awareness about the relative advantage in using straight fertilisers was one of the important constraints Lack of knowledge about alternative types of fertilisers difficulty in calculating the needed quantity of straight fertilisers and difficulty of buying small quantities of straight fertilisers were the major

Table 37 Constraints in following the recommended method of application of fertilisers (N)

(n-300)

Sl No	Constraint	Frequency	Percentage
1	Lack of conviction about the necessity of following a specific method of application	293	97 67
2	Lack of knowledge about the recommended method of application	289	96 33
3	Lack of knowledge about the procedural know-how about the methods	286	95 33
4	Non availability of the recommended fertiliser and other required materials (neem coated urea sulphur coated urea neem cake pellet form etc)	125	41 67
5	Perceived impracticability of the method (mixing of urea with soil)	124	41 33
6	Lack of time	56	18 67
7	Increased labour utilisation and increased expenditure	48	16 00
8	Non-availability of labour	34	11 33

Table 38 Constraints in choosing the right type of fertilisers (N P and K)

(n-300)

Sl No	Constraint	Frequency	Percentage
1	Lack of awareness about the relative advantage in using the desired fertiliser	194	64 67
2	Lack of knowledge about alternative type of fertilisers	174	58 00
3	Non-availability of desired fertiliser	166	55 33
4	Difficulties in calculating the required quantity of straight fertiliser	136	45 33
5	Difficulties in mixing and applying the straight fertilisers	101	33 67
6	Difficulties in obtaining small quantities of straight fertilisers	96	32 00

constraints as reported by the farmers in the selection of type of fertilisers

4.5.6 Related management practices

It could be noticed from Table 39 that there were many constraints in relation to the related management practices of fertiliser use behaviour for rice farmers Lack of assured irrigation facilities was the foremost constraint expressed by the farmers in following the related management practices in general Other important constraints were incidence of flood situation lack of knowledge scarcity of labourers in time delay in obtaining soil test results and non-availability of the liming materials in time

4 5 7 Constraints in composite fertiliser use behaviour of rice farmers

Table 40 presents the constraints of rice farmers with regard to the composite fertiliser use behaviour of rice farmers

The major constraints were lack of knowledge lack of assured irrigation facilities high rate of labour wages high cost of fertilisers increased occurrence of pests and diseases improper drainage and water stagnation scarcity of labourers in time non availability of organic manure and non availability or delay in obtaining soil test results

Table 39 Constraints in the use of related management practices

(n 300)

Sl No	Constraint	Frequency	Percentage
1	Lack of assured irrigation water	262	87 33
2	Lack of drainage facilities and flood situation due to heavy rains	246	82 00
3	Lack of knowledge about the practices	244	81 33
4	Scarcity of labour in time	240	80 00
5	High rate of wages of labourers	238	79 33
6	Non availability of liming materials in the desired time	208	69 33
7	Non availability/delay in obtaining soil test results	198	66 00
8	Lack of proper irrigation facilities	182	60 67
9	Cultivation of different varieties in the padasekharam in the same season	156	52 00
10	Position of the plot in the padasekharam	149	49 67
11	Non-coperation of the neighbouring farmers	148	49 33
12	Slope of the plot	136	45 33
13	Soil type	122	40 67
14	Lack of co-ordinated farming activities in the padasekharam	122	40 67

Table 40 Constraints experienced by farmers in their composite fertiliser use behaviour

(n 300)

Sl No	Constraint	Frequency	Percentage
1	Lack of knowledge about fertiliser use	279	93 00
2	Lack of assured irrigation water facilities	273	91 00
3	High cost of fertilisers	273	91 00
4	High rate of labour wages	272	90 67
5	Non-availability of organic manure	244	81 38
6	Improper drainage and water stagnation	243	81 00
7	Scarcity of labourers at required time	238	79 33
8	Increased incidence of pests and diseases	230	76 67
9	Non availability or delay in obtaining soil test results	205	68 33
10	Non-availability of desired fertiliser in time	165	55 33
11	Lack of guidance	126	42 00
12	Lack of transportation facilities	102	34 00

CHAPTER V

DISCUSSION

The salient results of the study are discussed in this chapter

5 1 Fertiliser use behaviour of rice farmers

The results obtained in respect of the fertiliser use behaviour in general and its various dimensions in particular and the zone wise comparisons made are discussed

It was revealed that majority of the farmers selected for the study had either good or satisfactory level of fertiliser use behaviour with respect to CFUBI and use of nitrogenous and phosphatic fertilisers and organic manure In the case of use of potassic fertiliser alone it was observed that farmers were almost equally distributed on four categories

The trend of large majority of farmers grouped under either good or satisfactory categories was observed for most of the dimensions under nitrogenous phosphatic and potassic fertiliser use and also use of organic manure However majority of farmers under poor or very poor categories was noticed with respect to the behaviour related to split application of nitrogenous and potassic fertilisers method of application of nitrogenous fertilisers quantity of organic manure and related management practices in the use of organic manure

The findings reflect the fact that majority of the farmers were above average in CFUBI and use behaviour indices of N and P nutrients and organic manure Besides in the use of potassic fertilisers when the use behaviour of other nutrients are analysed dimension wise also it becomes evident that for certain dimensions which are considered as crucial in relation to fertiliser efficiency majority of the farmers were below satisfactory level

The low level observed in potassic fertiliser use behaviour could be attributed to the simple reason that the major constraint of farmers in fertiliser use was no doubt lack of knowledge Knowledge with its cognitive affective and psychomotor components is a necessary condition for positive use behaviour Sulaiman (1989) also has reported that low level of adoption of fertiliser management practices of rice farmers in Palakkad and Kannur districts in Kerala was related with low level of knowledge about fertiliser use Lack of conviction among the farmers about the necessity of balanced nutrition could also be a reason for the observed low use behaviour of potassic fertilizers The NARP Status Report of KAU (1989) also had pointed out that rice farmers of Kerala are not fully aware of the benefits of balanced nutrition and had observed low adoption among the farmers Since farmers are not fully aware about the essentiality of potassic fertilisers and its function in crop growth they might have totally skipped or reduced its usage While the use of nitrogenous fertilisers could be directly observed by way of luxuriant greenish vegetative crop stand the use of potassic fertilisers does not exhibit such manifestation which could be observed directly It could be possible that farmers attach more importance to the appearance rather than utility and hence the result

Geethakutty (1993) observed that one of the alternative means adopted by the rice farmers in Thrissur district consequent to price rise of fertilisers was to skip the use of potassic fertilisers Singh and Sarup (1986) in their study in Himachal Pradesh also had observed that highest deviation in adoption was observed in the case of potassic and phosphatic fertilisers in all crops

The poor use behaviour with regard to split application of nitrogenous and potassic fertilise s indicate the need for giving proper emphasis to the recommended application of fertilisers in split doses The major constraints posed by the farmers for split application of these nutrients were lack of conviction about the relative advantage of split application A proper perception of the farmers about the attributes of a practice recommended for them have a bearing on its adoption Sulaiman (1989) had observed that the practice of split application of fertiliser was perceived to be the most practicable and efficient among the various fertiliser management practices by the farmers of Palakkad wherein majority of the farmers had also adopted split application of fertilisers

A large majority of farmers were under either very poor or poor use categories in respect of the method of application of nitrogenous fertiliser and this could be well explained taking into account the constraints indicated by the farmers The major constraints in the low use behaviour of method of application were lack of knowledge about specific methods of application lack of procedural knowledge about the practice non-availability of the materials required and perceived impracticability of the methods Sulaiman (1989) observed that the method of application of nitrogenous fertilizers specifically placement of fertilisers was perceived as the lowest in terms of practicability compatibility, simplicity and divisibility by the rice farmers of Palakkad Lal (1986) also had indicated ignorance of farmers about the method of application of fertilisers as one of the major reasons for low fertiliser efficiency

The dimensions of split application and method of application of fertilisers are comparatively no cost/low cost inputs If the farmers are properly convinced and are educated to perceive the importance of these practices properly they will be motivated to adopt the same Geethakutty (1982) observed that rice farmers with proper knowledge of principle aspects (why knowledge) of a practice had gone for its adoption even if the practice was a high cost one This points to the scope and need for improving efficiency of fertiliser use behaviour of farmers by properly educating them through different extension strategies

The very low use behaviour noticed in the case of quantity as well as related management practices in the case of organic manure also could be related to the constraints as reported by the farmers It is a fact that now organic manures are costly and also not readily available Therefore the farmers are compelled to have increasing dependence on inorganic fertilisers for crop nutrition The problem of availability of organic manure reflects the situation faced by the farmers in the rural areas Whereas earlier organic manures were mainly farm produced or could be obtained at nominal cost now they have moved over to the category of purchased inputs with relatively high market prices due to fast depletion of forest area and other related reasons The indigenous practices of using the farmyard composts other wastes dry leaves green manure ash etc are now a forgotten story for our farmers Considering this aspect the Government have now revived the old programme for compost making growing green manure crops etc on a massive scale to meet the need of organic manure

The NARP Status Report of KAU (1989) also reported that only 22 per cent of the farmers follow the recommended dose of organic manure in rice cultivation Sankaram (1992) pointed out that to use both inorganics and organics as a blend is not a compromise but a compulsion as a solution to crop yield improvement Organic manures build up soil fertility for artificial fertilisers to be fruitful

A comparison of the NARP zones in relation to fertiliser use behaviour of farmers revealed that the farmers in the Central zone stood first with regard to CFUBI However nutrient wise comparisons revealed that the farmers in the Problem zone were in the first position except for the use of organic manure With regard to the use of organic manures the farmers in the Problem zone were found to be the lowest The lowest position of Problem zone in the use of organic manure had actually pushed the Problem zone to a low position with regard to CFUBI The observed low use of organic manure in the Problem zone could be attributed to the specific use pattern adopted by the farmers in the zone Due to the inherent rich humus content of soil in the zone and the peculiar and traditional harvesting pattern followed leaving long stumps in the field and also residues of aquatic life forms might have resulted in the low level of organic manure use by the farmers which probably may be the reason for the observed results The farmers in the Problem zone also pointed out the difficulty in transportation of organic manure to the field as an important reason for low use

The farmers in the High Range zone had the first position with regard to organic manure use which might be due to the abundant availability of organic manures in the zone The tribal and also other farmers in the region were found to be more dependent on organic manure due to its greater availability

The relatively better position of Central and Problem zones with regard to the use of nutrients and their various dimensions could be attributed to the progressive nature of the zone itself In both these zones farmers were found to take up rice cultivation more or less in commercial lines against the subsistence type of cultivation followed by the farmers in the other three zones This could be supported by the Systems theory of Koontz et al (1986) and Ghosh et al (1988) which explains that an enterprise does not exist in vacuum but is dependent on its environment and is a part of larger systems Desai (1985) had also analysed various factors responsible for the growth of fertiliser consumption in India and had pointed out that the operating environment influences the above process He also stressed the importance of non price factors such as availability of credit infrastructure distribution system and the extension work in ensuring better efficiency of fertiliser use

The lowest position of Northern zone in CFUBI might have resulted due to its lowest position in the use of phosphatic and potassic fertilisers It was observed by the researcher that in Northern zone quite a large number of farmers were not even aware of the use of potassic fertilisers Together with their low level of knowledge relatively non progressive position in infrastructure facilities also might have contributed to the observed low position of CFUBI Sulaiman (1989) in a comparative study of Palakkad and Kannur districts of Kerala had indicated the higher knowledge and higher level of adoption among farmers of Palakkad than the farmers in Kannur Besides knowledge the better resource endowments of the area like fertility status availability of irrigation water etc and higher economic motivation of farmers in the Central and Problem zones might be the other reasons for the higher level of CFUBI and use of other nutrients observed in the study Zechernitz (1979) Ramasamy et al (1986) and Krishnappa (1986) had indicated that better infrastructural facilities would increase the likelihood of higher level of fertiliser use

The dimension wise comparison of zones also indicated the superior position of the farmers of Problem zone as well as the Central zone in their use behaviour of the various dimensions With regard to the different dimensions of fertiliser use also barring the use of organic manure the higher position of farmers in the Problem and Central zones taking into account their mean values could be explained using low coefficients of variation The low coefficient values indicate higher homogeneity or uniformity among the farmers in the zone with regard to the use of the different dimensions of fertilisers The observed low positions of Southern zone and Northern zone in the use of different dimensions of fertilisers could very well be attributed to the rainfed farming pattern prevalent in those zones Lack of sufficient irrigation facilities like canals and tanks coupled with marginal land holdings of the farmers might have compelled the farmers to go for the low use of different dimensions under fertilisers This wide variation in the use of fertilisers by the farmers in those zones is quite reflected in the high coefficient of variation obtained in these zones

The comparatively higher position of farmers in the Southern zone with regard to the type of phosphatic and nitrogenous fertilisers used may be explained taking into account the fact that in this zone the use of complex fertilisers and mixtures is not as popular as in other zones Almost all farmers depended on straight fertilisers especially for phosphatic fertilisers The lowest position of farmers in Northern zone with regard to this dimension indicated the higher use of complex fertilisers and mixture common in the zone During the study it was observed that even for top dressing complex/mixture fertilisers were used by the farmers in the zone Sulaiman (1989) also had indicated the high acceptance of complex/mixture fertilisers among the farmers of Kannur region

In the case of method of application all the five zones were found equally backward The farmers of all zones were found to be very poor in their use behaviour of method of application of nitrogenous fertilisers This throws light on the state of affairs that eventhough there are specific and definite recommendations on methods of application of nitrogenous fertilisers they have not percolated into the level of farmers unlike the other recommendations There are recommendations on different methods for each zone soil type and different climatic conditions such as neem coating coaltar coating or sulphur coating of urea for preventing denitrification and for water stagnant condition spraying urea under drought situation incubating of urea with soil for sandy soils placement of urea for preventing volatalisation and to increase its use efficiency But the farmers who face these problematic situations are not even aware of the methods It was also observed that many of the field level extension personnel were poor with regard to their knowledge about the specific recommendations on methods of application Besides this poor knowledge position many of the recommended materials are also not available at many places in the state This warrants immediate attention and action on the part of all concerned with agricultural development in the state There should be well defined action on the part of both research and extension personnel to tide over this situation The general trend of blanket recommendation may not do any good to the farmers in these cases The field staff should be equipped with specific know how on these matters and should be given specialised trainings such that they can advice the farmers and give specific solutions considering the situational and climatic factors Necessary actions are also to be taken to ensure the timely supply of the required materials in all the zones

With regard to the use behaviour of related management practices the farmers in Northern and Southern Zones were found in the lower position This might be due to the non progressive state of the infrastructure facilities and also lack of knowledge of the farmers about the different management practices

The zone specificity observed in the use of almost all dimensions has to be seriously taken into account in designing extension strategy for fertiliser education Lack of assured irrigation water being one of the major constraints in the use of chemical fertilisers it is necessary that steps have to be taken jointly by the Departments of Agriculture and Irrigation to augment the irrigation facilities and supply of sufficient irrigation water for the rice farmers in the required time Lal and Shukla (1990) had suggested that as the climate plays a major role in deciding the magnitude of response to remaining factors of productivity the agroclimatic based strategies should go a long way in maximising the fertiliser use and increasing production Similarly Panda (1990) also had opined that the agronomic potential for fertiliser use in any region would depend on so many factors like soil fertility extent of availability of optimum moisture and other climatic conditions cropping pattern genetic character of crops and use of inputs other than fertilisers

5 1 Principal component analysis of fertiliser use behaviour

The reason for the highest contribution of potassic fertiliser use behaviour index toward the variability in CFUBI is evident from the results obtained and discussed earlier With regard to potassic fertiliser use the farmers (pooled sample) were almost equally distributed under very poor poor satisfactory and good use behaviour which indicated a higher variation in its use Among the different zones also wide variations were noticed with regard to use of potassic fertilisers Probably these resulted in the observed maximum contribution of K index to the CFUB variability The observed low contribution of phosphatic fertiliser use index might be due to the wide popularity and adoption of the phosphatic fertilisers like Musooriephos and Factomphos among farmers all over the state The low use of organic manure and the variation noticed among the regions might be the reason for the significant contribution in CFUB variation by organic manure It was observed that there was much variation in the use of nitrogenous fertilisers especially in the Southern Zone Randhawa (1985) and Sulaiman (1987) in their studies had also indicated the variation in adoption of potassic fertilisers application accounts for the highest variation in the N index As indicated earlier the constraints of lack of knowledge and lack of conviction about the relative advantage of split application might have resulted mainly in the application of fertilisers in split doses by only a low percentage of farmers

The time of application of phosphatic fertilisers having widest variation among the farmers is reflected in the factor loadings of this dimension towards the P index the other dimensions having almost an equal contribution Another reason for the high variation was due to the observed use of complex or mixture fertilisers even for the split applications or top dressings by the farmers

It is evident from the factor loadings of potassic fertiliser use index that all the five dimensions were almost equally important in explaining the variability in K index This reflects the poor level of use behaviour for all the five dimensions of potassic fertiliser use among majority of the farmers the reasons for which were already discussed elsewhere

Similarly in the case of organic manure also all the three dimensions were significantly contributing to variability in its use behaviour Among them use of related management practice was found to have the maximum contribution This might be due to observed poor use behaviour of organic manure by the majority of farmers and the region specific nature in relation to use of related management practices

It can be confirmed from the results that the factors accountable for maximum variability in the composite fertiliser use behaviour among the rice farmers were use of potassic fertiliser split application of nitrogenous fertiliser time of application of phosphatic fertiliser and related management practices The farmers training programmes and other fertiliser education programmes should necessarily focus on these aspects and emphasis should be given on procedural as well as principles knowledge of the practices The observed high contribution of K index in explaining the variability of CFUBI must draw the attention of the extension personnel Much concerted efforts should be taken to popularise the use of balanced nutrition in rice cultivation and this is very much needed especially in the Northern NARP Zone

5 2 Dimensions of fertiliser use behaviour in predicting the yield of rice

The results indicated that the important dimension of nitrogenous fertiliser in deciding the yield of the crop is split application rather than the quantity applied It is a scientific truth that the crop will not be able to properly utilise all the nitrogenous fertilisers applied when we apply the full quantity in one lot due to various factors such as volatalization evaporation leaching denitrification and other such soil reactions On the other hand if the same quantity is applied in two or three split doses the chances for loss are reduced and thereby there is more proper utilisation by the crop The importance of split application highlights the need for timely application in different splits at different stages of the crop growth so that the crop can utilise the nutrients to the maximum extent for better yields

The observed finding of the need of split application as well as the timely application of the required quantity of the major nutrients underline the importance of the concept of fertiliser use efficiency or fertiliser management efficiency in crop production It is necessary that importance be given to the time of application and the number of applications (splits) of the major nutrients as important as the quantity applied The related management practices to be followed require equal attention as in the case of the quantity of application Split application as well as time of application are no cost inputs in comparison to the high cost input namely quantity The farmers should be educated that the efficiency of the quantity of fertilisers which they apply could be increased substantially if they apply them in split doses

Another important dimension important in deciding the yield of rice was the applied quantity of organic manure Since the humus content in the soil will decide the soil structure and which indirectly influences utilisation of nutrients in addition to the nutrient supply the presence of organic matter in the soil has a decisive role in the yield of rice Hence the use of organic manure has to be encouraged keeping in view of the observation of Sankaram (1992) mentioned elsewhere

5 3 Relationship between behavioural characteristics and fertiliser use behaviour of rice farmers

The multiple linear regression analysis carried out between the behavioural characteristics and CFUBI of rice farmers (Table 30) indicated that out of the 17 variables six variables could explain 86 80 per cent variation in the CFUBI These variables were main occupation level of aspiration rational decision making ability attitude towards fertiliser use information source utilization and economic performance index which were found to contribute significantly to the CFUBI

The probable reasons for the significant relationship of these independent variables with the fertiliser use behaviour of the farmers are discussed below

5 3 1 Main occupation

The positive significant relationship between primary occupation of the farmers and their fertiliser use behaviour is quite understandable Rice being a crop which requires constant attention by the farmer necessitates much time being spent by him in the field This will be reflected in all his activities including fertiliser use behaviour A farmer engaged in some allied activity and considering it as his primary occupation will not be able to attend to the needs of the crop and may not be able to care for the crop even if he desires so Moreover since he derives income from other sources he need not solely depend on the yield of crops for his livelihood which is not the case for a farmer with farming as his main occupation Viewed from this angle a farmer with farming as his main occupation could very well be expected to have a high CFUBI and hence the result

This finding derives support from the previous studies of Sreekumar (1985) Reddy (1987) Tantray (1987) Athimuthu (1990) and Latha (1990)

5 3 2 Level of aspiration

The significant relationship observed between level of aspiration and fertiliser use behaviour could be explained using the theory of self fulfilling prophecy (DeVito 1985) A person who is optimistic in his life and confident about his future will be striving for a better performance in his life This attitude will be reflected in all his activities Naturally he will be trying to reap good yield from his crop which indirectly may influence his input use behaviour also This finding is in line with the observations made in the earlier studies by Rajendran (1978) Reddy (1987) and Mahipal and Kerde (1989)

5 3 3 Rational decision making ability

A farmer who is rational in decision making will be analysing and weighing the different alternatives available before taking a final decision From his own past experience a rational farmer who has obtained good yields as a result of high CFUBI will be quite convinced about the benefits of fertiliser use and hence this behaviour is likely to be reinforced and repeated by that farmer This derives support from the law of result or achievement in the learning process

Prasad (1983) indicated a highly positive relationship between rational decision making ability and achievement motivation of rice farmers and pointed out that the setting of goals and preferences is a rational act and an achievement motivated individual will invariably act in a rational way

5 3 4 Attitude towards fertiliser use

The theory of attitude behaviour consistency (Fishbein and Raven 1962 McGuire 1969) indicates that the development of favourable or unfavourable attitude towards an object or situation will be dependent on the benefits associated with the object or situation The previous experience of higher yield obtained from a better CFUBI is likely to lead towards a positive attitude towards fertiliser use being developed This positive attitude towards the use of fertilisers naturally may reflect in his various farming activities and hence the obtained result The findings of Singh and Ray (1985) Balan (1987) and Sulaiman (1989) also indicated positive significant association between attitude towards fertiliser use and level of fertiliser use by farmers

5 3 5 Information source utilisation

The positive and significant relation between information source utilisation and CFUBI of rice farmer reinforces the Information Threshold Theory put forward by Gaikwad (1968) The high exposure of an individual to different information sources may enable him to compare the various technologies and select the most rational information to be used by him in his farming activity When a farmer receives the same technology through different information sources it may not be possible for him to resist his attention being concentrated on that technology and its further use In the case of a farmer who obtains information about fertiliser use from different sources the same process is likely to operate Hence the observed finding

This finding corroborates with the results reported by Balasubramaniam (1985) Jayapalan (1985) Wilson and Chaturvedi (1985) Singh and Reddy (1985) and Athimuthu (1990)

5 3 6 Economic performance index

A negative but significant relationship between economic performance index and CFUBI was noticed in the present study This might be due to the simple reason that those farmers who get low yields in comparison to low use of inputs especially costly chemical fertilisers may get themselves satisfied with their low fertiliser use behaviour Whatever yields they get with low input use will be considered as a profit by such farmers The preponderance of such behaviour manifested by the farmers especially in the Northern and Southern Zones might have resulted in this finding Some of the respondents of the study had also opined that eventhough they were not getting the returns commensurate with the cost of cultivation they are habituated in using fertilisers

A non significant relationship between economic performance index and use of fertiliser management practices had been reported by Sulaiman (1989) also

5 4 Perceived importance of technological and situational factors affecting fertiliser use behaviour of farmers

It was found that the factors commonly agreed to by the different categories of respondents as important in affecting CFUBI of rice farners were in the following order irrigation facilities (I) perceived appearance of crop stand (II) drainage facilities (III) price of produce (IV) availability of rain (V) and labour availability (VI)

5 4 1 Irrigation facilities

There is no need to over emphasise the importance and decisive role of irrigation facilities in the use of fertilisers by the farmers With the occurrence of frequent drought and lack of assured irrigation facilities farmers become reluctant to take the risk of applying fertilisers to the crop In addition to measures for supply of assured irrigation water there is also need for evolving feasible methods of foliar application of fertilisers to the crop

5 4 2 Perceived appearance of crop stand

The importance of the factor perceived appearance of the crop stand as reported by the farmers is very interesting since it reveals the rich experience of the farmers which they utilise in decision making Farmers from their past experiences decide the modalities of fertiliser application It is desirable that the scientists may also consider such perceptions of farmers and conduct field level experiments to verify the utility of such farmers experiences under field conditions

5 4 3 Drainage facilities

The importance attached to drainage facilities in deciding the fertiliser use behaviour is self explanatory

Usually farmers delay the application or deny fertilisers to rice crop when there is water stagnation or flooding due to rains Naturally farmers will not be ready to waste fertilisers a costly input in such risky situations where plants cannot utilise the nutrients If sufficient drainage facilities are provided in the fields such problematic situations are not likely to occur Eventhough there are special methods of application to tide over such problematic situations they are not popular among the farmers Even if they know they may not be in a position to adopt related management practices such as puddling and levelling drawing and keeping optimum water level liming and washing off in flooded situations Again the most common method of plot - to plot drainage is also inefficient and harmful All these factors together have an effect on CFUBI of farmers

5 4 4 Price of produce

If the prices of fertilisers and paddy the main produce of rice farmers are compared a drastic difference could be observed in their increase The price of fertilisers has gone sharply in the curve while for paddy the farmer gets more or less the same old price which again is very much fluctuating Together with the uneconomic yield they get the low price of paddy plays a decisive role in the fertiliser use behaviour of farmers

5 4 5 Availability of rain

Since majority of the farmers studied were having rainfed cultivation the mportance attached to the availability of rain is quite natural The farmers give much emphasis to the mystical phenomena such as njattuvela karivally optimum soil condition which are very much related to the receipt of rains in a season As discussed elsewhere rains can also cause flooded condition and thereby negatively affect fertiliser use behaviour

5 4 6 Labour availability

Labour availability is also a crucial factor which has got direct say on fertiliser use behaviour of the farmers In adopting the correct time of application number of split applications method of application and related management practices the timely availability of labour is a deciding factor

5 5 Constraints identified by the farmers with reference to the fertiliser use behaviour

Tables 34 to 40 had presented the major constraints perceived as important by the rice farmers in their fertiliser use behaviour

It could be seen from the tables that one of the major constraints identified by the farmers in relation to almost all the dimensions of CFUBI was lack of knowledge as well as lack of conviction about advantage of the specific practices Knowledge about the practice is a pre requisite for proper use behaviour This demands the special attention of those agencies vested with the responsibilities in imparting education on fertiliser use to the farmers Lack of guidance was also pointed by the farmers as another major constraint about which the extension agencies have to be concerned Lal (1986) and Singh and Ray (1985) had also reported lack of guidance as a major constraint in fertiliser use of farmers

The delay and or non availability of obtaining soil test results was another major constraint which was cited as a reason for low adoption of the recommended quantity of fertilisers and related management practices Balan (1987) had reported that one of the reasons for non adoption of fertiliser recommendation by majority of the farmers was the delay and non receipt of the soil test results Jayakrishnan (1984) Jayaramaiah (1987) Singh and Ray (1985) and Athimuthu (1990) have also reported similar findings This also warrants attention and action from the side of development agencies for quick and timely transmission of the soil test results to the farm rs which can influence their fertiliser use to a great extent

High cost of fertilisers and manures was still another important constraint which badly affects balanced and proper fertiliser use behaviour of the farmers This was especially inted out as a constraint in the use of the recommended quant ty of fertilisers and manures Proper policy measures are to be implemented as remedy for price rise of fertilisers The over dependence of farmers on inorganic fertilisers is also a problem Local production of organic manure and utilisation of biofertilisers are alternatives for this Efforts have to be undertaken for intensifying the production and also for popularising the use of biofertilisers by the farmers Sivasankara (1986) Kaur and Kumar (1989) Sulaiman (1989) Singh and Ray (1985) and Athimuthu (1990) have reported high price of fertilisers as a constraint in fertiliser use

In the case of nitrogenous fertilisers the major constraints for low use behaviour as reported by the farmers were incidence of pests and diseases occurrence of chaffy grains and poor quality of straw These reasons were expressed by farmers from their own experiences The farmers should be properly educated about the functions and role of major nutrients in crop growth and also about the proper management so as to get rid of many of their misconceptions and apprehensions

In the case of organic manures the main constraints identified by the farmers were non availability lack of knowledge about suitable green manure crops and the problem of adulteration It is to be accepted that the farmers are overdependent on inorganic fertilisers and are reluctant in growing and making organic manures from household and farmyard wastes due to various reasons Governmental and private agencies should take concerted efforts to popularise the use of organic manures among the farming community

The constraints identified for the low use behaviour with respect to time of application and split application of fertilisers and manures were lack of knowledge lack of conviction about its utility lack of irrigation water drought condition flooded situation scarcity as well as non availability of labour in time Infrastructural facilities in the village scenario have to be improved and developed for providing proper irrigation drainage and also for distribution of fertilizers Scarcity of labourers in time and also high labour charges pose serious problems to rice farmers Complete mechanisation cannot be a solution for this situation as far as Kerala is concerned due to trade union activity prevalent in the state However partial mechanisation is slowly being adopted by the farmers as seen in Palakkad It was observed that frequently emerging weed growth also prevent farmers from applying fertilisers and manures at the correct time

From the result presented in the Table 37 it could be noticed that eventhough there exist specific methods and technologies for application of nitrogenous fertilisers which are suggested as measures to increase the use efficiency such technologies are not found accepted by the farmers The main reasons were lack of knowledge and conviction and non availability of the required materials Neem cake neem coated urea sulphur coated urea and such materials are not easily available to the farmers though they are recommended as means of increasing efficiency of nitrogenous fertilisers Impracticability of such practice is also reported in soil incubation for urea on a large scale by many of the farmers Sulaiman (1989) had also pointed out the perceived impracticability of the methods of application of nitrogenous fertilisers among farmers Lal (1986) also had pointed out lack of knowledge about method of application as a constraint in fertiliser use

The constraints in relation to the use of type of fertilisers were lack of awareness about the relative advantage of using straight fertilisers lack of knowledge about alternative types of fertilisers and difficulty in calculating the correct quantities of straight fertilisers Lack of awareness and understanding about the alternative sources other than mixtures or complex fertilisers and lack of conviction about their relative advantage are really constraints in choosing the desired type of fertilisers Lal (1986) had indicated that ignorance about the suitable type of fertilisers was a constraint in fertiliser use The difficulty in calculating the correct quantity of different fertiliser nutrients for the different split applications necessitates skill on the part of the farmers In that sense the farmers might be perceiving the use of straight fertilisers as a burden compared to mixtures and complex fertilisers which are relatively easy to use There is also a tendency on the part of the dealers to suggest mixture/complex fertilisers when the farmers go for purchasing of small quantities of straight fertilisers

The respondents have rightly identified the constraints which impede use of related management practices in fertiliser use as lack of assured irrigation facilities incidence of flood lack of knowledge scarcity of labour in time delay in obtaining soil test results and non availability of liming materials Basically fertiliser use which is part of the HYV technology is strictly applicable to areas where water can be properly managed Due to lack of assured irrigation facilities on the one hand and incidence of flood situations on the other farmers many times are not able to follow the essential water management practices related to fertiliser use Non availability of liming materials also affect soil management for efficient fertiliser use Ramasamy et al (1986) Singh and Ray (1985) Srinivasmurthy (1985) Sivasankara (1986) Sulaiman (1989) and Athimuthu (1990) pointed out lack of irrigation facilities as one of the major constraints in fertiliser use If the most critical factor water is not available naturally the farmers will be reluctant to adopt other management practices which are more related to water management for efficient use of fertilisers

5 6 Empirical model of the study

The results on fertiliser use behaviour of rice farmers is represented diagramatically in the empirical model presented in Fig 13

The model consists of five concentric circles Inside the fifth circle (innermost circle) there are four smaller circles representing the three major fertiliser nutrients and organic manures which are connected with each other representing CFUBI The smaller circles are further divided into dimensions representing quantity time of application

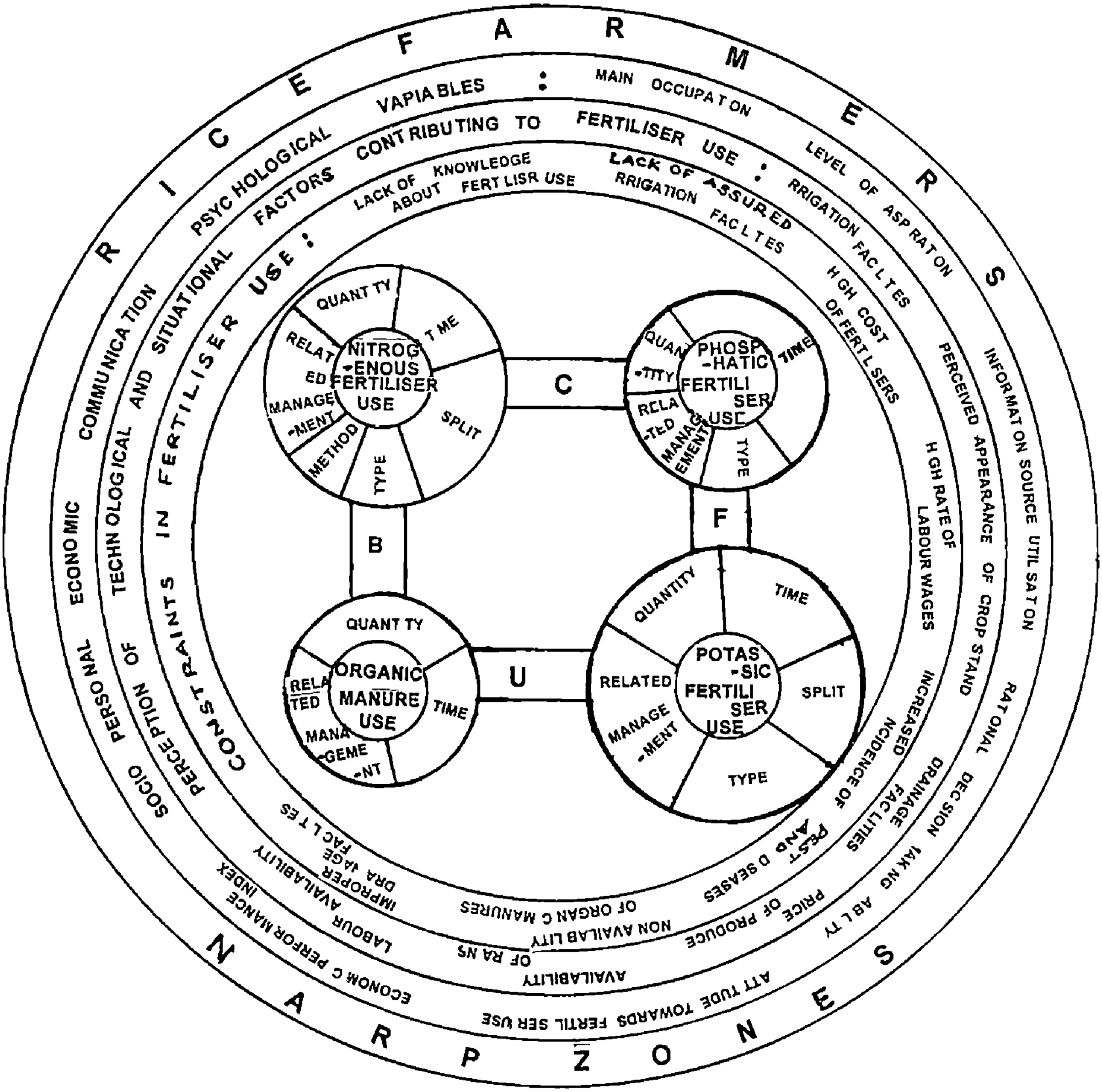

FIG 13 EMPIRICAL MODEL BASED ON THE FINDINGS OF THE STUDY

split application type of fertiliser method of application and related management practices

The results indicated that among the fertiliser nutrients potassic fertiliser use index was found to have great contribution in explaining the variation in CFUBI followed by the nitrogenous fertiliser use index With regard to the nitrogenous fertiliser use behaviour split application was found to explain maximum variability while time of application was important in the case of use behaviour of phosphatic fertilisers In the case of potassic fertilisers and organic manures all the dimensions were found to be important in explaining the variability in their use behaviour

The fourth inner circle presents the major constraints in fertiliser use as lack of knowledge lack of assured irrigation high cost of fertilisers non availability of organic manure high rate of labour wages increased incidence of pests and diseases and improper drainage facilities

The third inner circle depicts the important environmental and technological factors contributing to fertiliser use as perceived by rice farmers scientists agricultural extension personnel and the input dealers Irrigation facilities perceived appearance of crop stand drainage facilities labour availability availability of rain and price of produce were the important factors identified

The second circle represents the behavioural characteristics of farmers which were found significantly related to their fertiliser use The characteristics identified as important are attitude towards fertiliser use rational decision making ability level of aspiration information source utilisation main occupation and economic performance index

The outermost circle represents the rice farmers in the different NARP zones in the state who formed the main respondents of the study on whom the aspects depicted in the innermost circles (2 to 5) has profound influence in deciding the fertiliser use behaviour

Based on the findings of the study the model suggested in Fig 13 could be utilised by all those agencies concerned with fertiliser education and promotion to effectively gear up their activities

Summary

CHAPTER VI

SUMMARY

Fertilisers play an important role in increasing agricultural production Being an expensive input it forms a sizeable percentage of the total cost of cultivation of rice Therefore it is of critical importance to use every unit of this vital input efficiently Fertiliser use efficiency by the farmers depends on their fertiliser use behaviour There are various practices recommended for efficient fertiliser management aimed at increased nutrient availability to the crops and better yield In order to understand the acceptance and use pattern of the various recommended practices among the rice farmers it is necessary that one has to analyse the adoption pattern and also understand the reasons if they are not adopting the recommended practices With the above purpose in mind the present study was designed and conducted

The following were the specific objectives of the study

(i) to develop an index for measuring the fertiliser use behaviour of rice farmers

(ii) to identify the factors contributing to fertiliser use behaviour as perceived by the farmers extension personnel scientists and input agencies

(iii) to correlate the selected personal socio-economic and socio psychological characteristics of farmers with their fertiliser use behaviour

(iv) to identify the constraints in fertiliser use of rice farmers and

(v) to suggest a model for efficient fertiliser use behaviour of rice farmers

The study was conducted among the rice farmers of Kerala State A sample of 300 rice farmers was selected employing multistage sampling procedure The District with highest area under rice Agricultural Sub Division Block and Krishi Bhavans formed the different strata Ten Krishi Bhavans were selected from the five NARP Zones The Krishi Bhavans selected were Soornadu North and Soornadu South of Kollam District in Southern Zone Erimayoor and Kavasseri of Palakkad District in Central Zone Karimbam and Kurumathoor Krishi Bhavans of Kannur District in Northern Zone Ambalavayal and Nenmeni Krishi Bhavans of Wayanad District in High Range Zone and Champakulam and Nedumudi Krishi Bhavans of Alappuzha District in Special Zone on Problem Areas From each of the selected Krishi Bhavans 30 rice farmers were selected randomly from each Krishi Bhavan in such a way that farmers from all the categories were represented proportionately Thus a total sample of 300 (30 x 10) rice farmers were selected for the study Forty agricultural scientists 40 agricultural extension personnel and 40 imput dealers also were selected as other categories of respondents for the study

The dependent variable for the study was the fertiliser use behaviour of rice farmers which was transformed into an index called Composite Fertiliser Use Behaviour Index It was developed by identifying the different dimensions of fertiliser use for rice obtaining the weightage of the identified dimensions through judges rating and relevancy rating of the practices on fertiliser use of rice as given in in the Package of Practices Recommendations of Crops (1989) by the scientists and extension personnel The reliability and validity of the developed index were tested and the index was standardised for the purpose of the study Simultaneously using Principal Component Analysis (PCA) also the index of Composite Fertiliser Use Behaviour was developed

The personal socio economic and socio psychological characteristics of farmers viz education main occupation farm size area under rice annual income economic motivation level of aspiration rational decision making ability innovativeness attitude towards fertiliser use information source utilization personal guidance on better farming extension participation economic performance index irrigation index soil test utilisation index and knowledge about fertiliser use were selected as independent variables for the study based on judges rating and pilot study These variables were measured using available measuring instruments wherever possible and with tests developed for the purpose in some cases

The data were collected from the different groups of respondents using pretested and structured interview schedules during December 1991 to March 1992 The statistical tools used were mean percentage Delineous Hodges Cumulative Root f stratification coefficient of variation analysis of variance correlation analysis multiple regression analysis stepwise regression analysis Kendall s coefficient of concordance Chi square analysis and Principal Component Analysis

The salient findings of the study are presented below

1 The respondent farmers were categorised into four quartiles based on CFUBI It was found that more than 30 per cent of the farmers each were grouped under good and satisfactory categories respectively while 24 33

and 10 67 per cent of the farmers were grouped under poor and very poor categories respectively

2 The Central NARP Zone had higher percentage of farmers under good category of CFUBI with the highest mean value (70 26%) for CFUBI

3 With respect to the use of nitrogenous fertilisers 30 33 and 37 00 per cent of the farmers respectively were found in good and satisfactory levels while 21 67 and 11 00 per cent of the farmers respectively were in poor and very poor categories

4 Problem Zone had the highest percentage of farmers with good and satisfactory categories (81 67% with mean use value of 76 57) followed by the Central Zone (25% with mean use value of 69 11) in the case of nitrogenous fertiliser use behaviour while Southern Zone was found to be very poor

5 Majority of the farmers (63 00%) were classified as either good or satisfactory with respect to the use of phosphatic fertilisers while 22 67 and 14 33 per cent respectively came under poor and very poor categories

6 The Problem Zone had the highest percentage of farmers with good use behaviour (55 00% with mean use value of 80 71) followed by the Central Zone (33 33% with mean use value of 75 38) in the case of use of phosphatic fertilisers

7 With respect to the use of potassic fertilisers it was found that farmers were almost similarly distributed in the four categories good satisfactory poor and very poor

8 The Problem Zone had higher percentage of farmers under good category with regard to potassic fertiliser use while there were no farmers in the Northern Zone under good level of use whereas 66 67 per cent of farmers were under very poor category

9 Twenty three per cent of the farmers were classified under good and 33 33 per cent under satisfactory categories with respect to the use of organic manures while 18 00 and 25 62 per cent of farmers respectively were under poor and very poor categories

10 High Range Zone had the highest percentage of farmers with good level of use of organic manures (55 00 followed by Central Zone (26 67%) A large majority

(93 33%) of the farmers in the Problem Zone were with very poor organic manure use behaviour

11 Based on quantity of nitrogenous fertilisers used 15 67 per cent of the farmers were found under good category while 40 67 per cent of the farmers were under satisfactory category Twenty three and 20 67 per cent of farmers came under poor and very poor categories respectively

12 There was significant difference observed among the five NARP Zones in respect of the different components of nitrogenous phosphatic and potassic fertilisers and organic manure use

13 Significant association between the NARP Zones and fertiliser use behaviour of farmers were observed with respect to CFUBI use of nitrogenous phosphatic and potassic fertilisers and organic manures and also with respect to the components of each nutrient and organic manures

14 The result of PCA indicated that use behaviour of potassic fertilisers had the highest factor loading (0 895) in explaining 53 79 per cent variation in the CFUBI of farmers followed by the use of nitrogenous fertilisers

15 With regard to nitrogenous fertiliser use behaviour split application of nitrogenous fertiliser obtained the highest factor loading (0 924) followed by quantity of fertiliser and time of application in explaining 67 76 per cent of variation

16 Time of application emerged important in explaining the variation in relation to the use of phosphatic fertiliser with the highest factor loading of 0 854 followed by related management practices (0 808) which accounted for 60 71 per cent variability

17 All the five dimensions were found almost equally contributing to the variability in potassic fertiliser use which in total explained 85 53 per cent of variability

18 All the three factors were found to be significantly contributing to variability in explaining about 72 27 per cent of variability in the use of organic manures

19 Split application of nitrogenous fertilisers quantity and time of application of phosphatic fertilisers quantity and split application of potassic fertilisers and quantity of organic manures were found significant in predicting the yield index to the extent of 42 30 per cent

20 There was high agreement among the four categories of respondents viz farmers agricultural scientists agricultural extension personnel and input dealers with regard to the perception of importance of the different situational and technological factors contributing to fertiliser use behaviour of farmers The first six factors perceived as important in order of their rankings were irrigation facilities perceived appearance of the crop stand drainage facilities price of produce availability of rain and availability of labour

21 Main occupation level of aspiration rational decision making ability attitude towards fertiliser use information source utilisation and economic performance index were found to be significant in predicting the fertiliser use behaviour of farmers

Implications of the study

1 The fertiliser use behaviour index developed in this study may be useful to measure the fertiliser use behaviour of farmers engaged in cultivation of other crops also

2 The dimensions of fertiliser use behaviour found to be significant in explaining the variability in fertiliser

use behaviour could be further tested and used as indicators to predict the fertiliser use of farmers

3 Majority of farmers were classified under the satisfactory level in the case of CFUBI which reflects the general awareness about fertilisers and its acceptance among the rice farmers At the same time it also points to the need for improving the use efficiency of fertilisers so that majority of farmers could be pushed to good level of use behaviour through strategic fertiliser promotion programmes

4 The wide variation observed in the potassic fertiliser use in comparison to the use of nitrogenous and phosphatic fertilisers indicates the lack of awareness about the specific functions of each nutrient in crop production and also the lack of knowledge about balanced nutrition among the farmers This underlines the need for formulating effective extension strategies to educate the farmers about the principles of balanced nutrition and also the role of each nutrient in crop production

5 Wide variation observed in the use of organic manure reflects the overdependence of the farmers on inorganic chemical fertilisers The farmers should be educated about the concept of Integrated Nutrient Supply System

(INSS) wherein the role of organic manures in plant nutrition may also be emphasised

6 Regarding method of application and also split application it is necessary that enough stress be given in farmers training programmes to educate the farmers and make them adopt these practices and thereby enable them to derive advantage of these practices

7 The field level extension personnel also should be made competent in various practical aspects of fertiliser application so that they can provide need based recommendations for farmers For this location specific and problem based recommendations have to be formulated by the researchers which warrants conduct of location specific trials and research on the part of the researchers

8 The significant difference among the zones and the comparatively poor use behaviour noticed in the case of the Northern and Southern NARP Zones should draw the attention of the development agencies In addition to fertiliser educational efforts proper and adequate infrastructural facilities like irrigation water drainage supply of inputs etc are to be provided on an urgent basis in these areas

9 The perceived appearance of crop stand identified as the most important factor by the farmers in their fertiliser use is a good example for the need of utilising the rich and varied field experiences of the farmers in the conduct of research and also for further refinement of the recommended practices

10 The significance of the characteristics of farmers such as attitude towards fertiliser use level of aspiration information source utilisation and rational decision making ability reflect the need for re orienting the behaviour of farmers towards efficient use of fertilisers through different methods and media

11 The delay and also non receipt of soil test results was pointed by majority of the farmers as the reason for low fertiliser use behaviour This necessitates proper measures to be adopted by the authorities for quick despatch of soil test results to the farmers The service of mobile soil testing laboratories may be made available to more farmers

12 The non availability of materials like neem cake coal tar desired fertilisers lime etc and also adulteration in neem cake and organic manures were reported by the farmers which were found to affect the efficient use

behaviour of fertilisers Proper machinery should be organised to ensure the availability of the different materials of good quality in adequate quantity and also at proper time

13 Lack of proper guidance by the extension personnel was pointed out as one of the constraints is fertiliser use Much attention should be given to this aspect In most cases the input dealers advise the farmers about the use of fertilisers and they suggest the use of other fertilisers which are available with them The extension personnel have a potential role in properly guiding the farmers It is necessary that the field extension staff may give proper guidance to the farmers in proper decision making related to fertiliser use

Suggestions for future research

1 The fertiliser use behaviour of farmers under each NARP Zone may be studied separately in detail for drawing specific conclusions and recommendations

2 Similar studies may be conducted for each crop season so that valuable information for season wise conclusions and recommendations can be made

3 The index developed for the present study may be further tested in different locations seasons varieties and crops for improvement and standardisation

4 An index of integrated nutrient management may be developed including inorganic fertilisers organic manures lime micronutrients biofertilisers and such other practices

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Appendices

Appendix-I

Dimensions of fertiliser use behaviour

The possible dimensions of fertiliser use behaviour are grouped as follows The relevancy of measuring these six dimensions in the case of the three major nutrients (NPK) and organic manures may be marked by a / in the appropriate columns

Sl No	Dimensions of fertiliser use behaviour	Fertilisers/Manures							
		N		P_2O_5		K_2O		OM	
		Relevant	Not relevant	Relevant	Not relevant	Relevant	Not relevant	Relevant	Not relevant
1	Quantity applied								
2	Time of application								
3	Split application followed								
4	Type of fertilisers/ manures								
5	Method of application								
6	Related management practices								

Appendix-V

I Latent Vectors of Composite Fertiliser Use Behaviour Index (CFUBI)

Index	P I	P II	P III	P IV
N index	0 347	-0 006	0 798	-0 493
P index	0 201	0 104	0 448	0 865
K index	0 787	0 492	-0 370	-0 050
OM index	-0 470	0 864	0 162	-0 079

II Latent Vectors of N Index

Dimensions	P I	P II	P III
Qa (N)	0 505	-0 506	0 297
Ta (N)	0 437	0 525	-0 612
Ns (N)	0 598	0 354	-0 212
Tf (N)	0 317	0 542	0 695
Ma (N)	0 058	-0 030	-0 043
Rm (N)	0 306	0 220	0 084

III Latent Vectors of P ındex

Dımensıons	P I
Qa (P)	0 555
Ta (P)	0 630
Tf (P)	0 304
Rm (P)	0 450

IV Latent Vectors of K Index

Dımensıons	P I	P II
Qa (K)	0 424	-0 028
Ta (K)	0 478	-0 299
Ns (K)	0 451	0 857
Tf (K)	0 481	-0 408
Rm (K)	0 396	-0 090

V Latent Vectors of OM Index

Dımensıons	P I
Qa (OM)	0 408
Ta (OM)	0 527
Rm (OM)	0 746

Appendix VI

Directorate of Extension
Kerala Agricultural University
Mannuthy

Dated

From

Dr A G G Menon
Director of Extension

To

Deai Sir,

This is in connection with a research study undertaken by Smt P S Geethakutty, who is doing her Ph D programme under my guidance She is developing an index for measuring the fertiliser use behaviour of rice farmers of Kerala

Considering your rich experience you have been chosen as an expert for judging the appropriateness of the independent variables related to the study Please go through the enclosed list of variables which are supposed to be related to the fertiliser use behaviour of rice farmers You may please indicate your opinion about the inclusion of each variable in the study by marking (✓) against each variable under the appropriate column You can also add other variables which you think are related and also rate them under the appropriate column

I am aware that you have a busy schedule Yet I hope that you will kindly spare sometime for us Your kind and early action in the matter would greatly help us to complete the study in time Please return the duly filled annexure to the address indicated in the envelope at the earliest

Thanking you,

Yours faithfully

(A G G Menon)

Sl No	Variable	Mean relevancy score
* 1	Education	4 1
* 2	Farming experience	3 9
* 3	Status of land ownership	3 9
* 4	Main occupation	4 2
5	Caste	1 2
* 6	Farm size	3 8
* 7	Area under rice	3 7
* 8	Annual income	4 4
* 9	Economic performance index	4 2
*10	Risk orientation	4 1
*11	Economic motivation	4 0
*12	Self reliance	3 8
13	Deferred gratification	3 1
14	Scientific orientation	3 2
15	Competition orientation	3 2
*16	Rational decision making ability	3 8
*17	Level of aspiration	4 4
*18	Innovativeness	4 8
19	Perception about sustainable farming	2 2
*20	Attitude towards fertiliser use	4 8
21	Attitude towards fertiliser agency	2 2

*22	Information source utilisation index	4 4
*23	Personal guidance on scientific farm	3 8
*24	Extension participation	3 8
25	Social participation	3 2
26	Contact with extension agency	2 2
*27	Knowledge about fertiliser use	4 6
*28	Group farming participation	3 8
*29	Irrigation index	3 8
*30	Soil test utilisation index	3 7

* Variables selected for the pilot study

Appendix-VII

Items of knowledge test

Sl No	Items	Difficulty index (Pi)	Discrimination index
1	High yielding varieties are responsive to high doses of fertiliser application Yes/No	87 50	0 28
*** 2	There is no difference in fertiliser dosage for high yielding and local varieties of rice Yes/No	68 75	0 43
3	For short duration high yielding rice varieties the recommended fertiliser dosage is ------	22 90	0 38
4	All the fertilisers have to be applied at the time of final ploughing Yes/No	95 80	0 13
*** 5	N, P and K fertilisers should be applied in a definite proportion Yes/No	58 33	0 75
6	Full N is applied as basal dose Yes/No	29 20	0 38
7	Nitrogen application results in more number of tillers and thereby leads to more grain yield Yes/No	12 50	0 25

*** 8	Nitrogen application in split doses minimises losses and maximises its utilization by the plants Yes/No	31 30	0 44
9	Nitrogen application at the flowering stage leads to heavy grains	8 30	0 19
10	N is to be applied in 2 or 3 split doses Yes/No	20 80	0 44
*** 11	For top dressing of fertiliser one day prior to the application, the field should be drained Yes/No	58 30	0 78
*** 12	Nitrogen can be applied as foliar spray Yes/No	35 40	0 75
13	Neem coated urea is more efficient Yes/No	25 00	0 56
14	Urea is cheaper than ammonium sulphate Yes/No	18 80	0 44
15	Placement of urea briquettes will reduce loss than its broadcasting Yes/No	10 40	0 25
*** 16	Mixing of urea with soil will reduce leaching loss Yes/No	41 60	0 75
17	Phosphatic fertilisers are generally given as a basal single dose Yes/No	89 50	0 25

18	Super phosphate contains 16% P_2O_5 Yes/No	4 20	0 07
19	N P and K can be obtained from a complex fertiliser Yes/No	10 40	0 25
20	Name a phosphatic fertiliser --------	89 60	0 13
21	For high yielding short duration rice varieties we have to apply 45 kg P/ha Yes/No	4 20	0 13
22	For high yielding short duration varieties 35 kg of K_2O/ha is to be applied Yes/No	4 30	0 19
*** 23	K_2O is to be applied in a single basal dose Yes/No	37 50	0 38
24	An example of K fertiliser is --------	27 10	0 64
25	Lime is to be applied at the rate of --- - kg/ha	16 70	0 25
26	Full dose of lime is to be applied in a single application Yes/No	54 10	0 25
27	An example of liming material is -- ----	83 30	0 13
28	Lime can be applied as foliar spray Yes/No	2 10	0 07
29	Zinc deficiency in rice leads to -- --	0 00	0 00

30	For zinc deficiency ------- is to be applied as foliar spray	0 00	0 00
31	Manures help in maintaining the physical condition of the soil Yes/No	12 50	0 25
*** 32	Manures provide, N P and K which are available to the plant for a long time Yes/No	31 30	0 44
33	Manure application increases water holding capacity of the soil Yes/No	6 25	0 13
34	Organic manure is to be applied and incorporated into the soil while ploughing Yes/No	91 70	0 13
35	Recommended quantity of organic manure is 5 t/ha Yes/No	8 33	0 06
*** 36	Water is essential for the uptake of fertilisers by the plants Yes/No	35 40	0 56
37	Out of N, P and K any one type of fertiliser is enough for plant growth Yes/No	95 80	0 06
38	Nutrients from inorganic fertilisers are easily available to the plants Yes/No	10 40	0 19
39	Application of fertilisers will destroy the soil properties Yes/No	16 70	0 31

*** 40	Name a green manure crop that can be grown and incorporated into the soil ----	32 30	0 75
41	Name a biofertiliser used in rice cultivation -------	2 10	0 06
42	One legume crop that can be grown in paddy field is --------	16 70	0 31
*** 43	A time lag of one week should be given between application of lime and fertilisers Yes/No	35 40	0 44
44	A well puddled and levelled field will reduce the loss of water and nutrients through percolation Yes/No	4 25	0 06
*** 45	Soil test is to be conducted and fertiliser recommendation has to be modified based on soil test result Yes/No	70 80	0 61
46	Foliar application of fertiliser increases efficiency Yes/No	4 25	0 13
*** 47	Growing of leguminous crop in the rice field will increase N availability Yes/No	37 50	0 56
*** 48	There is more advantage in using straight fertiliser than fertiliser mixtures or complex fertilisers	35 40	0 44

*** Items selected for the knowledge test

Appendix VIII(a)

FERTILISER USE BEHAVIOUR OF RICE FARMERS OF KERALA

Date

Interview Schedule

NARP Region
District
Sub Division
Block
Krishi Bhavan

PART A

1 Name of the respondent

2 Education

Illiterate/can read only/
can read and write/
primary/middle school/
High school/collegiate

3 Occupation

a Primary occupation

b Secondary occupation

4 Farm size

Sl No	Particulars	Wet	Dry	Garden	Total
		(in hectares)			
a	Owned				
b	Leased in				
c	Leased out				
	Total				

5 Area under rice

Sl No	Particulars	Area (in hectares)
	I Crop	
	II Crop	
	III Crop	
	Total	

6 Annual income

Please state your annual income

From farming (Rs)

From other sources (Rs)

7 Economic motivation

Indicate whether you agree or disagree with the following statements

1 A farmer should work toward large yields and economic profit Agree/Disagree

2 The most successful farmer is one who makes the maximum profit Agree/Disagree

3 A farmer should try any new farming idea which may earn him more money Agree/Disagree

4 A farmer should grow cash crops to increase monetary benefits in comparison to growing of food crops for home consumption Agree/Disagree

5 It is difficult for the farmer s children to make good start unless he provides them with economic assistance — Agree/Disagree

6 A farmer must earn his living but the most important thing in life cannot be defined in economic terms — Agree/Disagree

8 Level of aspiration

You see the picture of a ladder with 10 steps Suppose we say that the top of the ladder (pointing up) represents the best possible life for you and botton (pointing down) represents the worst possible life for you

a Where on the ladder do you feel personally stand at present?

Step No

b Where on the ladder do you feel personally you stood 5 years ago?

Step No

c Where do you think you will be in five years from now?

Step No

10

9

8

7

6

5

4

3

2

1

0

9 Rational decision making ability

Please indicate how you have arrived at the following decisions by selecting the most appropriate reason (only one) in your case

A Decision on the type of fertiliser

1 Based on crop and soil

2 Advice of friends/relatives/neighbour

3 Used what at hand/available

4 Recommendations of salesman

5 Do not know

6 Based on the advice of the extension worker

7 Any other (specify)

B Decision about the quantity of fertiliser

1 Recommendations of extension worker

2 Based on soil test result

3 Recommendation of friends/relatives/neighbour

4 Always used the same quantity or same as last year

5 Recommendations of salesman

6 Used what at hand

7 Any other (specify)

C Decision on the area to be put under paddy last year

1 Ease in cultivation

2 Availability of water/labour/credit

3 Market conditions

4 Always sows the same area

5 Requirement of rice for the family

6 Do not know

7 Any other (specify)

D Decisions on the various plant protection measures

1 Recommendations of extension personnel

2 Nature of damage

3 Used the chemicals which were available

4 General experience and knowledge

5 Recommendations of neighbours/other farmers/dealers

6 Do not know

7 Any other (specify)

10 Innovativeness

Here are 8 statements You may please listen and indicate your response

1	Do you want to learn new ways to farm?	Yes/Undecided/No
2	If the agricultural extension worker gives a talk on improved cultivation aspects would you attend?	Yes/Undecided/No
3	If the government would help you establish a farm elsewhere, would you move?	Yes/Undecided/No
4	Do you want a change in your way of life?	Yes/Undecided/No
5	A farmer should try to farm the way his parents did	Yes/Undecided/No
6	Do you want your sons to be farmers	Yes/Undecided/No

11 Attitude towards fertiliser use
(Please indicate your response for each of the following statements)

		Scale value	Strongly agree	Agree	Disagree	Strongly disagree
1	Use of fertiliser is a very useful practice	8 80				
2	The crop yields can easily be increased by the use of fertilisers	8 50				
3	Use of fertilisers is one of the important ways to increase farm income	7 90				
4	Use of fertilisers results in further improvement in farming practices	6 70				
5	Use of fertilisers cannot remove all the problems of a farmer	3 56				
6	Most of the farmers should use fertilisers	8 42				
7	The continuous use of fertiliser spoils the land	1 36				
8	If a farmer wants to have a good crop, better he should fertilise	7 50				
9	Use of fertilisers means to invite diseases and pests in the farm	1 30				

12 Exposure to information sources

I will list out the sources through which farmers get information on fertiliser technology Kindly tell me through which source you get information with regard to fertiliser and manure use

	Source	Response		
		Never	Occasionally	Regularly
A	Official sources			
1	Agricultural Officer			
2	Agricultural Assistant			
3	University Scientists			
4	Bank officials			
5	Fertiliser Dealers			
6	Co-operative Society officials			
7	Block officials			
	Others (specify)			
B	Non-official sources			
8	Convenors of group farming committees			
9	Progressive farmers			
10	Friends			
11	Relatives			
12	Neighbours			
	Any others (specify)			

C Interpersonal sources

13 Newspaper

14 Other printed materials

15 Radio

16 Television/Video cassettes

17 Exhibitions

18 Meetings/Seminars

19 Any other (specify)

13 Personal guidance on scientific farming

Indicate your response to the following statements based on the extent of personal guidance you have received during the last year for your farming

a The extent to which you discussed your problems related to fertiliser use for your rice crop with the extension personnel

Very much/much/very little/never

b The extent to which extension personnel visited your rice crops

Very much/much/very little/never

c The extent of advice you received for proper selection of fertiliser

Very much/much/very little/never

d The extent of advice you received for proper use of fertilisers

Very much/much/very little/never

e The level of assistance in identifying pests and diseases and their control

Very much/much/very little/never

14 Extension participation

(Please indicate your frequency of participation in the following extension activities)

Sl No	Extension activities	Frequency of participation		
		Whenever conducted	Sometimes	Never
1	Group farming committee meeting			
2	Agricultural Seminars			
3	General meetings/ Discussions			
4	Exhibitions			
5	Demonstrations			
6	Campaigns			
7	Trainings			
8	Film shows			
9	Any other (specify)			

15 Economic performance index

Sl No	Season	Total acreage	Quantity produced per ha		Total production		Total value	Total cost of production			Economic performance Index 8/9x100
			Rice	Straw	Rice	Straw		Input	Labour		
									Hired	Family	
1	2	3	4	5	6	7	8	9	10	11	12

16 Irrigation index

Do you irrigate your crop? Yes/No

If yes specify the nature of irrigation to your crop

	Availability of irrigation water			Area irrigated			
	Throughout the season 3	Partially 2	Never 0	75 00% and above	50 00% to 74 99%	25 00% to 49 99%	Below 25 00%
1st season							
2nd season							

17 Soil Test Utilization

1. Did you get the soil tested for your paddy field during the last year — Yes/No

2. If yes, did you adopt the so l test recommendation? — Yes/No

18 Knowledge about fertiliser use for rice

1. There is no difference in fertiliser dosage for high yielding and local varieties of rice — Yes/No
2. N, P and K should be applied in a definite proportion — Yes/No
3. Nitrogen application in split doses minimises losses and maximises its utilisation by the plants — Yes/No
4. For top dressing one day prior to the application the field should be drained — Yes/No
5. Nitrogen can be applied as foliar spray — Yes/No
6. Mixing of urea with soil will reduce leaching loss — Yes/No
7. K_2O is to be applied in a single basal dose — Yes/No
8. Manures provide, N, P and K which area available to the plant for a long time — Yes/No
9. Water is essential for the uptake of fertilisers by the plants — Yes/No
10. Name a green manure crop that can be grown and incorporated into the soil — Yes/No
11. A time lag of one week should be given between application of lime and fertilisers — Yes/No

12 Soil test is to be conducted and fertiliser recommendation has to be modified based on soil test result Yes/No

13 Growing of leguminous crop in the rice field increase N availability Yes/No

14 There is more advantage in using straight fertiliser than fertiliser mixtures or complex fertilisers Yes/No

PART B

Some of the factors influencing the fertiliser use behaviour of rice farmers are listed below Please indicate how you perceive the importance of these factors in fertiliser use behaviour for rice Express their importance assigning the numbers between 0 and 10 based on the importance of your perception

Importance of the technological and situational factors contributing to the farmers' fertiliser use behaviour

	Factors affecting fertiliser use behaviour	0	1	2	3	4	5	6	7	8	9	10
1	Variety grown											
2	Irrigation facilities											
3	Drainage facilities											
4	Price of fertiliser											
5	Availability of fertiliser subsidy											
6	Availability of rain											
7	Availability of credit											
8	Soil type											
9	Crop season											
10	Cropping intensity											
11	Cropping pattern											
12	Availability of desired fertiliser in time											

	Factors affecting fertiliser use behaviour	0	1	2	3	4	5	6	7	8	9	10
13	Availability of organic manure											
14	Fertiliser use behaviour of neighbours and friends											
15	Price of produce											
16	Extension guidance											
17	Availability of information											
18	Promotional efforts by fertiliser agencies											
19	Group farming activities in the locality											
20	Perceived appearance of crops stand											
21	Yield obtained during the previous season											
22	Labour availability											
23	Soil testing facilities											

PART C

Season	Variety grown	Name of nutrients or manure	Quantity applied	No of split application	Qty in each split application	Time of each split application	Source of nutrients used	Method of application	Area cultivated	Area fertilised (ha)	Regularity in application	Yield Obtained kg/ha
		1 N 1										
		2										
		3										
		4										
		Reasons for improper/non adoption										
		2 P										
		Reason for IA/NA										
		3 K 1										
		2										
		Reasons for IA/NA										

4 Ca 1
2

Reason for IA/NA

5 OM

Reasons for IA/NA

Related management practices	Regularity in appln R	S	N	Extent of area adopted	Reason for NA/IA
1 For top dressing of fertilisers temporarily drain the field one day prior to the application and reflood after 24 hours					
2 The field should be puddled and levelled thoroughly to reduce the loss of water and nutrients through percolation					
3 Carry out soil testing and follow recommendations					
4 Foliar application of fertilisers will increase the efficiency					

PART D

Some of the constraints experienced by the farmers in the use of fertiliser and manures are given below On the basis of your experience, please indicate your response about each constraint

Sl No	Constraint	Most impor-tant	Impor-tant	Less impor-tant	Least impor tant
1	High cost of fertilisers				
2	Non-availability of the desired fertilisers in time				
3	Non-availability of organic manures				
4	Lack of transportation facilities				
5	Lack of assured irrigation				
6	Improper drainage facilities/water stagnation				
7	Scarcity of labour in time				
8	High rate of labour wages				
9	Lack of knowledge about fertiliser use				
10	Non-availability of soil test results in time				
11	Lack of guidance				
12	Increased incidence of pests and diseases				
	Any other (specify)				

Appendix VII(b)

Factors affecting the fertiliser use behaviour of rice farmers as perceived by scientists/extension personnel/input agencies

1 Name of the respondent

2 Address

3 Some of the technological and situational factors influencing the fertiliser use behaviour of rice farmers are listed below

Please indicate how you perceive the importance of each factor in influencing the rice farmers fertiliser use behaviour by putting a (/) mark in the relevant column (from 0 to 10 in the attached response sheet

In the present study Fertiliser Use Behaviour of rice farmers is operationally defined as the pattern of use of the fertilisers and manures recommended for rice such as the quantity of fertilisers and manures used time of application split application method of application type of fertilisers and manures and other related management practices

Importance of the technological and situational factors contributing to the farmers fertiliser use behaviour

	Factors affecting fertiliser use behaviour	0	1	2	3	4	5	6	7	8	9	10
1	Variety grown											
2	Irrigation facilities											
3	Drainage facilities											
4	Price of fertiliser											
5	Availability of fertiliser subsidy											
6	Availability of rain											
7	Availability of credit											
8	Soil type											
9	Crop season											
10	Cropping intensity											
11	Cropping pattern											
12	Availability of desired fertiliser in time											

13 Availability of organic manure

14 Fertiliser use behaviour of neighbours and friends

15 Price of produce

16 Extension guidance

17 Availability of information

18 Promotional efforts by fertiliser agencies

19 Group farming activities in the locality

20 Perceived appearance of crops' stand

21 Yield obtained during the previous season

22 Labour availability

23 Soil testing facilities

FERTILISER USE BEHAVIOUR OF RICE FARMERS OF KERALA

By

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ABSTRACT OF THE THESIS

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ABSTRACT

The study was conducted with the main objective of developing an index for measuring the fertiliser use behaviour of rice farmers. A total of 300 rice farmers were selected following multi stage random sampling procedure, 60 from each District, so selected that each District represented one NARP Zone. Besides farmer respondents, 40 agricultural scientists, 40 agricultural extension personnel and 40 input dealers were also selected as other categories of respondents for the study.

The Composite Fertiliser Use Behaviour Index (CFUBI) was developed by identifying six dimensions of fertiliser/manure use for rice, (quantity, time of application, split application type, method of application and related management practices). The weightages of the identified six dimensions were obtained through judges rating and also through the relevancy rating of the practices under the identified dimensions. The CFUBI derived by the formula method was compared with the index developed by the Principal Component Analysis (PCA) method.

Based on relevancy rating and pilot study 17 behavioural characteristics were selected as independent

variables The variables were quantified using standardised procedures Mean and percentage analysis, Delinious Hodges Cumulative Root 'f' stratification, Critical difference, Coefficient of variation, Analysis of variance, Kendall's coefficient of concordance Chi-square analysis, Correlation analysis, Multiple regression analysis and Principal Component Analysis were the statistical tools used for data analysis

The study revealed that more than 60 per cent of rice farmers were under 'good and satisfactory categories based on their CFUBI The NARP Central Zone had highest percentage of farmers under 'good' category of CFUBI, while the Problem Zone had the highest percentage of farmers with regard to the use of nitrogenous, phosphatic and potassic fertilisers The High Range Zone had the highest percentage of farmers with respect to the use of organic manures

Based on the use of nitrogenous and phosphatic fertilisers, majority of the farmers were categorised under either 'good' or 'satisfactory' category, while with respect to the use of potassic fertilisers, it was found that farmers were almost similarly distributed under good satisfactory' poor and very poor categories

The Problem zone and Northern zone were found to be very poor' with respect to the use behaviour of organic manures and potassic fertilisers respectively There was significant difference among the five NARP Zones in respect of the different dimensions of use of nitrogenous, phosphatic and potassic fertilisers and organic manures

The use behaviour of potassic fertilisers had the highest factor loadings in explaining variability in the CFUBI of farmers followed by the use behaviour of nitrogenous fertilisers

Split application of nitrogenous fertilisers quantity and time of application of phosphatic fertilisers, quantity and split application of potassic fertilisers and quantity of organic manures were found significant in predicting the AYI of farmers

The behavioural characteristics of farmers found to be significant in predicting the fertiliser use behaviour of rice farmers were main occupation level of aspiration rational decision making ability attitude towards fertiliser use, information source utilisation and economic performance index

The important technological and situational factors contributing to fertiliser use behaviour as perceived by the farmers extension personnel scientists and input dealers were irrigation facilities perceived appearance of crop stand, drainage facilities, price of produce, availability of rain and availability of labour

Lack of knowledge about fertiliser use lack of assured irrigation facilities, high cost of fertilisers, high rate of labour wages, increased incidence of pests and diseases, non availability of organic manures and improper drainage facilities were the major constraints in the composite fertiliser use behaviour of rice farmers in Kerala