ANALYSIS OF TRANSFER OF TECHNOLOGY WITH RESPECT TO BIOFERTILISERS

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THESIS

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DECLARATION

I hereby declare that the thesis entitled "**Analysis of transfer of technology with respect to biofertilisers**" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, fellowship, associateship or other similar title, of any other university or society.

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CERTIFICATE

Certified that this thesis entitled "**Analysis of transfer of technology with respect to biofertilisers**" is a record of research work done independently by **Miss. Mercykutty, M.J.**, 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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CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

Introduction

CHAPTER-I

INTRODUCTION

The Indian farming scenario has changed tremendously during the late sixties and seventies with the widespread adoption of modern agricultural technologies comprising of high yielding varieties, chemical fertilisers, assured irrigation and improved agronomic practices.

Agriculture in India has shown increased use of chemical fertilisers. The total consumption of fertiliser in our country has been estimated to be about 9.2 metric tonnes and this may possibly increase to 20 metric tonnes by the end of twentieth centuary.

Exhaustive cropping systems have reduced soil health by excessive mining of nature fertility and leaving hardly any crop residue, which is necessary to maintain an optimum level of organic matter.

In India, at present there is a gap of about 10 million tonnes of plant nutrients between removal by crops and replenishment through fertilisers. Supply of nutrients from organic manure has not so far been able to fill up this gap. The nutrient supply from this source is unlikely to improve due to competing demand for alternate uses like fuel and fodder. Of late, biofertilisers are being promoted as an important component in supplementing plant nutrient need of the country.

A challenge faced by India is to augment its productivity with integrated use of such inputs which are not only cost effective but also eco-friendly. Biofertilizers of different kinds utilising different traits of useful soil microorganisms in mobilising plant nutrients have now been established as a new vista in the fertiliser prescription for use over a variety of crops.

With almost twice the quantity of plant nutrients being removed from soil that of what is added through fertilisers, the growing nutrient imbalance poses a major threat to sustain soil health and crop productivity. This has underlined the need for adoption of Integrated Nutrient Supply System (INSS) which involves the combined use of different nutrient sources such as chemical fertilisers, organic manure and biofertilisers.

In India, systematic studies on biofertilisers started about 75 years ago with the first report of the isolation and identification of Rhizobium from different cultivated legumes (Motsara *et al.*, 1994). Now several inoculants such as Rhizobium, Azotobactor, Azospirillum, Blue Green Algae, Azolla, Vesicular Arbuscular Mycorrhizae, Phosphate solubiliser etc. are widely recognised as effective biofertilisers in different cropping situations.

India is one of the important countries in biofertiliser production and consumption in the world. The present production capacity of different biofertiliser production units in the country is about 4500 tonnes per annum.

Biofertilizers are apparently eco-friendly renewable source of non-bulky, low cost organic agro-input.

Despite the recent production increases, crop productivity and input use in India are amongst the lowest in the world. It is certainly not because of lack of improved technology but on account of other missing links.

Transfer of farm worthy technology is vital for harnessing the fruits of research. In this endeavour, reorientation of the agricultural extension system to make it technology oriented and demand driven with appropriate policy setting, extension planning, technology assessment, refinement and transfer through innovative methods that help extension system to respond to the changing diverse needs of different agro climatic situations would be important.

There is a demand for a shift in the production paradigm so that short term requirements of higher production are carefully balanced against long term goals of sustainability, ecological compatibility and environmental safety.

The growing concern about environmental degradation, shrinking natural resources and the urgency to meet the food needs of a burgeoning population are compelling farm scientists and policy makers to seriously examine alternatives to chemical agriculture. A sustainable agriculture backed-up by 'green technologies' in an integrated farming system has been considered a promising and potential path way.

The gravity of the environmental degradation, arising from faulty practices, has set several experts in the field to focus attention on ecologically sound, viable and sustainable farming systems.

Capitalisation on the level of technology in hand, realisation of the need for refinement, action for ensuring much needed refinement, transfer of farm worthy technology with impact analysis to ensure equity, social justice and overall growth would be the key to success. This would call for setting objectives and goals in the right perspective.

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

Objectives of the study

1. To study the evaluative perception on the feasibility of biofertiliser technology by researchers, extension personnel and farmers in Thrissur district.

2. To study the extent of adoption of biofertiliser technology in different crops by farmers in Thrissur district.

3. To identify the factors influencing adoption of biofertiliser technology by the farmers.

4. To analyse the constraints in different systems of the transfer of biofertiliser technology.

Scope of study

It is an attempt to study the extent of adoption of biofertiliser technology. Since this technology is eco-friendly and is suitable to agro-ecosystems, this study assumes enduring importance to document the adoption behaviour of farmers which may exert a considerable influence on the diffusion of the technology.

The study also throws light on the evaluative perception on the feasibility of biofertiliser technology. These findings and suggested strategy would help the planners, scientists and extension personnel in designing and popularising effective eco-friendly technologies in agriculture.

Limitations of the study

The present research work formed a part of post-graduate programme which was a single student investigation and hence it has all the limiations of time, finance mobility and other resources. The study was restricted to three panchayaths of Thrissur district comprising of Thrissur, Irinjalakkuda and Wadakkancherry subdivisions and as such it may not be possible to generalise the findings of the study for the entire state. Inspite of these limitations, every effort was made by the researcher to carry out the study as systematic and objective as possible.

Presentation of the study

Besides the present chapter, the second chapter viz., theoretical orientation deals with the review of selected important variables and related studies in the field of present investigation, and a conceptual frame work of the study.

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

The fourth chapter brings out the results and discussion of the study. The last chapter consists of the summary. The references and appendices are given at the end.

Theoretical Orientation

CHAPTER-II

THEORETICAL ORIENTATION

The chapter is aimed at developing a theoretical framework for the present study. A review of research work conducted earlier in the area of the study helps the researcher to get an insight into the various empirical procedures adopted in the previous studies and also the findings obtained by those studies. Much studies were not available regarding the transfer of biofertiliser technology. But a review of the related works would help to identify the variables that are relevent to the area of the present research and to count on probable relationship among them. Hence the review on the available studies related directly or indirectly to the present research work are presented under the following heads.

2.1 Concept of perception

2.2 Concept of evaluative perception

2.3 Concept of transfer of technology

2.4 Concept of extent of adoption of biofertiliser technology

2.5 Relationship between selected personal, socio-economic and situational variables and adoption of biofertiliser technology

2.6 Constraints in the research system, extension system, client system and support and service system with respect to transfer of biofertiliser technology

2.1 Concept of perception

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

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

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

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

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

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

According to Bhatia (1978), the simplest definition for perception is sensation plus meaning, sensation meaning quality and perception meaning an object suggested by that quality.

Ryan (1979) stated that social structure and farm family played an important role in the process of formation of attitudes and perceptions and their effects on the adoption of new technologies.

Brady (1981) in a study on developing and transfering technology to small scale farmers reported significant influences of social benefit on perception.

Within the area of interpersonal perception, it has been noted that an individual may infer the causes of another's actions to be a function of personal and environmental force (Heider, 1958).

Action = f (personal force + environmental force)

This is quite close to saying that individuals attempt to determine whether another person is intrinsically motivated to perform an activity (action due to personal force) or extrinsically motivated (action due to environmental force) or both. The extent to which an individual will infer intrinsic motivation on the part of another is predicted to be affected by the clarity and strength of external forces within situation (Jones and Nisbett, 1971). When there are strong forces bearing on the individual to perform an activity, there is little reason to assume that a behaviour is self-determined, whereas a high level of intrinsic motivation might be inferred if environmental force is minimum. Several studies dealing with interpersonal perception have supported this general conclusions (Jones *et al.*, 1961).

2.2 Concept of evaluative perception

Evaluative perception can be operationaly defined as the perception of the respondents about biofertiliser technology which is derived by the critical appraisal or evaluation of the technology.

Scientific studies of evaluative perception on feasibility of biofertiliser technology were not available. Hence, studies conducted in similar or related areas, which were directly and indirectly connected with present study were reviewed for developing the theoretical framework.

Barnett (1953) stated that the novelties would appeal only if they were superior to existing devices in saving time and labour. Also the cost of acquiring or using a novelty might be prohibitive as far as same potential acceptors were concerned.

Jaiswal and Roy (1968) found that the perception of farmers of all the six characteristics ie., profitability, cost, physical compatability, cultural compatability, complexily and communicablity significantly influenced the adoption of agricultural innovations.

Tully (1968) suggested that a farmer might not become interested in any information, if he does not perceive it as relevent to his own farming situation, resources and goals. Further, the farmer's perception would depend on his values, beliefs and attitudes.

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

Ramamoorthy (1973) observed that the characteristics of complex fertilisers which motivated the respondents to adopt were the availability of all the three nutrients, lack of need for physical mixing, easiness and economy to apply and easiness to work out the dosage.

In a study on perception of farm practice attributes, Chandrakandan and Subramanyan (1975) found that farmers were likely to adopt farm practices when they perceive the practices to be more communicable, simple to adopt, less costly, highly divisible and more profitable.

Ravishankar (1979) and Niranjanakumar (1979) reported that majority of extension workers were favourably predisposed to most of the characteristics of innovations. It was also pointed out that they had unfavourable perception of certain characteristics of innovations.

Harwood (1981) in a study on agronomic and economic consideration of technology acceptance in transfering for small scale farming revealed that low requirement of resources is significant in perception.

Rajagopalan (1986) reported observability to be the reason for adoption of Di-ammonium phosphate in paddy nursery.

Sulaiman (1989) observed that the practice of growing leguminous crop was perceived as high in terms of observability and profitability.

Rajendran (1992) found that simplicity, initial cost, physical compatibility, efficiency and availability of technology as crucial determinants of feasibility of technologies.

2.3 Concept of transfer of technology

Transfer

The term 'transfer' was defined differently. According to Chatterjee (1974), transfer means some sort of change of position, usually from one location or system to another location or system.

The second definition given to 'transfer' by Chatterjee (1974) was in terms of an interaction between learning or performance across different tasks, varying across one or more dimensions.

The third definition given by him was more apt to the derived term 'transference' which has special relevance in the client - therapist interactional situation dealt in psychological literature.

Samantha and Kishore (1984) said that transfer might be conceived as equivalent to teaching. Transfer was therefore defined as the successful creation of opportunities or situations in which people gain the abilities on the situation necessary for successfully meeting their needs and interests in such a way as to attain continuous improvement and self-satisfaction.

Technology

Schumacher (1973) opined that any technology developed to the scale appropriate to the human needs and satisfying to them may be called as appropriate technology.

Koontz *et al.* (1980) defined technology as the sum total of knowledge of ways of doing things. It included inventions, techniques and the vast store of organised knowledge of how to do things.

According to Rogers (1983), technology was a design for instrumental action that reduced the uncertainty in the cause effect relationship involved in achieving a desired outcome. A technology had two components (a) hardware aspect consisting of the tool that embodies the technology as material or physical objects and (b) software aspects, consisting of the information base for the tool.

Transfer of Technology (TOT)

Dwarakinath and Channegowda (1974) pointed out three transfer deficiencies. Firstly, not all the available technology is transmitted to the field. It appears that only those elements that make a conspicuous impact on application are taken care of. Secondly, not all potential adopters get exposed to the new information to the same degree. Thirdly, even among the adopters of new technology all the elements of technology are not adopted.

Verma (1974) defined TOT as shifting a technology from one person to another and from one place to another place.

Jaiswal and Arya (1981) defined TOT as a process by which the recommended practices produced by research and development agencies are transmitted through extension agents to producers. Therefore, TOT starts after its perfection and ends in its utilisation by the target consumers.

Reddy (1981) expressed the view that effective TOT takes place when the maximum number of potential adopters understand, accept and actually put into practice the major part of an item of technology with the minimum time lag and with the maximum possible material and financial benefits.

Samantha and Kishore (1984) opined that most effective system for diffusion and adoption of technology depends upon efficient functioning of four systems viz., research, extension, client and support systems.

Singh (1984) viewed that the success of TOT would depend upon understanding the nature and characteristics of the technology and their specific requirements, the characteristics of the farming community and effective communication strategy.

2.4 Extent of adoption of biofertiliser technology

Wilkening (1952) postulated adoption of innovation as a process composed of learning, deciding and acting over a period of time. The adoption or a decision to act has a series of actions and thought decisions.

Copp *et al.* (1958) defined adoption as an activity of farmers taking place over a period of time. They perceived adoption of farm practices as a bundle of related events flowing through time, not as instantaneous.

Rogers (1962) defined adoption process as the mental process through which an individual passes from the first hearing about an innovation to its final adoption.

Review of literature regarding the adoption of biofertiliser technology are summarised below.

In a study conducted at Thailand, Kuchaisit *et al.* (1985) revealed that adoption of rhizobium inoculation in groundnut was still low despite their recognition of its usefulness, but more farmers expressed their interest in this practice provided that the inoculum is locally available.

Singh and Bisoyi (1993) revealed that biofertilisers such as Azolla, blue-green algae, and green manures for rice, Azotobacter and Azospirillum for wheat, millets and vegetables and Rhizobium for pulses and oil legume crops have been widely used in India for a number of years.

Chinchung and Young (1994) revealed that the use of Rhizobium, D-solubilizing bacteria and vesicular arbuscular mycorrhizal fungi for soyabeans, ground nut, maize and trees were practised in Taiwan.

Patronobis (1994) revealed that farmers of Purulia district in West Bengal and Balasore and Ganjam districts of Orissa had come forward and were using Rhizobium culture on their own in ground nut cultivation.

Singh and Dixit (1994) reported adoption of biofertiliser in Tamil Nadu state and it was revealed that the users were benefited with increased yields and additional profits.

2.5 Relationship between selected personal, socio-economic and situational variables and adoption of biofertiliser technology

2.5.1 Age

The nature and degree of relationships reported in earlier studies between age and adoption are presented below:

Author with year	Relationship established
Annamalai (1980)	No association
Sanoria and Sharma (1983)	Positive significant association
Jayakrishnan (1984)	-do-
Krishnamoorthy (1984)	-do-
Chenniappan (1987)	-do-
Rathinasabapathi (1987)	No Association
Krishnamoorthy (1988)	-do-
Quazi and Iqbal (1991)	Negative significant association
Babu (1995)	No association

In the previous studies, a positive and significant relationship is established between age and adoption in many cases. However some negative significant associations are also noted by some authors. So in this study also a positive and significant association is hypothesised.

2.5.2 Education

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

Author with year	Relationship restablished
Ramamoorthy (1973)	Positive relationship
Sinha (1980)	Positive significant association
Chandrakandan (1982)	-do-
Geethakutty (1982)	-do-
Ramaswamy (1983)	-do-
Agarwal (1984)	-do-
Nanjaiyan (1985)	-do-
Ramaswamy *et al* (1986)	Positive relationship
Krishnappa (1986)	Significant positive association
Tantray (1987)	No association
Sulaiman (1989)	Significant positive association
Satheesh (1990)	-do-
Gopala (1991)	-do-
Krishnamoorthy (1991)	Non significant
Susamma (1994)	Significant positive association
Babu (1995)	-do-

Eventhough positive and significant association is observed in most cases, no association was noted in a few cases. Therefore, a positive and significant relationship is anticipated here.

2.5.3 Farming experience

The nature and extent of relationship reported in earlier studies between farming experience and adoption is presented below.

Author with year	Relationship established
Ravichandran (1980)	Non significant relationship
Gothandapani (1985)	Non significant relationship
Nanjaiyan (1985)	Negatively significant
Palani (1987)	Non significant relationship
Ramaswamy (1987)	Positively significant
Krishnamoorthy (1988)	Negatively significant

The past studies show nonsignificant relationships between these two variables however positive and negative relationships are also observed. A positive and significant relationship is anticipated for the present study.

2.5.4 Farm size

Farm size is expected to have direct correlation 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
Sanoria and Sharma (1983)	Positive significant association
Anatharaman *et al.* (1985)	-do-
Godhandapani (1985)	-do-
Krishnappa (1986)	-do-
Olowu *et al.* (1988)	-do-
Reddy (1988)	-do-
Reddy and Reddy (1988)	-do-
Aswathanarayana (1989)	-do-
Theodre (1988)	No significant relationship
Agarwal and Arora (1989)	No significant association
Haque (1989)	Positive significant relationship
Sagar (1989)	-do-
Athimuthu (1990)	-do-
Satheesh (1990)	-do-
Gopala (1991)	-do-
Babu (1995)	-do-

The previous studies revealed a positive and significant relationship between farm size and adoption. No relationship was also observed in some cases. In the present study also a positive relationship is hypothesised.

2.5.5 Cropping intensity

The relationships established between cropping intensity and adoption of farm technologies as reported by researchers are presented here

Author with year	Relationship established
Prasad (1978)	Significant positive relation
Shukla (1980)	Positive relation
Balan (1987)	Significant positive relation
Himantharaju (1987)	No relationship
Rotti (1987)	Negative non-significant relation

The nature and extent of relationship between cropping intensity and adoption is found to be positive and significant. However non significant relationships are also observed. In this study also, a positive and significant relationship is anticipated.

2.5.6 Social participation

It can be defined as the extent of participation of the respondent in the meetings or activities of various social organisations, as member or office bearers and the regularity in attending the meetings/activities.

The nature and extent relationship reported in earlier studies between social participation and adoption are presented below.

Author with year	Relationship established
Viju, 1985	Positively significant
Aswathanarayana, 1989	-do-
Gopala, 1991	Non significant
Krishnamoorthy, 1991	Positively significant
Susamma, 1994	-do-

The previous studies reveal positive and significant relationship and non significant relationship between these two variables. For the present study a positive and significant relationship is anticipated.

2.5.7 Extension participation

It refers to the extent of participation of farmers in different extension activities conducted during the past one year.

The relationship between adoption of biofertiliser technology and extension participation established in past studies are listed below:

Author with year	Relationship established
Manjunath (1986)	Positive and significant
Nataraju and Channegowda (1986)	Positive relationship
Shivasankara (1986)	-do-
Baadgaonkar (1987)	Non-significant
Pandurangaiah (1987)	Postive relationship
Ramegowda and Siddaramaiah (1987)	Positively significant
Sudha (1987)	-do-
Suresh (1987)	Positive relationship
Nandakumar (1988)	Non-significant
Shyamala (1988)	-do-
Aswathanarayana (1989)	Positively significant
Khare and Singh (1989)	-do-
Gopala (1991)	Non-significant
Reddy (1991)	Positively significant
Babu (1995)	Positively significant

The previous studies revealed a positive and significant relationship between these two variables. However, in some studies non significant relationship is also observed. Based on this a positive and significant relationship is anticipated here.

2.5.8 Innovativeness

Innovativeness indicates the degree to which an individual exhibits interest and readiness to accept new practices.

The nature and degree 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
Krishnamoorthy (1991)	Positve relationship
Reddy (1991)	-do-
Susamma (1994)	-do-

It is clear from the above studies that there is a positive and significant relationship between innovativeness and adoption. In this study also a positive and significant relationship is anticipated.

2.5.9 Information source utilisation

It is defined as the extent of use of different information soruces by a farmer with a view to obtain information about improved agricultural practices.

Author with year	Relationship established
Balasubramanian (1985)	Positive and significant
Godhandapani (1985)	-do-
Jayapalan (1985)	-do-
Naujaiyan (1985)	Non-significant relation
Singh and Ray (1985)	Positve and significant
Wilson and Chaturvedi (1985)	-do-
Theodore (1988)	Non-significant relation
Sulaiman (1989)	Positive and significant relation
Athimuthu (1990)	Positve relation

The above studies showed a positive and significant relationship between these two variables. However, some cases of non significant relationship are also reported. For the present study also a positive and significant relationship is hypothesised.

2.5.10 Scientific orientation

The relationship established between scientific orientation with the adoption of farm technologies as reported by researchers are presented here

Author with year	Relationship established
Jayapalan (1985)	Significant positive association
Nanjaiyan (1985)	-do-
Wilson and Chaturvedi (1985)	-do-
Shyamala (1988)	Positive significant association
Anithakumari (1989)	-do-
Bonny (1991)	Negative significant association
Umale *et al.* (1991)	Positive significant association
Ramachandran (1992)	-do-
Jnanadevan (1993)	-do-

The reviewed studies revealed a positive and significant relationship between scientific orientation and adoption. But certain negative association is also observed. In the present study, positive and significant relationship is hypothesised between these two variables.

2.5.11 Risk orientation

Risk orientation is operationally defined as the degree to which the respondent is oriented towards risk and incertainity and exhibits coverage to face problems of risk.

The relationship established between risk orientation with adoption of farm technologies as reported by researchers are presented.

Author with year	Relationship established
Rajendran (1978)	Positive significant relationship
Balan (1980)	Non significant
Jayakrishnan (1984)	Positive significant relationship
Nanjaiyan (1985)	-do-
Palani (1987)	-do-
Rathinasabapathi (1987)	-do-
Anandarao (1988)	Non significant
Krishnamoorthy (1988)	Positively significant relationship
Selvakumar (1988)	Non significant
Ajaykumar (1989)	Positively significant relationship
Anithakumari (1989)	-do-
Juliana *et al.* (1991)	-do-
Govind (1992)	-do-
Jaleel (1992)	-do-

The above findings reveal a positive and significant relationship between these two variables, however certain non significant cases are also reported. In this study a positive and significant relationship is hypothesised.

2.5.12 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 effective means, from among the available alternatives on the basis of scientific criteria for achieving maximum ends.

It was found that there were no studies reported on the relationship between rationality in decision making and adoption of biofertiliser technology. However, studies, which are closely related are reviewed here.

Sawant and Thorat (1977) found positive and significant correlation of rationality with adoption of improved farm practices.

Geethakutty (1993) observed that there was signfiicant correlation between rational decision making ability and fertiliser use behaviour of rice farmers.

In the present study also, a positive and significant relationship is hypothesised.

2.5.13 Economic motivation

It 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
Viju (1985)	Positively significant
Kubde and Kalantri (1986)	-do-
Krishnappa (1986)	-do
Prakashkumar (1986)	-do-
Balan (1987)	-do-
Palani (1987)	-do-
Rameshbabu (1987)	-do-

Author with year	Relationship established
Haque (1988)	Positively significant
Krishnamoorthy (1988)	-do-
Anithakumari (1989)	No relationship
Gogoi and Gogoi (1989)	Negative relationship
Mahipal and Khurde (1989)	Positively significant
Satheesh (1990)	Non significant relation
Gopala (1991)	-do-
Rajendran (1992)	Positive relationship
Jnanadevan (1993)	Negative relationship
Susamma (1994)	Positively significant
Babu (1995)	-do-

The previous studies revealed a positive and significant relationship between these two variables. But certain non significant and negative relationship is also observed. For the present study, a positive and significant relationship is anticipated between these two variables.

2.5.14 Achievement motivation

It can be defined as a social value that emphasises desire for excellence for an individual in order to attain a sense of personal accomplishment.

Studies using achievement motivation as a variable influencing adoption process were not common and those which could be located are reviewed here. The nature and extent of relationship of achievement motivation with adoption of farm technologies as reported by different researchers are listed below.

Author with year	Relationship established
Prasad (1983)	Positively significant
Naik (1988)	Non significant association
Ajaykumar (1989)	Positively significant
Reddy (1991)	Non significant

The nature and extent of relationship between achievement motivation and adoption is found to be positive and significant in the previous studies. However, cases of non significant relationship are also reported. For the present study also, a positively significant relationship is anticipated.

2.5.15 Accessibility to the sales point

It was found that there was no study reported in the relationship between accessibility to the sales point and adoption of the technology, however a positive and significant relationship is anticipated for the present study.

2.5.16 Attitude towards biofertiliser 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. Scientific studies of attitude towards biofertiliser use in relation to the adoption were not available. Hence studies conducted in other areas viz., attitude towards fertiliser use which were directly or indirectly connected with present study are presented below.

Author with year	Relationship established
Singh and Ray (1985)	Positive relation
Shivasankara (1986)	-do-
Balan (1987)	Positive and significant relation
Singh (1989)	Positive relation
Sulaiman (1989)	Positive and significant relation
Athimuthu (1990)	Non significant relation
Chandra and Singh (1992)	Positive and significant relationship
Singh *et al.* (1992)	-do-
Sulaiman and Prasad (1993)	-do-
Susamma (1994)	-do-

Based on the reviews presented, a positive relation between attitude towards biofertiliser use and adoption of biofertiliser technology is anticipated for the present study.

2.5.17 Knowledge on biofertiliser use

Scientific studies of knowledge on biofertiliser use in relation to its adoption were not available. Hence, studies conducted in other areas which were directly or indirectly connected with the present study analysing the relationship between knowledge and adoption process are listed below.

Author with year	Relationship established
Geethakutty (1982)	Positively significant
Kaur and Bharathukumar (1984)	-do-
Singh and Ray (1985)	-do-

Author with year	Relationship established
Jayaramaiah (1987)	Positively significant
Theodre (1988)	-do-
Sulaiman (1989)	-do-
Bonny (1990)	-do-
Sulaiman and Prasad (1993)	-do-
Susamma (1994)	-do-

The previous studies reveal a positive and significant relationship between these two variables. Therefore, for the present study also, positive and significant relationship is anticipated.

2.6 Concept of constraints in the Research system, extension system and client system with respect to transfer of biofertiliser technology

According to Mann (1983) most economic decision-making involves choosing an optimum strategy subject to the limits imposed on the decision maker. These limits are often referred to as constraints.

Pandya and Trivedi (1988) defined constraints as those items of difficulties or problems faced by individuals in adoption of a technology. According to Zinyama (1988) a constraint is any problem or limitation.

Any problem or limitation in the research system or extension system or client system or support and service system which hinders the adoption of biofertiliser technology is considered as a constraint in the present study.

Many researchers had identified diverse constraints in the transfer of biofertiliser technology, they had been summarised and outlined in the following pages.

According to Hegde and Dwivedi (1994) most important characteristic common to biofertilisers in the unpredictability of their performance. The success rate with any biofertiliser in terms of significant impact on yield ranges from 30-65 per cent.

According to Adkar and Dwivedi (1994) constraints in production and marketing of biofertiliser were as follows.

- lack of standardisation of quality control procedures at the national level.
- lack of standardisation of packaging and doses of biofertiliser.
- due to variation in above a lot of fluctuations in the unit price of biofertiliser produced by various manufacturers and the one produced by the organised sector.
- lack of availability of adequate distribution/marketing machinery as the service margins generated are of low order.
- lack of popularity of biofertiliser as a commodity due to inadequate extension efforts by fellow manufacturers/State Governments.
- lack of adequate and timely planning by state level machinery to project the realistic demand of biofertiliser over a specified time schedule.
- lack of adequate transport facilities which can ensure longer shelf life and fastest deliveries within the stipulated time at village level destinations.

Kute and Patel (1994) revealed that non-availability of raw materials and unpredictable performance of bacterial strain due to the variation in agroclimatic condition act as constraints in the production technology. According to them marketing constraints include lack of definite pricing policy, lack of adequate awareness and inadequate shelf-life.

Many constraints had been identified which were responsible for poor demand of biofertilisers (Singh and Dixit, 1994). Constraints were as follows.

1. Biological constraints

- Presence of nature ineffective strains, which cannot be displaced easily by the inoculated strains, of they are not very effective.
- Presence of antagonism, which minimise the number of biological nitrogen fixing microorganisms in rhizosphere.

2. Technical constraints

- Mutation is the problem of which arises during fermentation, resulting reduction in effectiveness of bioinoculants.
- Region wise unavailability of soil specific strains, which limit the use of bioinoculants.
- Region wise unavailability of soil specific strains, which limit the use of bioinoculants.
- Shelf life is the major constraint in the development of adequate market.

3. Marketing constraints

- Demand is limited because of the unawareness of farmers to advantages of bio-fertiliser.

- Extenion centres, by and large do not have well qualified technical staff who can attend to all technical problems.

- Unavailability of proper transportation and storage facilities is also a major constraint for development of effective market.

4. Field Level constraints

- Existing soil conditions such as acidity alkalinity, pesticides application and high nitrate level limit the nitrogen fixing capacity of the inoculants resulting in poor results of inoculants.

- Presence of certain toxic elements and deficiency of P, Cu, Co and Mo is unfavourable for bacterial fertilisers.

- Use of substandard inoculants or faulty inoculation techniques, any adverse effect of agrochemical and unfavourable conditions such as waterlogging reduces the effectiveness of biofertilisers.

5. Resource constraints

- Manufactures especially small producers do not have and can not afford to have distribution system of their own. This results in poor quality after productions, as also inability to make bioinoculants available to the farmer in accessible places.

Verma and Bhattacharyya (1990) listed out the following constraints.

(i) Production and distribution level

(a) Unavailability of appropriate and efficient strains.

(b) Unavailability of a good carrier and

(c) Poor storage facilities

(ii) Field level

(a) Soil and climatic problems such as unfavourable pH, high temperature, drought, high nitrate level, presence of certain elements in toxic level, or deficiency of P, Cu, Co and Mo.

- Competition from nature strains and compatibility with the host legume cultivar supply of energy (carbohydrates) to the nodules, prevalence of plant diseases etc.
- Use of sub-standard inoculants or faulty inculation techniques, any adverse effect of agro chemicals and unfavourable conditions such as water logging.

Market level constraints

- Unavailability of proper transportation and storage facilities.

According to Motsara *et al.* (1994) the poor demand for biofertilisers was mainly due to following reasons.

- Lack of appropriate marketing net work
- Unwareness among farmers
- Apathy of extension workers
- Supply of poor quality biofertilisers by different production units

Conceptual frame work of the study

Adoption process, according to Rogers (1983) is a mental process through which an individual passes from the first hearing about an innovation to its final adoption. Adoption behaviour is a multivariate process depending on wide spectrum of socio, economic, cultural, situational and personal factors. These variables will exert a strong influence on the adoption process.

Berlo (1960) explained that fidelity of communication would be associated with the communication skill of the source. This will inturn affect the diffusion process and transfer of technology.

Attitude and perception are two important concepts governing human behaviour. According to Segall *et al.* (1960) perception is subjected to many of the influences that shape other aspects of behaviour. In particular, each individual's experiences combine in a complex fashion to determine his reaction to a given stimulus situtation. Ryan (1979) stated that social structure and farm family played an important role in the process of formation of attitudes and perception and their effect on the adoption of new technologies. A favourable attitude resulting in good evaluative perception of the technology leads to early adoption of the technology in the given social system.

The external stimuli such as constraints also have profound influence on the adoption of any technology. The strong constraints which are prevailing at the research system, extension system, client system and support and service system act as disincentives for the technology utilisation. This naturally retards the diffusion process and leads to poor adoption of the technology by the system at large.

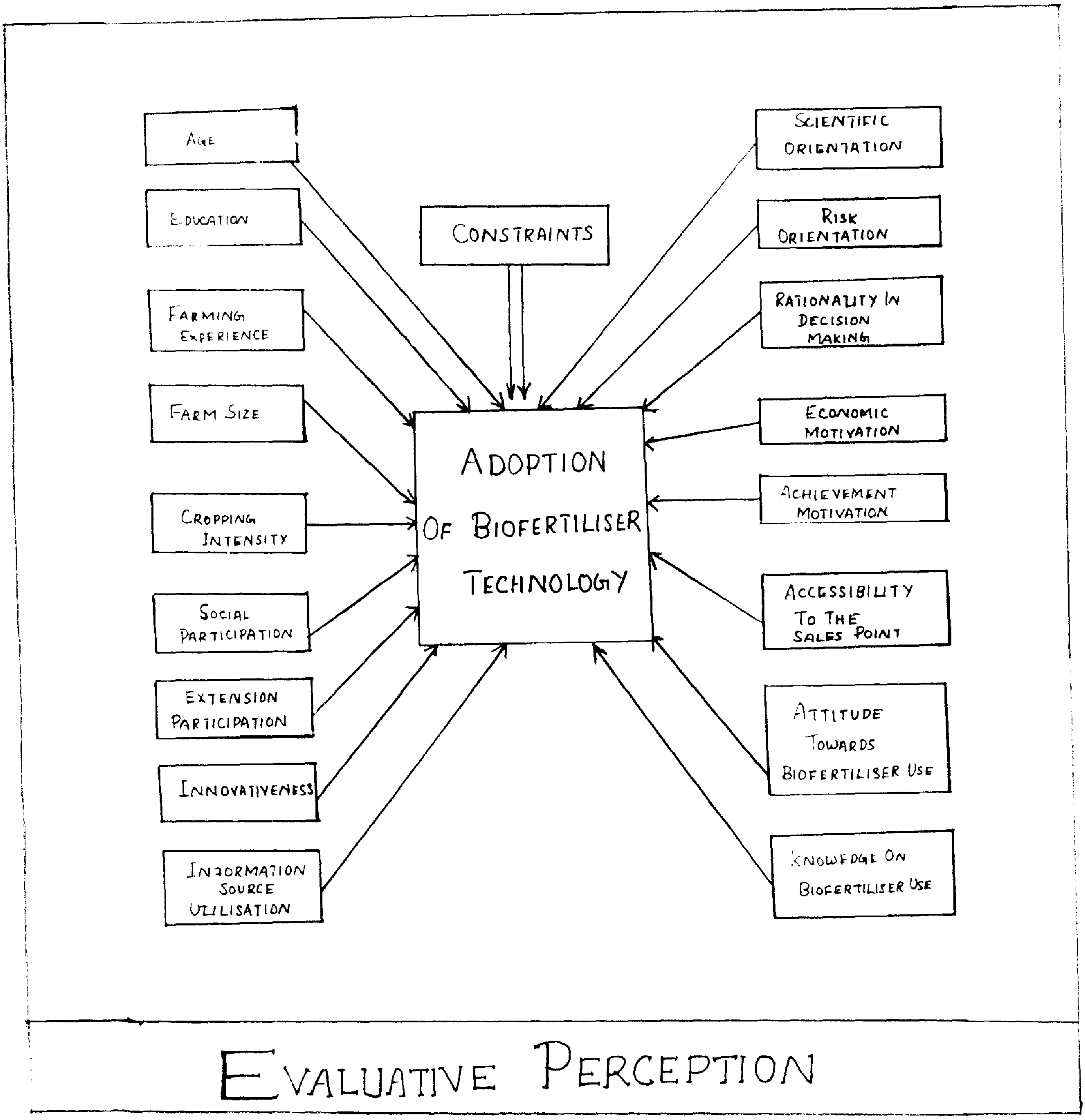

Fig. 1. Conceptual Model For The Study

In this conceptual frame work, the present study on adoption of biofertiliser technology by the farmers was designed. All the probable system variables and influencing factors at individual and social levels were conceived within the framework of the study and the conceptual model is depicted in Fig.1.

Methodology

CHAPTER-III

METHODOLOGY

In this chapter, the methods employed in the study for data collection, data analysis and interpretation are presented under the following heads.

3.1 Location of the study

3.2 Selection of sample

3.3 Operationalisation and measurement of variables

3.4 Evaluative perception on the feasibility of biofertiliser technology by researchers, extension personnel and farmer respondents

3.5 Constraints experienced in the transfer of biofertiliser technology and reasons for non-adoption of the technology

3.6 Methods used for data collection

3.7 Statistical tools used for the study

3.1 Location of the study - Selection of district

Thrissur district was purposively selected for the study since this district accounted a considerable area under rice, coconut, banana and vegetable cultivation.

The study was conducted in all the three agricultural sub-divisions of Thrissur district viz., Thrissur, Irinjalakkuda and Wadakkancheri subdivisions.

Selection of blocks

Out of the three subdivisions, one block each was purposively selected on the ground that these blocks possessed intensive cultivation of different crops.

The selected blocks were Cherpu, Irinjalakkuda and Pazhayannur from Thrissur, Irinjalakkuda and Wadakkancheri subdivisions respectively.

Selection of panchayaths

Out of the three selected blocks one panchayath each was purposively selected on the ground that these panchayaths had the potential of adoption of biofertiliser since the supply and service system was prevelent in that area. The panchayaths selected were Koorkkancherry, Porthasserry and Vallatholnagar from Thrissur, Irinjalakkuda and Pazhayannur blocks respectively. The map showing the location of the study is given as Fig.2.

3.2 Selection of sample

3.2.1 Farmers

The study was designed to analyse the transfer of technology with respect to biofertilisers. It was confined to selected three panchayaths. The lists of farmers having cultivation of different crops were obtained from the respective Krishi Bhavans. From these lists, 50 farmers were seldcted randomly from each panchayat. Thus, a total of 150 farmers were selected from the three panchayats.

3.2.2 Scientists

A list of subject matter specialists of Kerala Agricultural University and Tamil Nadu Agricultural University in the disciplines of Agronomy, Soil Science and Plant Pathology was prepared. From the list, 30 scientists were selected at random as the respondents for the study.

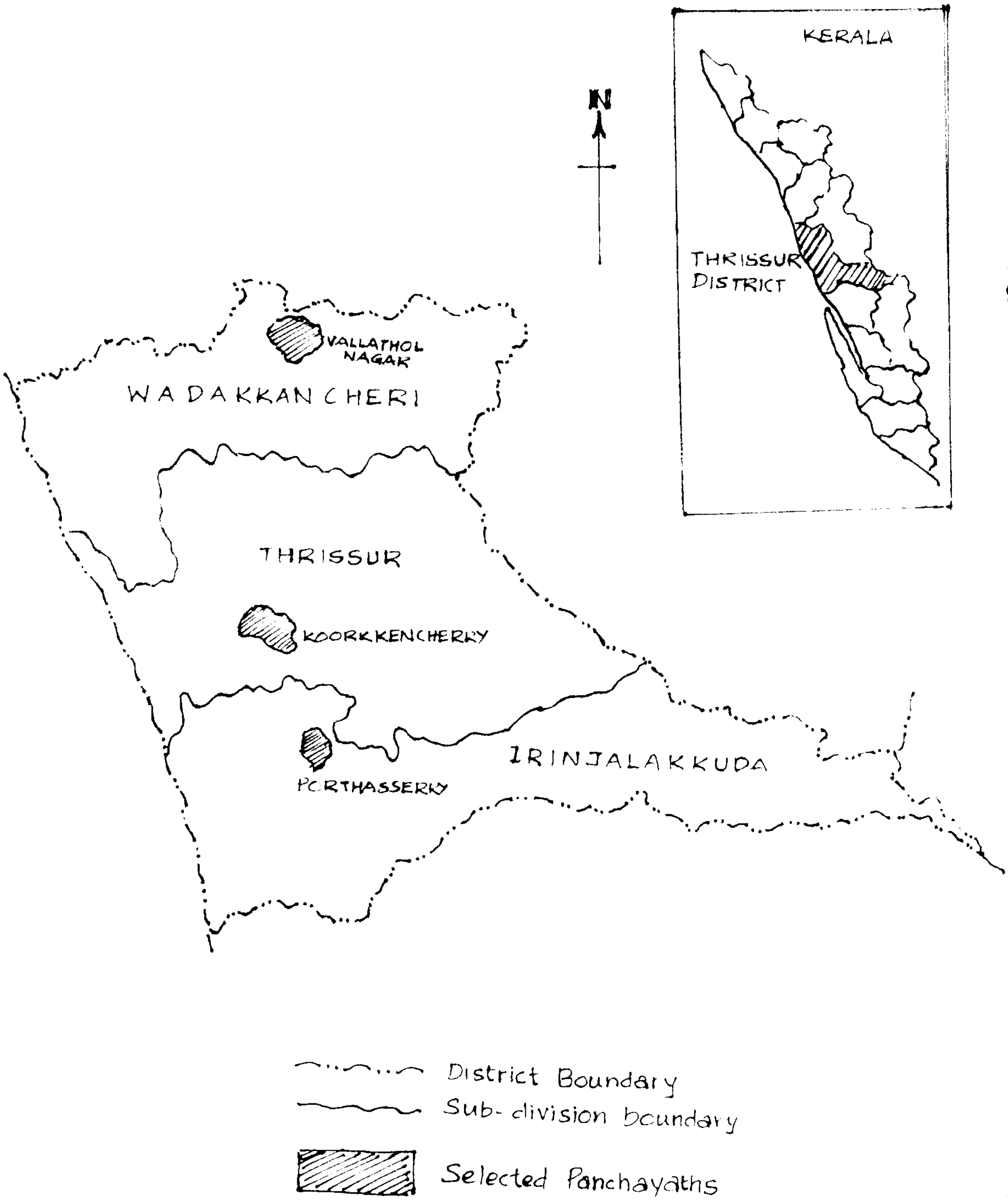

Fig. 2. MAP OF THRISSUR SHOWING THE LOCALE OF THE STUDY

3.2.3 Extension personnel

A list of extension personnel (Agricultural Officers and Agricultural Assistants) in the Krishi Bhavans in the selected three Agricultural Subdivisions was prepared. From the prepared list, 30 agricultural extension personnel were selected at random as respondents.

3.3 Operationalisation and measurement of variables

3.3.1 Dependent variable

Extent of adoption of biofertiliser technology

Rogers (1962) defined adoption process as the mental process an individual passes from first hearing about an innovation to its final adoption. According to Feder *et al.* (1992) the adoption at individual farm level is defined as the degree to use a new technology in long run equilibrium when the farmer has full information about the new technology and its potential. The adoption in the present study is operationally defined as the decision to make full use of the biofertiliser technology.

Many researchers had standardised various methods to quantify adoption behaviour of farmers. The approach followed in the present study to operationalise adoption was based on the conclusion derived from a review of the following studies.

Wilkening (1952) developed an index for measuring adoption of improved farm practices. The index of adoption used was the percentage of practices adopted to the total number of practices applicable for a farmer.

Duncan and Kreetlow (1954) used a 25 item index of farm practices adoption which was a modification of the index developed by Wilkening.

Singh and Singh (1974) used an adoption quotient which was a modification of the one developed by Chattopadhyay (1963). According to this, adoption quotient of each respondent was calculated by using the formula,

$$AQ = \frac{\Sigma\, e/p \times 100}{N}$$

where

AQ - Adoption Quotient

e - extent of adoption of each practice

p - potential for adoption of each practice

N - Total number of practices selected

Chandrakandan and Knight (1989) measured adoption of farm technology of groundnut cultivars using 'adoption quotient'. Four dimensions were considered for this study which included weightage for individual practices, magnitude of adoption, potentiality for adoption and applicability of individual practices.

The formula used was

$$\text{Adoption Quotient} = \frac{\sum_{i=1}^{m} \frac{ei}{Ei} + \frac{qi}{Qi} \times Wi}{2 \sum_{i=1}^{m} Wi}$$

where

ei - Area put under i^{th} practice

Ei - potential area for i^{th} practice

qi - quantity used for i^{th} practice

Qi - Quantity recommended for i^{th} practice

Wi - Weightage assigned to i^{th} practice

m - number of applicable practices

In the present study for the measurement of adoption quotient formula developed by Chandrakandan and Knight (1985) was used with necessary modification to suit the purpose of the study.

$$AQ = \frac{Y}{X} \times 100$$

where

AQ - Adoption quotient

Y - area put under biofertiliser application

X - potential area for biofertiliser application

The adoption quotients for the farmer respondents were calculated based on this.

3.3.2 Distribution of adopters based on their extent of adoption

The mean (X) of adoption index was calculated and this was used for categorisation of respondents into three strata (i) Below (X-SD), (ii) Between (X±SD) and (iii) Above (X+SD) which referred low, medium and high categories respectively.

3.3.3 Measurement of personal, socio-economic and situational variables

The personal, socio-economic and situational variables selected for the study were, age (X_1), education (X_2), farming experience (X_3), farm size (X_4), social participation (X_6), extension participation (X_7), innovativeness (X_8), information source utilisation (X_9), scientific orientation (X_{10}), risk orientation (X_{11}), rationality in decision making (X_{12}), economic motivation (X_{13}), achievement motivation (X_{14}), accessibility to the sales point (X_{15}), attitude towards biofertiliser use (X_{16}) and knowledge on biofertiliser (X_{17}). These variables were selected based on the objectives, review of relevant literature and discussion with the experts of the Kerala Agricultural University.

a) Age

It is operationally defined as the number of chronological years the respondent has completed at the time of this study since his birth. It was expressed in years.

b) Education

It refers to the extent of formal learning received by the farmer respondent. Education was measured by assigning scores for different levels of education in the scoring system followed in the Socio-Economic Status scale of Trivedi (1963). The categorisation of respondents and corresponding score assigned were

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

c) Farming experience

It can be operationalised as the number of years the respondent had actually engaged in farming. It was expressed in years.

d) Farm size

It can be defined as the total area of land expressed in terms of standard acres owned by the respondent.

e) Cropping intensity

It is defined as the number of crops raised in an year in a unit area by the farmer expressed in percentage.

The procedure followed by Prasad (1978) and as described by Balan (1987) was used for the measurement of cropping intensity. The farmer was asked to indicate single cropped land cultivated by him and was asked to provide the above data for both garden and wet land. Total cropped area per year was obtained by summation of single cropped area, twice the double cropped area and thrice the triple cropped area. The cropping intensity was calculated as below:

$$\text{Cropping intensity} = \frac{\text{Gross cropped area}}{\text{Net cropped area}} \times 100$$

f) Social participation

Social participation is operationally defined as the degree of involvement of the respondents in formal and nonformal social organisations either as a member or as office bearer which also includes their degree of participation in organisational activities.

The procedure followed by Kamaruddeen (1981) was adopted for the measurement of social participation as indicated below:

Category	Score
1. Membership in organisation	
No membership in any organisation	0
Membership in each organisation	1
Office bearer in each organisation	2
2. Frequency of attending meetings	
Never attending any meetings activities	0
Occasionally attending meetings activities	1
Regularly attending meetings activities	2

The score for each social organisation was obtained by multiplying the membership score with frequency score. By adding up the scores of all organisations, the total score for social participation of the farmer was obtained.

g) Extension participation

Bhaskaran (1979) had measured extension participation by summing up the scores obtained by a farmer for his participation in various extension activities like campaigns, film shows, seminars, group meetings, exhibitions, demonstrations etc. The scores were assigned for the responses on as follows:

Response	Score
Whenever conducted	2
Sometimes	1
Never	0

h) Innovativeness

This is operationalised as the degree to which the respondent is relatively earlier in adopting new ideas.

The procedure developed by Singh (1977) and adopted by Selvanayagam (1986) was used to measure innovativeness of a farmer. The question "When would you prefer to adopt an improved practice in farming?" was asked and responses were recorded as follows.

Response	Score
1. As soon as it is brought to my knowledge	3
2. After I have seen some other farmers using it successfully	2
3. Prefer to wait and take my own time	1

The total score was obtained by summing up the scores for each statement.

i) Information source utilization

The information sources used were studied interms of utilization of mass media, personal cosmopolite and personal localite sources of communication.

The procedure followed by Nair (1969) is adopted in the present study to develop an index on information source utilization.

Each respondent was asked to indicate as to how often he received information regarding improved agricultural practices from each of the mass media, personal cosmopolite and personal localite sources of communication.

The range of responses and scoring pattern was as follows:

Frequency	Scores
Most often	4
Often	3
Sometimes	2
Rarely	1

The scores were summed up across each item to form the index of each category.

The index for information source utilization of each respondent was arrived at by summing up the indices of mass media, personal cosmopolite and personal localite sources of communication.

j) Scientific orientation

Supe (1969) operationalised scientific orientation as the degree to which a farmer is oriented to the use of scientific methods in decision making in farming.

For the measurement of this variable, scale developed by Supe (1969) was followed with slight modification to suit the purpose of the present study. The scale consisted of six statements in which five statements were positive and one was negative. The statements were suggested to respondents in the following scoring.

Category	Score
Agree	3
Undecided	2
Disagree	1

In the case of negative statements, scoring system was reversed.

k) Risk orientation

Risk orientation is operationally defined as the degree to which a farmer is oriented towards risk and uncertainity and portrayed the courage to face problems in farming.

To measure this variable, the scale adopted by Selvanayagam (1986) was used with suitable modification to suit the purpose of the present study. The scale consisted of five statements in which four statements were positive and one statement was negative. These statements were suggested to respondents in the following scoring continuum.

Category	Score
Agree	3
Undecided	2
Disagree	1

The scoring pattern was reversed in case of negative statements.

l) Rationality in decision making

Rationality in decision making can be operationally defined as the quality or the state of the respondent of being logical and hig acceptability of reasonableness as perceived by the respondent. This covered the discriminating ability of a farmer to say what, when, where to whom and to what extent. The scale developed by Vipinkumar (1994) was used in the study. This dimension again was measured by using three multiple choice questions, each with three choices of most to least favourable and with scoring pattern ranging from 2 to 0. The individual scores were added upto get the total score of rationality.

m) Economic motivation

Economic motivation referred to the extent to which an individual is oriented towards achievement of the maximum economic ends such as maximisation of the product.

The scale developed by Supe (1969) with slight modification was used to measure economic motivation. The scale consisted of four statements in which three were positive and one was negative. These statements were suggested to respondents in the following three point continuum.

Category	Score
Agree	3
Undecided	2
Disagree	1

The total score was found out by summing up the score of each statement.

n) Achievement motivation

Mc Clelland (1961) stated that achievement motivation is the desire to do well, not so much for the sake of social recognition or prestige, but to attain an inner feeling of personal accomplishment.

In the present study, achievement motivation was measured using the scale developed by Singh (1974). The scale had five items. Each item in the scale has five alternative responses and the responses to each item in the scale were scored to 1 to 5. The scores of the respondents were obtained by adding up the scores corresponding to their response patterns.

o) Accessibility to the sales point

This variable can be operationally defined as the perception of farmer about their accessibility to the biofertiliser sales point.

Accessibility to the sales point was measured using an arbitrary scale developed for the study.

Category	Score
1. Distance to be travelled for reaching the sales point	
Upto 2 km	3
2-4 km	2
More than 4 km	1
2. Frequency of visit	
Once in a week	3
Once in a month	2
Whenever needed	1
Never	0

The score for each respondent was obtained by multiplying the distance score with the frequency score.

p) Attitude towards biofertiliser use

For this study, attitude is operationally defined as the degree of positive or negative disposition associated with biofertiliser technology.

A number of attitude scales have been developed in the past for measuring the attitude of respondents towards a technology or practice or programme. An attitude scale is one that assesses the degree of effect that individuals may associate with some psychological object. Tripathi *et al.* (1982) used Likert's (1932) technique of five point rating scale for measuring the attitude of gramsevaks towards

Community Development Programme. Cherian (1984) had developed an attitude scale following the method of summated ratings to measure the attitude of farmer respondents towards T & V system. While studying the utilization of biogas technology, Latha (1990) had developed an attitude scale following the method of summated ratings. In the present study also, attitude of farmer respondents was measured using an attitude scale developed for the purpose utilizing Likert's summated rating technique.

As a first step, the statements regarding different aspects of biofertiliser technology were collected on the basis of review of literature and discussion with the experts of Kerala Agricultural University. Care was taken to develop a universe of content including all possible statements that would reflect the attitude of the respondents towards the stimulus under study. The collected statements were then edited by comparing against the criteria described by Edwards (1957). Out of 30 statements, 17 statements were selected after editing. Case was taken to include both positive and negative statements on biofertiliser technology.

The edited statements were administered to 20 non-sample respondents. They were asked to respond to each statement in terms of their own agreement or disagreement with the statements on a five point continuum as follows:

SA - Strongly agree

A - Agree

UD - Undecided

DA - Disagree

SDA - Strongly disagree

After collecting the responses from the farmers, these statements were subjected to item analysis. The purpose of item analysis is to examine how well each statement discriminates between respondents with different attitudes.

The procedure involved in item analysis as suggested by Edwards (1957) was followed. First of all, the total score was found out for each respondent by summing up the scores obtained for all the statements in the list. The various responses were assigned numerical weights such that strongly agree response was given score of 4, agree - 3, undecided - 2, disagree - 1, strongly disagree - 0 for positive statements. The order was reversed for negative statements. Thus the total score of an individual was the summation of numerical weights assigned to the responses. The respondents were then arranged in descending order of the total scores. From these, 25 per cent of the subjects with the highest total score were taken up for item analysis. It was assumed that these two groups would provide the criterion groups in term of which one can evaluate the individual statement. The following formula was used for evaluating the responses of high and low group to each statement:

$$t = \frac{XH - XL}{\frac{SH^2}{nH} + \frac{SL^2}{nL}}$$

where,

XH - the mean score as a given statement for the high group

XL - the mean score as a given statement for the low group

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

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

nH - the number of subjects in the high group

nL - the number of subjects in the low group

The value of 't' is a measure of the extent to which a given statement differentiates between the high and low groups.

As an appropriate rule of thumb, any value of 't' equal to or greater than 1.75 only was considered. Statements with 't' values were arranged in ascending order of magnitude and seven statements having the maximum 't' values were selected for the final scale which consisted of three positive and four negative statements. The statements with their 't' values are furnished in Appendix-I.

To measure the attitude towards use of biofertiliser, the respondents were asked to express their opinion on seven statements, of which three were positve and the rest negative. The responses to these statements were collected on a three point continuum.

Category	Score
Agree	3
Undecided	2
Disagree	1

For negative statements, the scoring pattern was reversed. The total score obtained by summing up the score for each statement yielded the attitude towards biofertiliser use.

q) Knowledge on biofertiliser use

Knowledge on biofertiliser use was operationalised as the extent of information possessed by a farmer regarding the use of biofertiliser technology.

In the present study a knowledge test was developed for measuring the knowledge of the respondent about the biofertiliser technology. To measure this variable, the procedure followed by Sureshkumar (1994) was adopted with suitable modifications.

For this, an item pool of questions was prepared based on the relevant review of literature and discussion with the experts. Care was taken to avoid 'too easy' or 'too difficult' items to make them discriminable. These questions were administered to non sample respondents in a pilot study prior to the preparation of final interview schedule. Scores of one and zero were given to the correct and incorrect answers, respectively. The scores obtained for all questions were found out separately and these questions were arranged in the descending order of the total scores obtained by them. For effective discrimination nine questions were retained after eliminating the terminal questions with low and high scores. These nine questions were included in the final interview schedule. The total number of correct answers were summed up to get the knowledge score of the respondents.

3.3.4 Distribution of the respondents based on their personal, socio-economic and situational factors

The mean score (X) of all the personal, socio-economic and situational variables was calculated and was used for categorisation of respondents into two strata (i) Below X (low) and (ii) X and above X (high). In case of the variable age, it was categorised into three strata (i) Below (X-SD), (ii) Between (X$\pm$SD) and (iii) Above (X+SD) which referred young, middle and old categories respectively.

3.4 Evaluative perception on the feasibility of biofertiliser technology by researchers, extension personnel and farmer respondents

The evaluative perception in this study was operationally defined as the perception of the respondent on the feasibility of biofertiliser technology which was derived based on the critical assessment or appraisal of the technology.

Based on the relevant review of literature and discussion with experts of Department of Agriculture and Kerala Agricultural University, a list of statements reflecting critical evaluation of the biofertiliser technology was prepared. After editing the statements, opinion about these statements were gathered from the non-sample respondents in a pilot study. After suitable amendments, ten statements were included in the interview schedule and questionnaire. Since the statements were based on the critical assessment of biofertiliser technology, the same set of statements were included for all the three respondent groups. This would help in effective comparison of responses by the three respondent categories.

To measure the evaluative perception, the respondents were asked to express their opinion on these ten statements. The response to each statement was obtained on a three point continuum namely, agree, undecided and disagree, with weights 3, 2 and 1 respectively. The total score obtained by summing up the score for each statement yielded the score for evaluative perception on the feasibility of biofertiliser technology.

3.4.1 Distribution on respondent based on their evaluative perception on the feasibility of biofertiliser technology

The mean score (X) of evaluative perception was calculated and was used for categorisation of respondents into three strata (i) Below (X-SD), (ii) Between (X$\pm$SD) and (iii) Above (X+SD) which referred low, medium and high respectively.

3.5 Constraints experienced in the transfer of biofertiliser technology

Based on discussion with farmers, scientists, experts in Agriculture department and also through relevent review of literature, the major constraints experienced in the research system, extension system, client system and support and service system were identified. These were listed and included in the interview schedule and questionnaire. The response to each constraint was obtained in a three point continuum namely agree, undecided and disagree with weights 3, 2 and 1 respectively. Cumulative value for each constraint was worked out and based on this value constraints were ranked.

Reasons for non-adoption of biofertiliser technology

A list of possible reasons were prepared based on the review of relevent literature and discussion with farmers and the experts of Kerala Agricultural University. The opinion about these reasons were gathered from the non-sample respondents in a pilot study. After suitable modification seven major reasons were included in the interview schedule and was administered to the farmer respondents. The reasons expressed by all the respondents were recorded and based on the frequency the reasons were ranked.

3.6 Methods used for data collection

A structured interview schedule was prepared for collecting the data which was pre-tested and finalised based on a pilot study. The pilot study was conducted in a non-sample area which closely resembled the area selected for the main study and their responses were recorded. Modifications were made so as to remove ambignity, to keep the logical sequence and to keep the frame of reference of the respondents in the light of the pilot study and the schedule (Appendix-II) was finalised for collecting the data from the farmer-resondents. Questionnaire (Appendix-III was employed for the collection of data from the other respondent categories viz., researchers and extension personnel.

The data collection was done during the months of May-August, 1996. The farmer respondents were personally interviewed by the researcher. The questions were put in a conversational manner and responses were transcribed in the schedule itself. In the case of responses which were not clear, rechecking was also done.

3.7 Statistical tools used for the study

The following statistical procedures were employed to analyse the data.

1. Percentage analysis

Percentage were calculated for making simple comparisons among the different groups.

2. Correlation analysis

Zero order correlation coefficient was calculated to find out the intensity of association between the dependent variable and each of the personal, socio-economic and situational variables.

The formula used was

$$r = \frac{\Sigma XY - \frac{\Sigma X \Sigma Y}{n}}{\left(\Sigma X^2 - \frac{(\Sigma X)^2}{n}\right)\left(\Sigma Y^2 - \frac{(\Sigma Y)^2}{n}\right)}$$

where

r - correlation coefficient

X - independent variable

Y - dependent variable

n - number of observations

3. Multiple regression analysis

Multiple regression analysis was done to determine the net contribution of each of the selected personal, socio-economic and situational variables to the dependent variable and to know the percentage of variation that a set of personal, socio-economic and situational variables jointly explains on the dependent variable. The regression equation employed in the study is of the form.

$$Y = a + b_1x_1 + b_2x_2 + \ldots\ldots\ldots\ldots\ldots + b_nx_n$$

where,

y = independent variable

a = intercept

$x_1, \ldots\ldots\ldots, x_n$ = independent variables

$b_1, \ldots\ldots\ldots, b_n$ = regression coefficients

Coefficient of multiple determinant (R^2) was estimated from the regression equation to know the adequacy of the linear model. A significant R^2 suggest the desirability of regression analysis in predicting the dependent variable. The test of significance of regression coefficients (b's) was carried out with the help of 't' values computed.

4. Step-down regression analysis

This was employed to get the best subset of personal, socio-economic and situational variables in predicting the dependent variables after eliminating unimportant variables. The best fitting regression equation of dependent variable on a few important personal, socio-economic and situational variables was evolved by applying the procedure suggested by Draper and Smith (1966).

5. Path coefficient analysis

Path analysis explains the cause and effect relationship between dependent and independent variables. It is possible to represent the whole system of variables in the form of a diagram known as "path diagram".

In path coefficient analysis, the correlation coefficient between a causal factor and effect is split into that due to the direct effect of the causal factor and indirect effect of other factors on this factor.

Path analysis was carried out following the matrix method as given by Singh and Chowdhari (1979).

Path coefficients are standardised regression coefficients. If 'Y' is the effect and 'X' is the cause, the path coefficient for the path from cause 'X_1' to the effect 'Y' is defined as

$$P_{iy} = \frac{b_1 \sigma x_i}{\sigma y}$$

where,

b_i is the partial regression coefficient of X_i on Y_i.

The statistical analysis were done using the computer facility available at the Department of Agricultural Extension, College of Horticulture, Vellanikkara.

Results and Discussion

CHAPTER-IV

RESULTS AND DISCUSSION

The findings of the present study and discussion of the salient results are presented in this chapter under the following heads.

4.1 Distribution of the respondents based on the selected personal, socio-economic and situational variables

4.2 Evaluative perception of the respondents on the feasibility of biofertiliser technology

4.3 Adoption of biofertiliser technology

4.4 Relationship between the extent of adoption of biofertiliser technology and personal, socio-economic and situational variables

4.5 Reasons for non-adoption of biofertiliser technology

4.6 Constraints experienced in different systems of the transfer of biofertiliser technology

4.1 Distribution of the respondents based on the selected personal, socio-economic and situational variables

The perusal of Table 1 revealed that the majority of the respondents were in the low category with respect to variables namely education, farm size, cropping intensity, social participation, extension participation, innovativeness, information source utilisation, scientific orientation, risk orientation, rationality in decision making, economic motivation, achievement motivation, attitude towards use of biofertiliser, knowledge of the respondents were in the high category with respect to age, farming experience and accessibility to the sales point.

Table 1. Distribution of the respondents based on their personal, socio economic and situational characteristics

(n = 150)

Sl.No.	Characteristic	Category	Score	f	%
1	Age	Young	Below 49 years	22	14.66
		Middle	Between 49-68	100	66.66
		Old	Above 68	28	18.68
2	Education	Low	Below 3.740	78	52.00
		High	3.740 & above	72	48.00
3	Farming experience	Low	Below 40 years	53	35.33
		High	40 and above	97	64.67
4	Farm size	Low	Below 1.642	102	68.00
		High	1.642 & above	48	32.00
5	Cropping intensity	Low	Below 151.927	81	54.00
		High	151.927 & above	69	46.00
6	Social participation	Low	Below 6.053	110	73.33
		High	6.053 & above	40	26.67
7	Extension participation	Low	Below 5.727	118	78.67
		High	5.727 & above	32	21.33
8	Innovativeness	Low	Below 3.693	82	54.67
		High	3.693 & above	68	45.33
9	Information source utilisation	Low	Below 28.653	96	64.00
		High	28.653 & above	54	36.00
10	Scientific orientation	Low	Below 11.013	112	74.67
		High	11.013 & above	38	25.33
11	Risk orientation	Low	Below 9.487	116	77.33
		High	9.487 & above	34	22.67
12	Rationality in decision making	Low	Below 6.307	96	64.00
		High	6.307 & above	54	36.00
13	Economic motivation	Low	Below 9.380	100	66.67
		High	9.380 & above	50	33.33
14	Achievement motivation	Low	Below 9.500	107	71.33
		High	9.506 & above	43	29.67
15	Accessibility to sales point	Low	Below 4.687	71	47.33
		High	4.687 & above	79	52.69
16	Attitude towards biofertiliser use	Low	Below 14.44	115	76.67
		High	14.440 & above	35	23.33
17	Knowledge on biofertiliser use	Low	Below 3.22	107	71.33
		High	3.22 & above	43	29.67

It could be seen from Table 1 that majority (66.66%) of the farmers were found to belong to the middle aged category followed by 18.68 per cent in old aged category. Less percentage (14.66%) was found among young category. From this it could be inferred that majority of the farmers were middle aged.

It was observed that 78.00 per cent of the respondents were in the low category with respect to education.

It is also evident from the Table 1 that 64.67 per cent of farmers possessed higher farming experience. This might be due to the fact that majority of the farmers belonged to the middle aged category as explained earlier.

About 68.00 per cent of the respondents were found in the low category in the case of farm size.

It is clear from the Table 1 that 54.00 per cent of the respondents in the low category with respect to cropping intensity.

It could be noted that 73.33 per cent of the respondents were in the low category with respect to social participation.

For the variable extension participation most (78.67%) of the respondents were found in the low category.

It was observed that 54.67 per cent of the respondents were in the low category with respect to their innovativeness.

It is evident from Table 1 that 64.00 per cent of the respondents belonged to the low category with respect to the information source utilisation.

About 74.67 per cent of the respondents were found in the low category in the case of scientific orientation and 77.33 per cent in case of risk orientation.

It was observed that majority of the respondents (64.00%) were in the low category with respect to rationality in decision making.

The next important variable which had a majority (66.67%) of the respondents under low category was economic motivation.

Regarding the variable achievement motivation 71.33 per cent belonged to the low category.

It could be noted that 52.69 per cent of the respondents were in the high category with respect to accessibility to sales point.

Table 1 also showed that 76.67 per cent and 71.33 per cent of the respondents were in the low category with respect to attitude towards use of biofertiliser and knowledge on biofertiliser respectively.

4.2 Evaluative perception on the respondents on the feasibility of biofertiliser technology

4.2.1 Farmer-respondents

It is evident from Table 2 and Fig.3 that the majority (74.60%) of the farmer respondents were in the medium category in terms of evaluative perception. This indicated that the feasibility of biofertiliser technology has been perceived moderately by a large majority of the farmers.

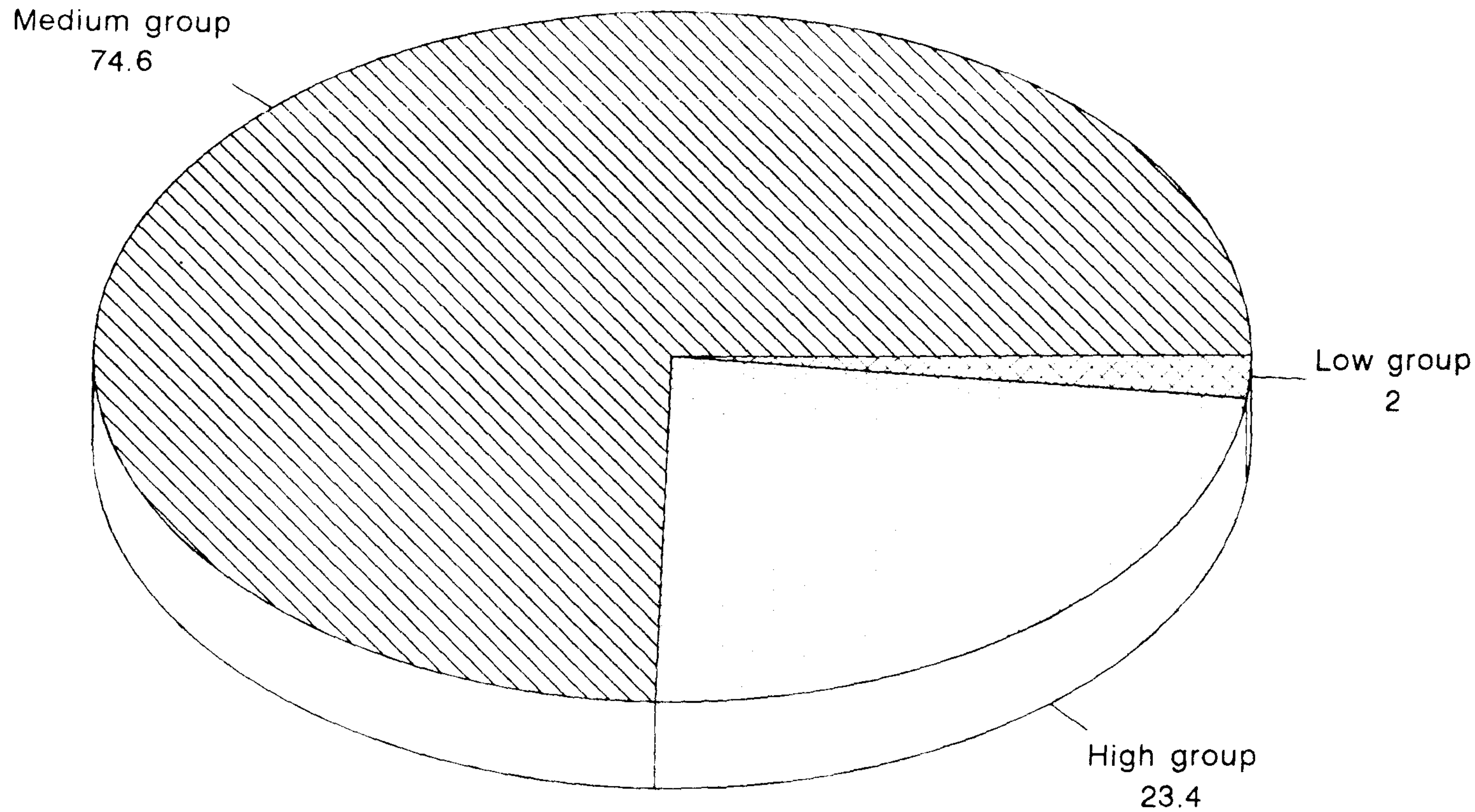

Fig. 3. Distribution of the farmer-respondents based on the evaluative perception on the feasibility of biofertiliser technology

Table 2. Distribution of the farmer-respondents based on the evaluative perception on the feasibility of biofertiliser technology

(n = 150)

Sl.No.	Category	Class limits	Frequency	Percentage
1	Low Below (X - SD)	<20.36	3	2
2	Medium Between (X ± SD)	29.36-26.9	112	74.6
3	High above (X + SD)	>26.9	35	23.4

It could be seen that only a small percentage (2.00%) of respondents were under the low category. It was interesting to note that about 23.40 per cent of farmers were in the high category. It is clear from the results that only a very small portion of the farmers had poor perception on the feasibility of biofertiliser technology. A number of reasons could be attributed to the relatively better perception. Biofertilisers are environment friendly, low cost agricultural input playing a significant role in improving nutrient availability to the crop plants. The cost of biofertiliser is so low that even small increases in crop yields, though not significant, will be in excess of the likely cost of inoculation which would make this technology attractive to farmers. Regarding the Kerala farmers, possessing a relatively higher level of education and exposure to different mass media sources would have resulted in accurate evaluation of the biofertiliser technology.

4.2.2 Scientists

It is evident from Table 3 and Fig.4 that the majority (86.70%) of the scientist respondents were in the medium category in terms of evaluative perception. It could be seen that only a small percentage (13.30%) of respondents were under the low category while in the higher category, there were no respondent at all.

It is clear from Table 3 that not even a single person is included in the higher category. This might be due to the constraints experienced in the research system. Constraints such as the effect of unfavourable soil and climatic conditions, competition from native strains, antagonistic effect of the soil microbes and other constraints effect the efficiency of the biofertiliser technology. This will explain the reason for the above distribution of the respondents.

Table 3. Distribution of the scientist-respondents based on the evaluative perception on the feasibility of biofertiliser technology

(n = 30)

Sl.No.	Category	Class limit	Frequency	Percentage
1	Low (Below X - SD)	<24.63	4	13.3
2	Medium (Between X ± SD)	24.63-29.09	26	86.7
3	High (Above X + SD)	>29.09	--	0.00

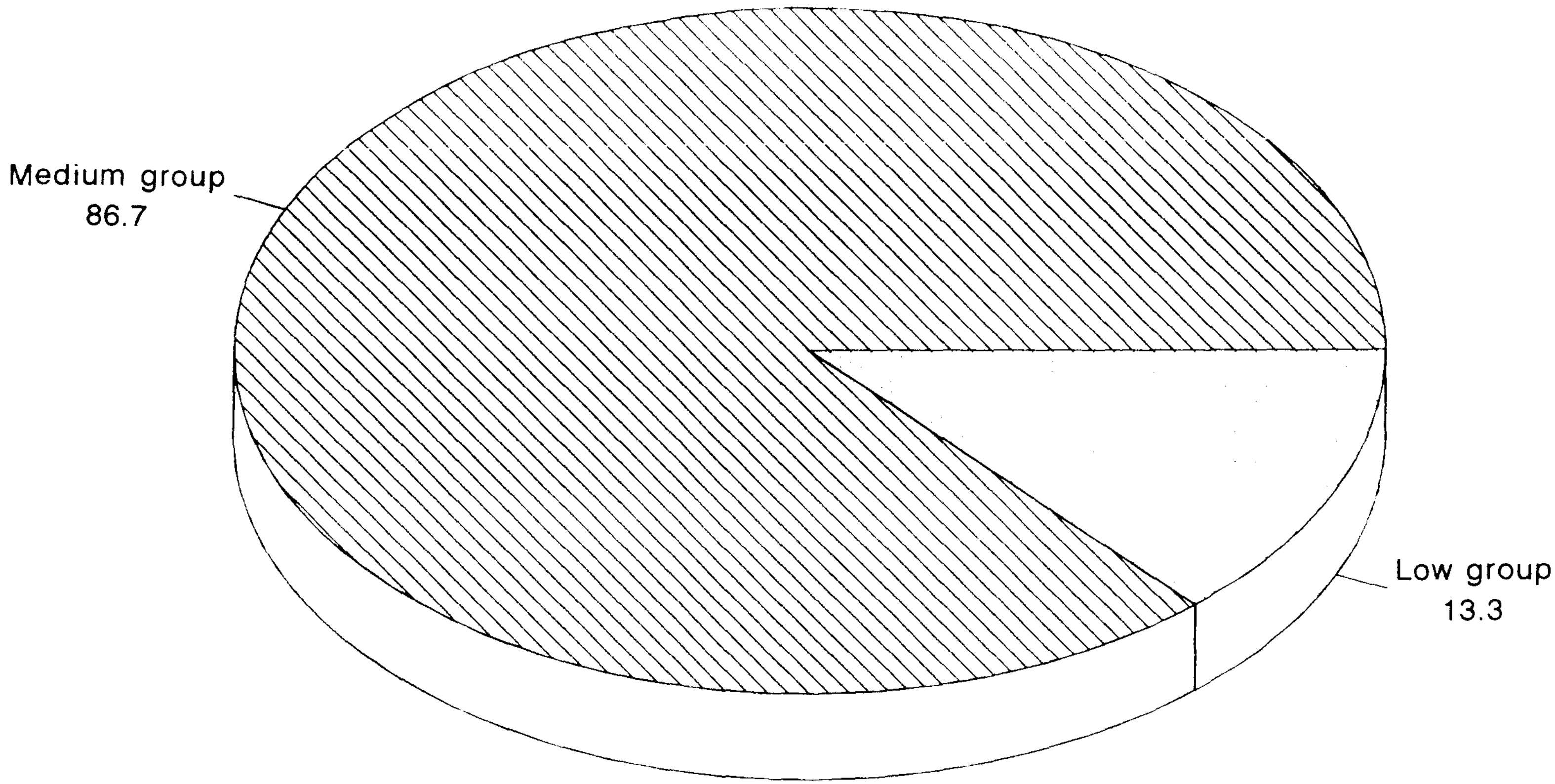

Fig. 4. Distribution of the scientist-respondents based on the evaluative perception on the feasibility of biofertiliser technology

The scientists are well aware of the advantages and disadvantages of the biofertiliser technology. Based on these criteria, they will be critically analysing the technology. This might be the possible reason for accumulation of respondent in the medium category.

4.2.3 Extension personnel

The results of Table 4 and Fig.5 distinctly project that the majority (80.00%) of the respondents were in the medium category in terms of evaluative perception. It could be observed that only a small percentage (10.00%) each of respondents were under the low and high categories.

A number of reasons could be attributed to the high accumulation of extension personnel in the medium category and equitable distribution of respondents with respect to low and high categories. Extension personnel are aware of the technological constraints as well as the advantages of technology in the field condition. Biofertilizer is a natural product and is required in smaller doses. In Kerala, since the majority of the farm holdings are small and marginal, it is very difficult for the farmer to purchase and use recommended fertiliser doses at current prices. They need to exploit other less expensive nutrient sources to the maximum. In order to raise their income and living standards, these land holders must maximise crop productivity per unit area in the most effective manner. Biofertiliser, based on renewable energy source are a cost effective supplement to chemical fertilisers and can help to economise on the high investment needed for fertiliser use. An appraisal of the technology taking into account of the above facts will explain the observed perception of the biofertiliser technology.

Table 4. Distribution of the extension personnel based on the evaluative perception on the feasibility of biofertiliser technology

(n = 30)

Sl.No.	Category	Class limits	Frequency	Percentage
1	Low (Below X - SD)	<26.714	3	10
2	Medium (Between X ± SD)	26.714-29.006	24	80
3	High (Above X + SD)	>29.006	3	10

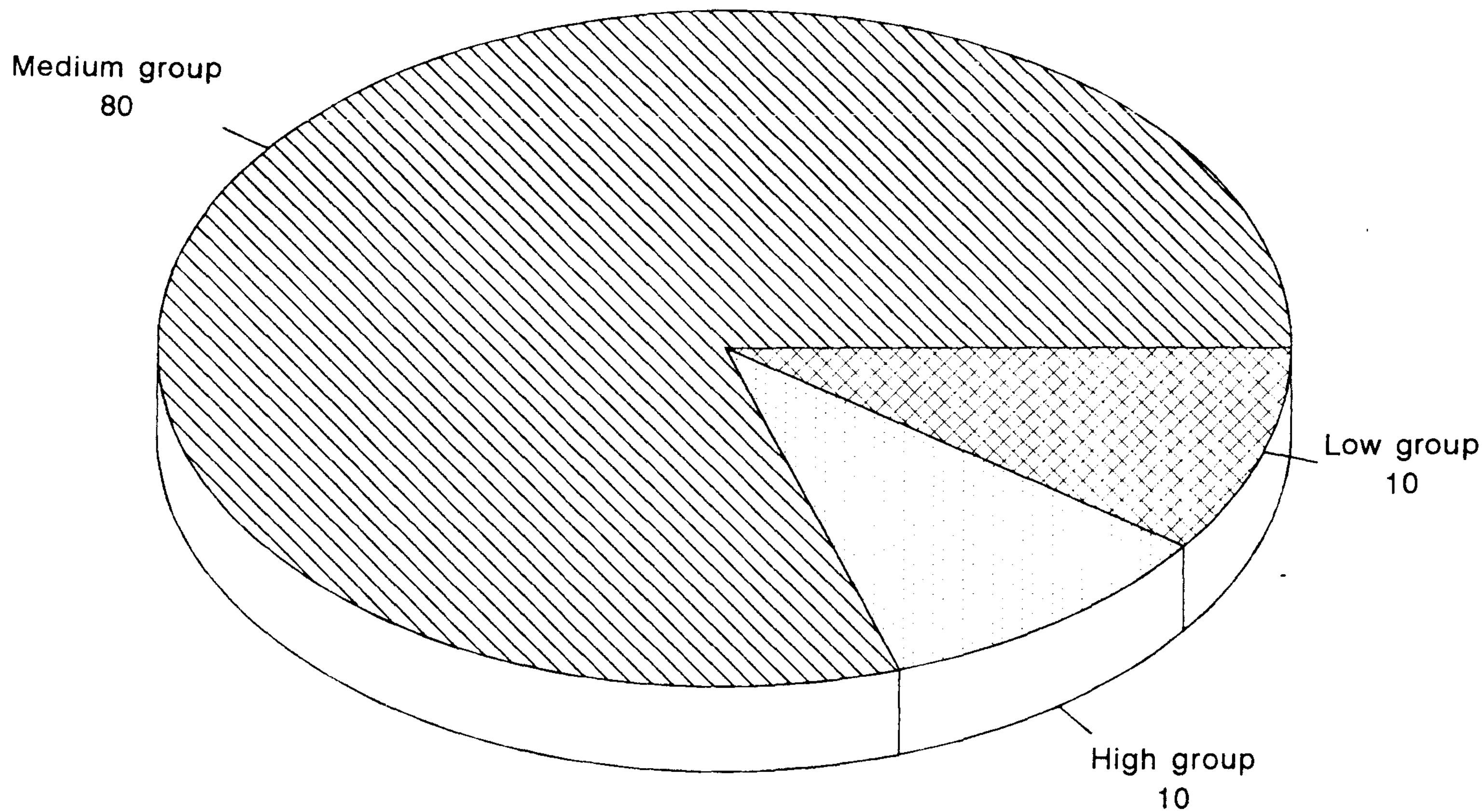

Fig.5. Distribution of the extension personnel based on the evaluative perception on the feasibility of biofertiliser technology

4.3 Adoption of biofertiliser technology

This section deals with the findings in terms of extent of adoption, distribution of adoption based on their extent of adoption and distribution of adopters based on the crop-wise adoption of biofertiliser.

4.3.1 Extent of adoption of biofertiliser technology

It is evident from Table 5 and Fig.6 that only 21.33 per cent of the respondents were adopting the technology. The majority of the respondents were non-adopters. This can be explained by various reasons (Table 12) such as perceived incompatibility and non-profitability of the technology, lack of technical knowledge and technical guidance from the extension agency about the technology, financial constraints and inaccessibility to the sales point. Moreover, regarding the distribution of the respondents (Table 1), majority of them were in the low category in case of most of the selected personal, socio-cultural and techno-economic variables.

4.3.2 Distribution of adopters based on their extent of adoption

It is clear from Table 6 and Fig.7 that majority (87.50%) of the adopters were under the medium category and only minority (12.50%) were under the low category. But in the case of high category, there were no respondent at all. This might be attributed to different constraints experienced in the client system (Table 15) such as inadequate awareness about biofertiliser technology, lack of technical knowledge on the nutrients supplied by biofertiliser, lack of suitable technological recommendation, non-availability of quality materials during the crop season and inaccessibility to the sales point.

Table 5. Adoption of biofertiliser technology by the farmer-respondents
(n = 150)

Category	Frequency	Percentage
Adopters	32	21.33
Non-adopters	118	78.67

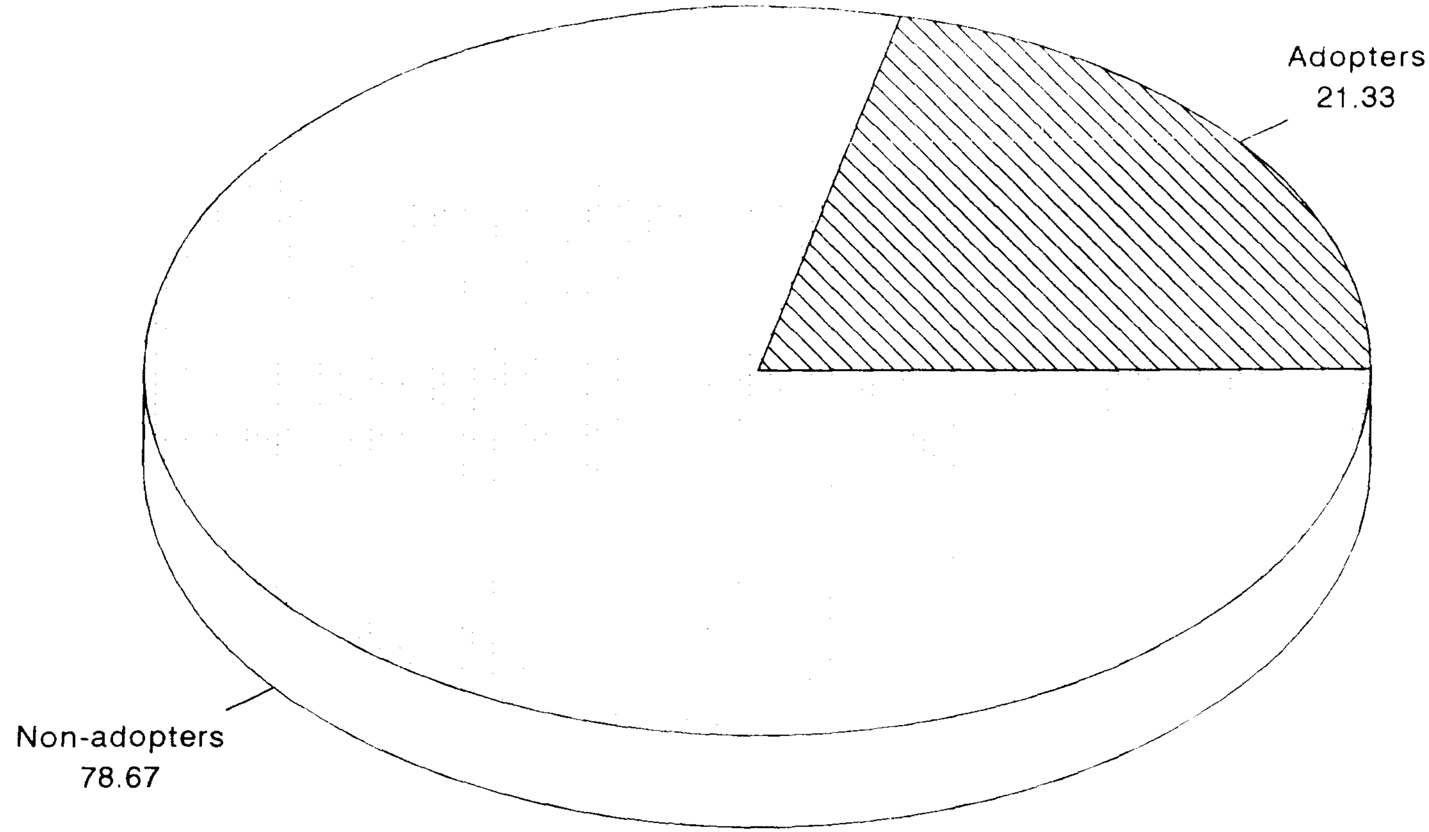

Fig. 6. Distribution of adopters and non-adopters of biofertiliser technology

Table 6. Distribution of adopters based on their extent of adoption of biofertiliser technology

(n = 32)

Level of adoption	Adoption index	Frequency	Percentage
Low (Below X - SD)	<62.49	4	12.50
Medium (Between X ± SD)	62.49-100.00	28	87.50
High (Above X + SD)	>100.00	--	0.00

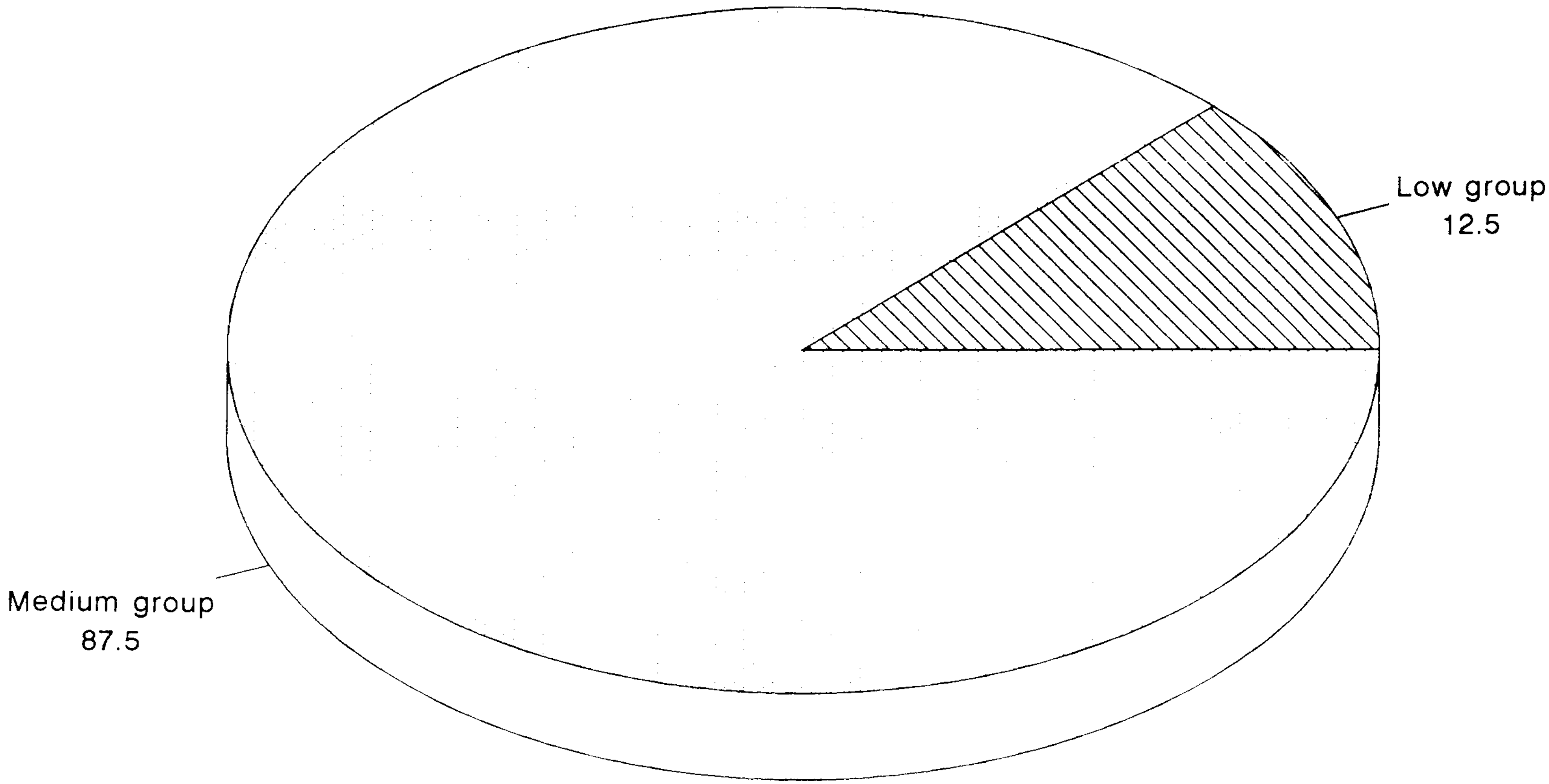

Fig. 7. Distribution of adopters based on their extent of adoption

4.3.3 Distribution of adopters based on the crop-wise adoption of biofertiliser

Table 7 and Fig.8 reveal that majority of the adopters were using biofertiliser in banana cultivation (96.87%) followed by coconut (87.50%) and vegetables (78.12%).

Banana is a versatile crop cultivated by most of the farmers and is considered as an efficient enterprise in terms of utilisation of time and also derivation of profit. Since banana is cultivated continously in the field, the advantages of biofertiliser over other chemical fertilisers can be easily compared. The farmers might have experienced a favourable profit margin for this crop. The effect of the biofertiliser can be evaluated by observing the crop stand in the field also. Moreover, the residual effect of biofertiliser derived from the previous crop might lead to reduction in the dosage of inorganic fertiliser in the next crop. These might have resulted in higher adoption of biofertiliser in banana cultivation.

Coconut based cropping system is prevelent in Kerala. Eventhough it takes comparatively larger period to yield the benefits of the technology in coconut, farmers are having very good opinion about the effect of the technology. In the case of vegetables, since they are short duration crops, the effect of biofertiliser can be observed in the field condition and the benefits can be derived in the same season also. These might be the possible reasons for higher adoption.

Regarding the other crops, viz., rice and rubber, farmers possessed a comparitively larger area and that might be the reason for lower adoption of the technology.

Table 7. Distribution of adopters based on the crop-wise adoption of biofertiliser technology

(n = 32)

Sl.No.	Crops	Frequency	Percentage	Rank
1	Rice	20	62.50	IV
2	Coconut	28	87.50	II
3	Banana	31	96.87	I
4	Vegetables	25	78.12	III
5	Rubber	3	9.37	V

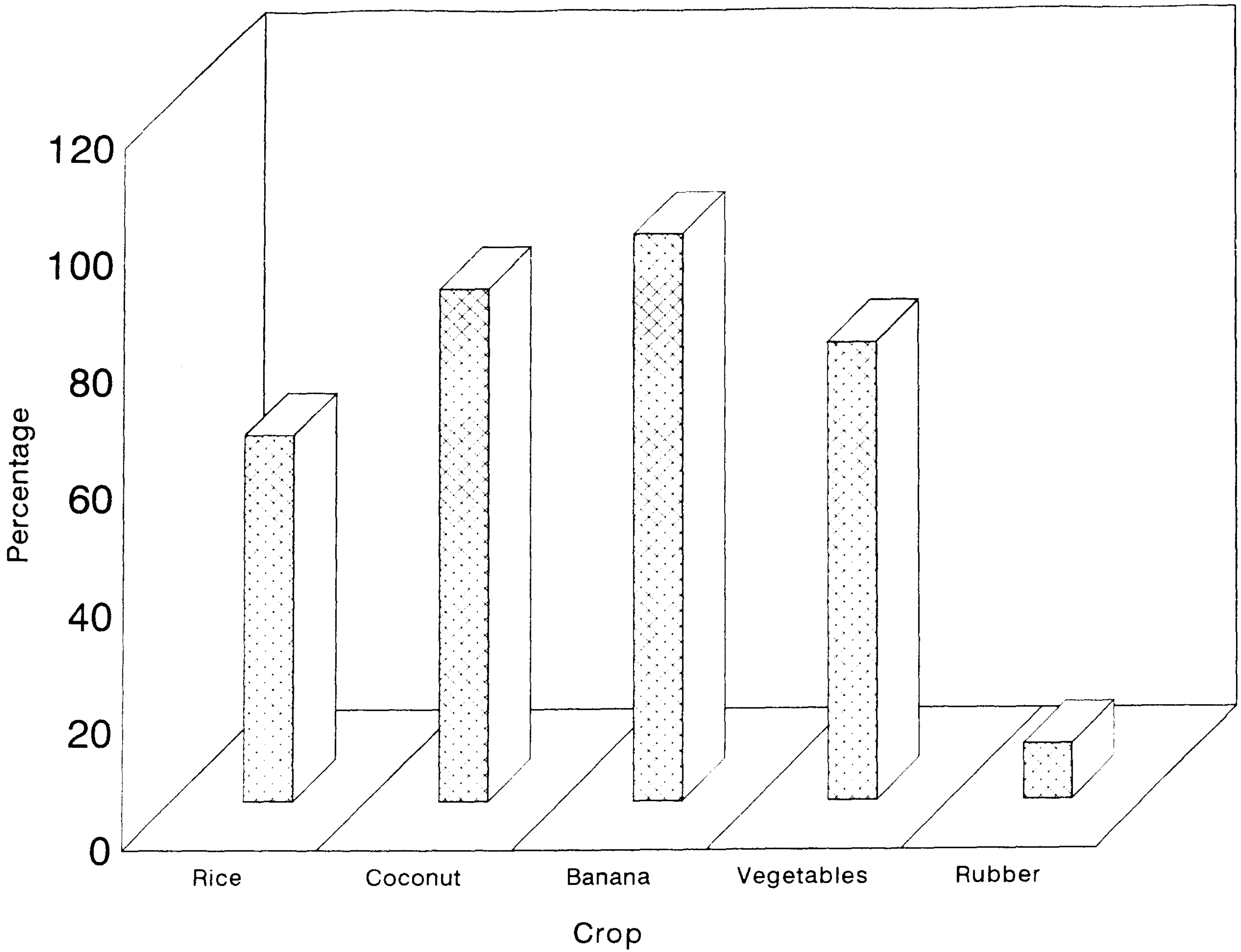

Fig. 8. Distribution of adopters based on the crop-wise adoption of biofertiliser

4.4 Relationship of the personal, socio-economic and situational variables with extent of adoption of biofertiliser technology

4.4.1 Simple correlation analysis

Simple correlation analysis was carried out to find out the relationship between personal, socio-economic and situational variables and extent of adoption of biofertiliser technology. The results are furnished in Table 8 and Fig.9. It is evident from Table 8 that out of the 17 variables analysed 15 were found significantly correlated with extent of adoption. Education, farm size, social participation, extension participation, innovativeness, information source utilisation, scientific orientation, risk orientation, rationality in decision making, economic motivation, achievement motivation, knowledge on biofertiliser and attitude towards use of biofertiliser had positive and significant relationship with extent of adoption of biofertiliser. Variables like age and farming experience showed negative and significant relationship with extent of adoption. The other variables viz., cropping intensity and accessibility to the sales point had no significant relationship with adoption.

Education level of the farmer was found to be positively related with the extent of adoption. Education paves way for bringing about changes in knowledge, attitude, skills, abilities and practices. Since the educated farmers will be more oriented towards the scientific agricultural development, they are eager to know various modern technologies which are being practised. Since they are well informed about the economic gain and other advantages of the technology there will be high adoption. Regarding biofertiliser technology, the educated people will be able to understand the scientific reasons and merits of technology in a better way. Hence positive relationship between education and extent of adoption could be justified.

Table 8. Relationship between extent of adoption of biofertiliser technology and selected personal, socio-economic and situational variables

(n = 150)

Variable No.	Name of variable	Coefficient of correlation
X_1	Age	-0.448**
X_2	Education	0.496**
X_3	Farming experience	-0.410**
X_4	Farm size	0.365**
X_5	Cropping intensity	-0.065 NS
X_6	Social participation	0.742**
X_7	Extension participation	0.820**
X_8	Innovativeness	0.737**
X_9	Information source utilisation	0.801**
X_{10}	Scientific orientation	0.844**
X_{11}	Risk orientation	0.798**
X_{12}	Rationality in decision making	0.587**
X_{13}	Economic motivation	0.778**
X_{14}	Achievement motivation	0.831**
X_{15}	Accessibility to the sales point	0.275 NS
X_{16}	Attitude towards biofertiliser use	0.833**
X_{17}	Knowledge on biofertiliser use	0.766**

NS - Non significant
** Significant at 1 per cent level

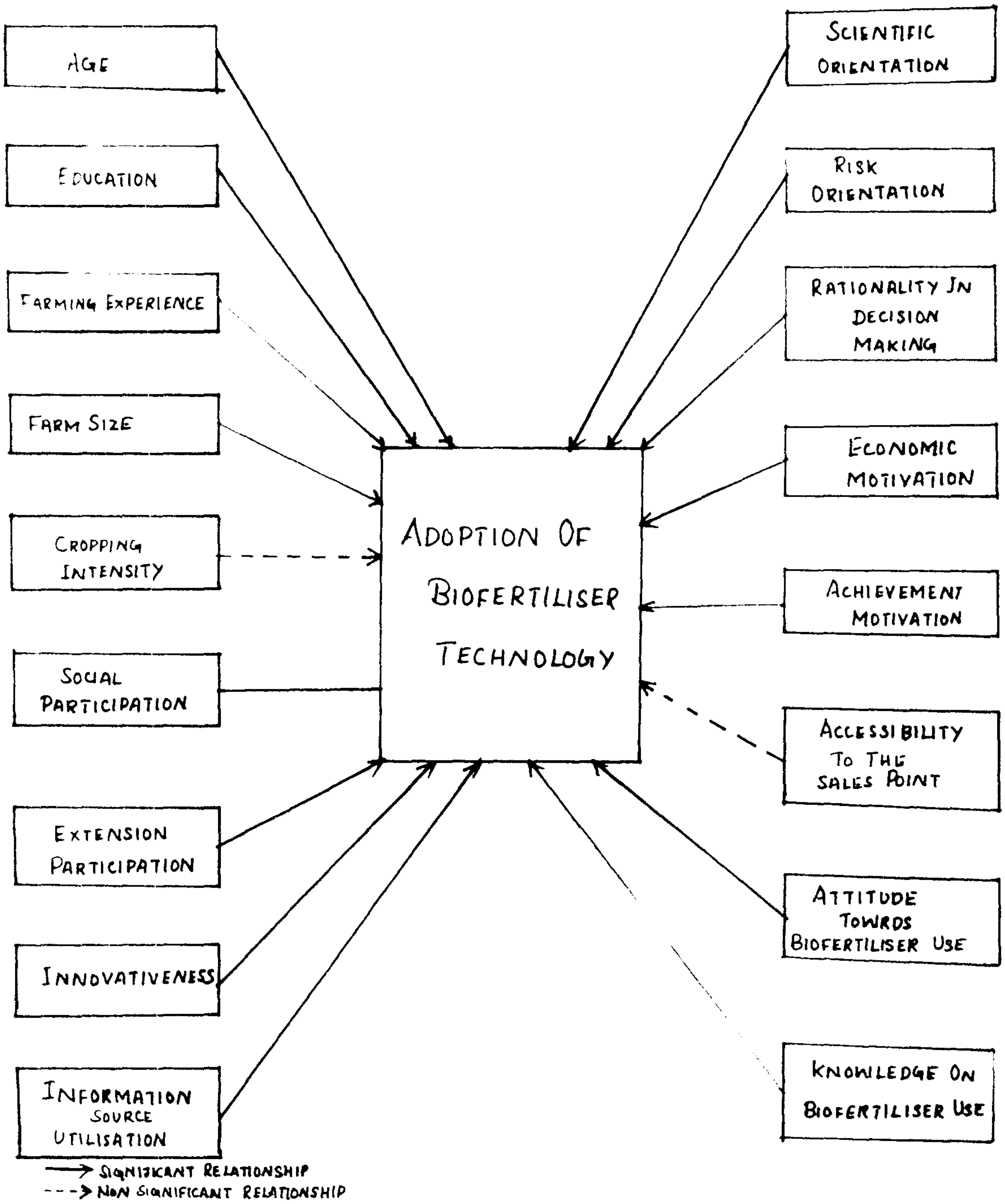

Fig. 9. EMPIRICAL MODEL SHOWING THE RELATIONSHIP BETWEEN THE EXTENT OF ADOPTION AND SELECTED PERSONAL, SOCIO-ECONOMIC AND SITUATIONAL VARIABLES

Ramaswamy *et al.* (1986), Krishnappa (1986), Sulaiman (1989), Satheesh (1990), Gopala (1991), Susamma (1994) and Babu (1995) also reported significant positive relationship between the two variables.

The present study established a positive significant relationship between farm size and extent of adoption. This finding was in conformity with the results of Sagar (1989), Aswathanarayana (1989), Athimuthu (1990), Satheesh (1990), Gopala (1991), Susamma (1994) and Babu (1995). The farmers with more cropped area can easily implement the technology because they can do trials in their field in an effective manner. Based on the trials, they can take decision for the adoption of the technology.

Positive and significant relationship was observed between social participation and extent of adoption. The participation of farmers in various social organisation like co-operative societies, group farming committees and other farmers organisations widenes his opportunity to get information on various improved technologies. In most cases majority of farmers wait before adopting the innovation by themselves until they discuss the innovations with others who already have experiences. By getting an idea about the farming practices of other farmers, they may be interested to practice the technology. Regarding the adoption of biofertiliser technology, social participation resulted in more access to information and enhanced confidence of the farmers. This finding was in conformity with the results of Viju (1985), Aswathanarayana (1981), Krishnamoorthy (1991) and Susamma (1994).

Participation in various extension activities helps the farmers to ensure that the knowledge and skill of farmers are continually enhanced. It was found that extension participation of the farmers was positively related to extent of adoption.

They can easily gain information about all the aspects of the various recommended practices. This actually encourages the adoption of the biofertiliser technology. This finding was supported by the studies of Aswathanarayana (1989), Khare and Singh (1989), Reddy (1991) and Babu (1995).

According to Rogers and Shoemaker (1971) the inquisitiveness and curiosity arising out of a farmer's research for efficient and latest farm technologies leads him to gather enough knowledge on improved practices. The positive and significant relationship between innovativeness and extent of adoption can be well explained based on the above mentioned phenomenon. Biofertiliser technology, as such being an innovation to the people of Kerala, demands the acceptance and readiness of the farmers to adopt it. This finding was in conformity with the results of Anithakumari (1989), Ravi (1989), Krishnamoorthy (1991), Reddy (1991) and Susamma (1994).

Information source utilization was found to have positive significant relationship with extent of adoption. Exposure to various information sources broadens farmers' opportunity to get knowledge about various improved practices. It will advocate the farmers to practise various modern technologies in field conditions. This explains the observed positive relationship between these two variables. This positive relationship was in line with the results of Jayapalan 91985), Sulaiman (1989) and Athimuthu (1990).

In conformation with the results of Umale *et al.* (1991), Ramachandran (1992) and Jnanadevan (1993), the present study also established a positive significant relationship between scientific orientation and extent of adoption. Farmers having very good exposure towards scientific developments, will be able to understand and comprehend the importance of various improved technologies. It will directly promote the adoption of the technology. Hence the positive relationship between scientific orientation and adoption of biofertiliser technology could be justified.

Regarding the adoption of any new technology, there will be certain amount of risk to be encountered by the farmer. It is not assured that the anticipated results could be achieved. Farmers who exhibit courage to face the problems of risk will be interested in the adoption of new technologies. It justifies the positive relationship between these two variables. Similar results have been reported by Ajaykumar (1989), Anithakumari (1989), Govind (1992) and Susamma (1994).

Significant positive relationship was observed between rationality in decision making and extent of adoption. Farmers who make rational decisions are capable of analysing and selecting the technology effectively. Only after that they may switch over to adoption. Hence the positive relationship between rationality in decision making and extent of adoption of biofertiliser technology is justified.

Economic motivation was found to have positive and significant relationship with extent of adoption of biofertiliser technology. Economic motivation is concerned with profit maximisation through increased production. So the farmers will be ready to adopt the technology which yields more economic returns. It is applicable in the case of biofertiliser technology also. So the positive reationship between these two variables is justified. The finding was in conformity with the results of Rajendran (1992), Jnanadevan (1993), Susamma (1994) and Babu (1995).

Positive significant relationship was observed between achievement motivation and extent of adoption. Prasad (1983), Reddy (1987) and Reddy (1991) also had reported positive relationship between achievement motivation and extent of adoption. Farmers who are motivated to achieve more will be prepared to adopt various modern technologies. The accomplishment can be obtained through the acceptance and readiness in the adoption of technology. This phenomenon will explain the positive relationship between these two variables.

It was found that attitude towards biofertiliser technology had positive relationship with extent of adoption. Attitude is the mental disposition or readiness organised in one's mind through perception, knowledge and first hand experience with biofertiliser technology. Attitude being a component of behaviour, a favourable attitude will lead to a favourable behaviour. Hence the positive relationship between the attitude towards adoption of biofertiliser technology could be justified. This finding was on par with the findings of Chandra and Singh (1992), Singh *et al.* (1992), Sulaiman and Prasad (1993) and Susamma (1994).

Knowledge is the body of understanding, information possessed by an individual. It is one of the three components of behaviour. Changes in the behaviour are possible by the changes in the cognitive component because there is a tendency to conform with the knowledge component. So it could be explained as the possible reason for the observed positive relationship. This result was supported by the findings of Krishnamoorthy (1988), Bonny (1990), Bhatia and Singh (1991), Sulaiman and Prasad (1993) and Susamma (1994).

It was found that age and farming experience had negative and significant relationship with the extent of adoption of biofertiliser technology.

Regarding the aged farmers, they will be more inclined towards the traditional methods employed in agriculture. Since they are having more experience in farming, they may stick or to the old practices. It is not an easy job to replace their old methods with the modern technologies. This could be explained as the possible reason for the observed negative relationship.

Cropping intensity and accessibility to the sales point were found to have no significant relationship with extent of adoption.

4.4.2 Multiple regression analysis

The results of multiple regression analysis between adoption of biofertiliser technology by the respondents and the selected personal, socio-economic and situational variables are presented in Table 9.

A high R^2 value of 0.779 indicated that 78 per cent of the variation in the adoption of biofertiliser technology could be explained by the personal, socio-economic and situational variables selected.

From Table 9 it is evident that out of 17 variables only two variables were positively and significantly related with adoption of biofertiliser technology. They were farming experience (0.3504) and risk orientation (0.3609).

It may be noted that the partial regression coefficients and correlation coefficients of education and farm experience were not in the same line. This could happen probably because of the multicollinearity present in the regression.

Table 9. Results of multiple linear regression analysis of extent of adoption of biofertiliser technology with the selected personal, socio-economic and situational variables (n = 150)

Sl. No.	Independent variable	Partial regression coefficient 'b'	Standard error of b	't' value
1	Age	-0.4319	0.0456	-2.966*
2	Education	-0.1851	0.0745	-2.484*
3	Farming experience	0.3504	0.1419	2.470*
4	Farm size	-0.0023	0.0513	-0.045 NS
5	Cropping intensity	0.0614	0.0492	1.248 NS
6	Social participation	-0.0272	0.0934	-0.292 NS
7	Extension participation	0.0283	0.0228	1.240 NS
8	Innovativeness	-0.0277	0.0975	-0.285 NS
9	Information source utilisation	0.0923	0.1363	0.677 NS
10	Scientific orientation	0.1431	0.1921	0.745 NS
11	Risk orientation	0.3609	0.1460	2.471*
12	Rationality in decision making	0.0506	0.0563	0.898 NS
13	Economic motivation	0.0541	0.0192	0.454 NS
14	Achievement motivation	-0.0429	0.1527	-0.281 NS
15	Accessibility to the sales point	0.0829	0.0718	1.155 NS
16	Attitude towards biofertiliser use	0.0307	0.1465	0.210 NS
17	Knowledge on biofertiliser use	0.0634	0.1189	0.534 NS

Intercept = -106.5690, R^2 = 0.779, Standard Error = 17.242
NS - Non significant
* Significant at 5 per cent level

4.4.3 Step down regression analysis

The step down regression analysis was employed to identify the best set of variables that could predict the dependent variable. All the variables were used for this analysis and the results are presented in Table 10.

Though 77.9 per cent of variation in the dependent variable was explained by 17 variables, it could be observed that 77.17 per cent of variation in the dependent variable was contributed by six variables viz., age, education, farming experience, extension participation, risk orientation and accessibility to the sales point. Thus these six variables could be considered as the best, predicting the extent of adoption of biofertiliser technology using step down regression analysis.

Presence of collinearity among independent variables was evident here also. In this analysis with six variables, the regression coefficient of age was positive but in the regression with 17 variables as well as in the correlations with the independent variables age had a negative trend. Similarly regression coefficients of education in both the regression models were negative while its correlation with dependent variable was positive.

In these circumstances, path analysis could be relied upon to know the various types of influences of this independent variables in the adoption of biofertiliser technology.

4.4.4 Path analysis

Adoption of biofertiliser technology has been associated with a number of variables. But these variables themselves are inter-related and such interdependent

Table 10. Results of step down regression analysis of extent of adoption of biofertiliser technology with the selected personal, socio-economic and situational variables

(n = 150)

Variable No.	Independent variable	Partial regression coefficient b	Standard error of b	't' value of b
1	Age	51.774	0.502	3.573
2	Education	-6.450	2.387	2.702
3	Farming experience	1.436	0.486	2.954
4	Extension participation	10.071	2.026	4.971
5	Risk orientation	6.547	1.917	8.415
6	Accessibility to the sales point	2.531	0.941	2.688

R^2 = 0.7717, Intercept constant = 42.79, 'F' value = 80.55

Table 11. Results of path analysis of selected personal, socio-economic and situational variables with the adoption biofertiliser technology

(n = 150)

Variables	Characteristics	Direct effect		Total indirect effect		Indirect effect	
		Effect	Rank	Effect	Rank	Effect	Variable
X_2	Education	2.1756	VII	7.6211	III	10.7031	X_6
X_6	Social participation	-1.5403	VI	2.0049	V	12.2237	X_6
X_7	Extension participation	15.2561	I	-10.4485	XII	3.2540	X_7
X_8	Innovativeness	3.8448	II	-3.3157	IX	12.9116	X_7
X_9	Information source utilisation	-4.2216	IX	4.8285	IV	14.7508	X_7
X_{10}	Scientific orientation	-11.4050	XII	11.9509	II	14.5578	X_7
X_{11}	Risk orientation	4.8083	X	-4.1798	X	14.6457	X_7
X_{12}	Rationality in decision making	-2.4427	VIII	0.4433	VIII	13.1144	X_7
X_{13}	Economic motivation	-9.2303	II	0.5958	VI	15.0636	X_7
X_{14}	Achievement motivation	0.2573	IV	17.0244	I	13.4389	X_7
X_{16}	Attitude towards biofertiliser use	2.7909	III	-4.7754	XI	14.2270	X_7
X_{17}	Knowledge on biofertiliser	0.5912	V	0.5333	VII	13.9076	X_7

Residual effect 0.1602

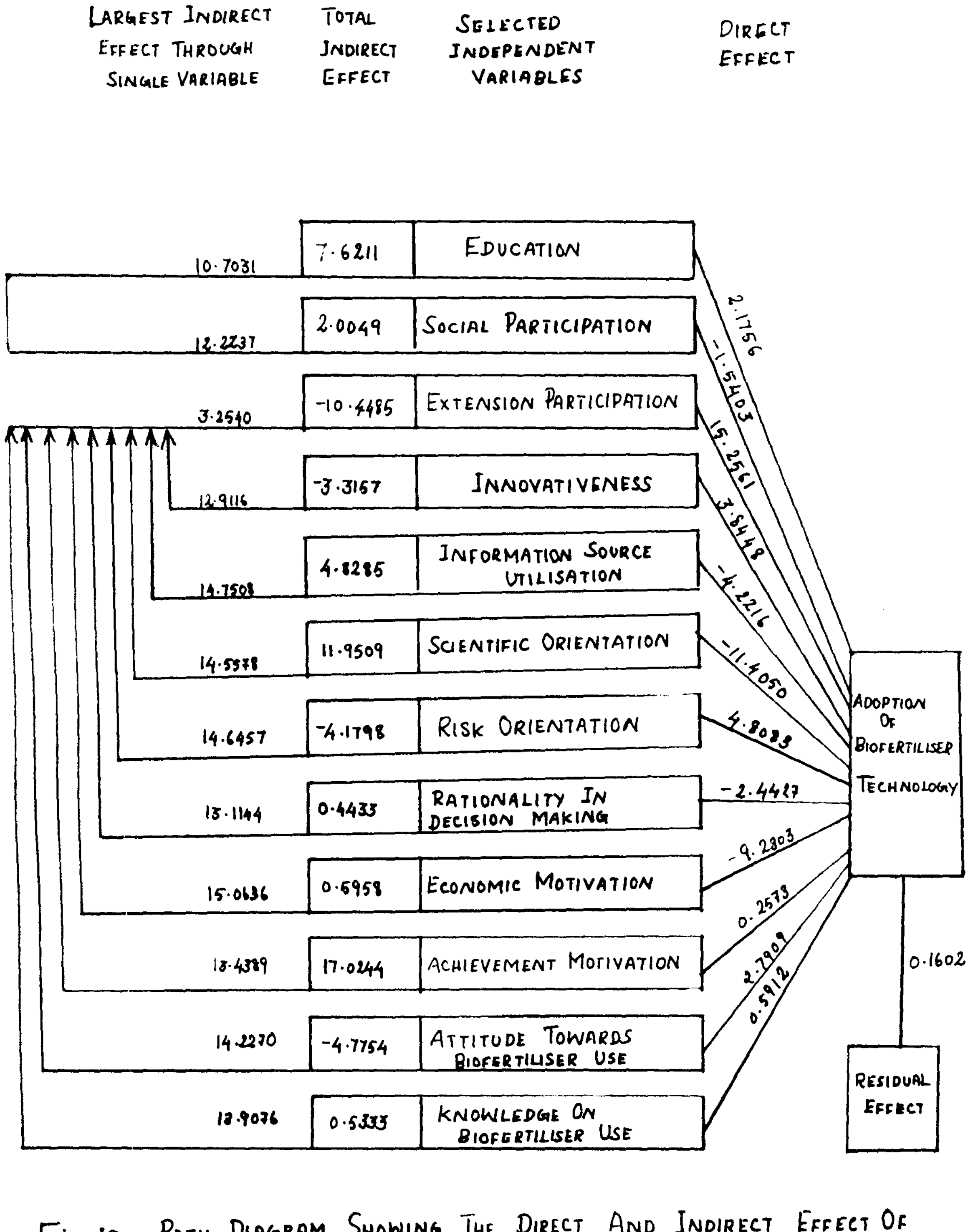

Fig. 10. Path Diagram Showing The Direct And Indirect Effect Of The Selected Personal, Socio-Economic And Situational Variables On The Adoption Of Biofertiliser Technology

factors having direct relationship with the adoption, thereby making the correlation coefficients unreliable as indices. Path analysis permits the separation of direct and indirect effects through the other related variables by apportioning the correlation coefficients. Hence an attempt has been made to identify the direct and indirect effects of the variable through path coefficient analysis.

Since interpretation would be very difficult if all the 17 independent variables were considered in the path analysis, twelve independent variables having maximum correlation with adoption of biofertiliser technology were selected for path coefficient analysis. The matrix of direct and indirect effects of selected personal, socio-economic and situational variables on adoption of biofertiliser technology is furnished as Appendix-IV. The direct and indirect effects of these variables are presented in Table 11 and Fig.10. The residual effect was relatively small indicating the sufficiency of the independent variables included in the regression. The left out variables were otherwise represented through the variables included in this analysis.

Extension participation had the highest direct effect. The indirect effect of all other variables through this character was also very high pointing to the high influence of this variable on adoption of biofertiliser technology. For the individuals who are more oriented towards extension participation, this will enhance to get up-to-date information on agricultural technologies from authentic sources. The greater the degree of participation in extension activity, the more would be the awareness on scientific practices. The extension activities conducted by various agencies and the strong extension network established at Krishi Bhavans might have created a favourable atmosphere for the adoption of biofertiliser technology. This explains the highest direct and indirect effects of extension participation.

Extension participation had large negative and indirect effect through scientific orientation, which had large negative direct effect on adoption. It could be expalined logically that as the farmers develop high scientific orientation, they would be exposed to a number of technologies which were feasible to them. Regarding the biofertiliser technology, adoption was influenced by lot of constraints experienced at client system, extension system, service and support system, which might retard the adoption of biofertiliser technology. While economic motivation had positive indirect effect through extension participation, it had fairly large negative direct effect on the dependent variable. Since the farmers have high economic motivation, they will compare the technology with other technologies in economic terms. Farmer is the ultimate decision maker to adopt the technologies which are feasible to his farming system. Biofertiliser technology may not be perceived as a viable proposal by the farmer when he gives more importance to quick economic returns, as endorsed by the present findings.

Information source utilisation, rationality in decision making and social participation were also similar variables which had negative direct effects as well as negative indirect effects of other variables through them though their contribution to the dependent variable was low compared to that of extension participation and economic motivation.

Among the independent variables considered in the path analysis, achievement motivation had least direct effect on the dependent variable. Similar was the case of knowledge on biofertiliser.

4.4.5 Reasons for non-adoption of biofertiliser technology

From Table 12 it could be observed that perceived incompatibility of the technology (97.45%) was the major reason for the non-adoption of biofertilisers. Lack of technical knowledge about the technology (94.91%) was the other important reason based on the frequency. The other reasons observed were perceived non-profitability of the technology (93.22%), lack of technical guidance from the extension agency (85.59%), financial constraints (45.76%) and inaccessibility to the sales point (11.86%).

4.6 Constraints experienced in different systems of the transfer of biofertiliser technology

4.6.1 Research system constraints

The constraints in the research system were identified and opinion about these constraints by the scientists were analysed. These constraints were ranked based on the importance with which they were encounted. The major constraints experienced in the research system are presented in Table 13.

Effect of unfavourable soil and climatic condition and competition from native strain and compatibility with the host legume were found to be the most important constraints, as the scores indicated.

Unavailability of appropriate and efficient strains of biofertiliser, antagonistive effect of the soil miscrobes, improper selection of suitable strain and presence of numerous parasites and predators in the soil were the other constraints in the order of importance. The ranks obtained by other constraints are shown in Table 13.

Table 12. Reasons for non-adoption of the biofertiliser technology

(n = 118)

Sl.No.	Reasons	Number	Per cent	Rank
1	Perceived incompatibility of the technology	115	97.45	I
2	Inacessibility to the sales point	14	11.86	VI
3	Lack of technical knowledge about the technology	112	94.91	II
4	Lack of technical guidance from the esxtension agency	101	85.59	IV
5	Perceived non-profitability of the technology	110	93.22	III
6	Financial constraints	54	45.76	V

Table 13. Research system constraints

(n = 30)

Sl.No.	Constraints	Score	Rank
1	Unfavourable soil and climatic conditions affects the efficiency of biofertiliser	88	I
2	Competition from native strains and compatibility with the host legume	88	I
3	Unavailability of appropriate and efficient strains of biofertilisers	80	II
4	Antagonistic effect of the soil microbes leads to improper functioning of biofertilisers	80	II
5	Improper selection of suitable strain for a largest crop	75	III
6	Presence of numerous parasites and predators cause problems in the establishment of biofertilisers	70	IV
7	Lack of immediate response of biofertilisers	69	V
8	Unavailability of suitable and standard carrier for biofertilisers	63	VI
9	Unpredictability of the performance of biofertilisers	62	VII
10	Inadequate shelf life	61	VIII
11	Reduction in effectiveness of bioinoculants due to fermentation	58	IX
12	Lack of specific recommended dose of application	55	X
13	Higher cost	50	XI

4.6.2 Extension system constraints

An attempt was made to identify the extension system constraints perceived as important by the extension personnel in adopting the biofertiliser technology.

The major constraints experienced by the extension personnel are presented in Table 14. There are constraints were ranked based on the importance with which they were encountered.

The major constraints found were lack of adequate technical competence among the extension workers in biofertiliser technology, lack of training for extension worker on biofertiliser, inadequacy of field level demonstrations and lack of adequate awareness programmes for the farmers by the development agencies. The other constraints identified were lack of adequate promotional efforts and knowledge on biofertiliser among the extension workers.

4.6.3 Client system constraints

An effort was made to identify the constraints perceived as important by the farmer-respondents in adopting biofertiliser technology.

The major constraints experienced by the farmers are presented in Table 15. These constraints were ranked based on the importance with which they were felt by farmers.

Inadequate awareness about biofertiliser and lack of technical knowledge on the nutrients were ranked by the respondents as the most important constraints.

Table 14. Extension system constraints

(n = 30)

Sl.No.	Constraints	Score	Rank
1	Lack of adequate technical competence among the the extension workers on biofertiliser technology	87	I
2	Lack of training for extension workers on biofertilisers	87	I
3	Inadequacy of field level demonstrations	87	I
4	Lack of adequate awareness programmes for the farmers by the development agencies	87	I
5	Lack of adequate promotional efforts by the agencies	84	II
6	Inadequate knowledge on biofertiliser among the extension workers	75	III

Table 15. Client system constraints

(n = 150)

Sl.No.	Constraints	Score	Rank
1	Inadequate awareness about biofertiliser	450	I
2	Lack of technical knowledge on the nutrients supplied by biofertiliser	450	I
3	Lack of suitable technological recommendations (available to the farmers)	446	II
4	Non-availability of quality materials during the crop season	426	III
5	In accessibility to the (sales) point	426	III
6	Financial constraints	390	IV
7	Uneconomic size of holding	343	V

The next important constraint was lack of suitable technological recommendations. Non-availability of quality materials during the crop season and inaccessibility to the sales point were the other constraints in the order of importance.

4.6.4 Support and service system constraints

An attempt was made to identify the constraints in the service and support system. The major constraints encountered and this system were identified and the opinion about their importance was analysed by the respondent categories viz., farmers, scientists and extension personnel. These constraints were ranked based on the importance with which they were experienced and it is presented in Table 16.

The most important constraint experienced was lack of interest on the part of dealer which was immediately followed by inadequate number of sales point for biofertiliser.

Table 16. Support and Service system constraints

(n = 210)

Sl.No.	Constraints	Score	Rank
1	Lack of interest on the part of dealer	622	I
2	Lack of adequate number of sales points for biofertiliser	621	II
3	Lack of supply of the quality products in time	617	III
4	Lack of adequate storage facilities to ensure longer shelf life	607	IV
5	Lack of adequate publicity	602	V
6	Lack of standardisation of quality control measures	540	VI
7	Lack of standardisation of packaging	494	VII

Summary

CHAPTER-V

SUMMARY

Biofertilisers are environment friendly, low cost agricultural inputs playing a significant role in improving nutrient availability to the crop plants.

In agriculture, the future belongs to biofertiliser and biopesticides in terms of input use. The current level of agronomical use of fertilisers is not ecologically sustainable. Use of fertilisers of biological origin must be increased as Indian soils are deficient in nitrogen and organic matter. There is no difference of opinion about the usefulness and importance of biofertiliser in Indian agriculture. Having the world's largest area under crops where biofertiliser use has been quite beneficial, India has significant potential to promote biofertiliser technology. Considerable efforts particularly in the last ten years have also been made to promote the use of biofertiliser. However, the success has not been to the desired extent due to various constraints at different levels of transfer of technology.

Against this background, a study was undertaken with the following specific objectives.

1. To study the evaluative perception on the feasibility of biofertiliser technology by researchers, extension personnel and farmers in Thrissur district.

2. To study the extent of adoption of biofertiliser technology in different crops by farmers in Thrissur district.

3. To identify the factors influencing adoption of biofertiliser technology by the farmers.

4. To analyse the constraints in different systems of the transfer of biofertiliser technology.

The study was conducted during 1996 in Thrissur district. One block each from three agricultural sub-divisions were selected and one panchayat each was selected from each of these three blocks.

Thus Koorkkancherry, Porthassery and Vallatholnagar panchayaths were selected from Trichur, Irinjalakkuda and Vadakkancheri subdivisions respectively.

The dependent variable in this study was the extent of adoption of biofertiliser technology. The independent variables selected were age, education, farming experience, farm size, cropping intensity, social participation, extension participation, innovativeness, information source utilisation, scientific orientation, risk orientation, rationality in decision making, economic motivation, achievement motivation, accessibility to the sales point attitude towards use of biofertilisers and knowledge on biofertilisers.

The extent of adoption of biofertiliser technology was measured using the adoption index developed for the purpose.

The independent variables were quantified using already existing scales and established procedures.

The data were collected by conducting personal interviews with the farmer respondents using well structured and pre-tested interview schedule developed for the purpose. For the other respondents, viz., researchers and extenstion personnel, questionnaires were employed. The statistical tools used for the study were percentage analysis, correlation analysis, multiple regression analysis, step down regression analysis and path coefficient analysis.

The salient findings of the study are furnished below.

1. Regarding the distribution of respondents based on the personal, socio-economic and situational characteristics, majority of the respondents, belonged to the higher category with respect to age, farming experience and accessibility to the sales point. For the rest of the variables such as education, farm size, cropping intensity, social participation, extension participation innovativeness, information source utilisation, scientific orientation, risk orientation, rationality in decision making, economic motivation, achievement motivation, attitude on biofertiliser use and knowledge on biofertilisers majority of the respondents were in low category.

2. Evaluative perceptions on the feasibility of biofertiliser technology by the respondent categories were as follows.

(i) With regard to the evaluative perception on the feasibility of biofertiliser technology, majority (74.60%) of the farmer respondents were in the medium category. There were 23.40 per cent and 2.00 per cent of respondent in high and low category respectively.

(ii) In the case of scientist respondents, majority (86.70%) had medium level of perception while the remaining (13.30%) possessed low level of perception.

(iii) Majority (80.00%) of the extension personnel were in the medium category. An equitable distribution (10.00%) each was observed in high and low category.

3. The nature and extent of adoption of biofertiliser technology were as follows.

(i) Regarding the extent of adoption of the biofertiliser technology, only 21.33 per cent of the respondents were adopting the technology.

(ii) With regard to the distribution of adopters based on their extent of adoption majority (87.50%) of the adopters were under the medium category and the remaining (12.50%) were under the low category.

(iii) With respect to distribution of respondents based on crop-wise adoption, majority (96.87%) of the adopters were using biofertiliser in banana cultivation followed by coconut (87.50%) and vegetables (78.12%).

4. Correlation analysis revealed that out of 17 independent variables, 13 variables namely education, farm size, social participation, extension participation, innovativeness, information source utilisation, scientific orientation, risk orientation, rationality in decision making, knowledge on biofertiliser, attitude towards use of biofertiliser, economic motivation and achievement motivation were positively and significantly correlated with the dependent variable extent of adoption.

5. The results of multiple regression analysis indicated that 78 per cent of the variation in the extent of adoption of biofertiliser technology could be explained by the selected independent variables.

6. The results of step-down regression analysis revealed that while 78 per cent of the total variation was explained by all 17 variables together, 77.17 per cent could be explained by six variables namely, age, education, farming

experience, extension participation risk orientation and accessibility to the sales point.

7. The results of path analysis showed that extension participation had the highest direct effect on extent of adoption of biofertiliser technology. The indirect effect of all other variables except education and social participation through extension participation was very high pointing to the high influence of this variable on adoption of biofertiliser technology.

8. Regarding the reasons for non-adoption of the biofertiliser technology, it was observed that perceived incompatibility of the technology (97.45%) was the major reason. Lack of technical knowledge about the technology (94.91%), perceived non-profitability of the technology (93.22%), lack of technical guidance from the extension agency (85.59%) were the other important reasons.

9. Constraints in different systems of the transfer of biofertiliser technology were as follows.

(i) The most important constraints experienced by the farmer-respondents were inadequate awareness about biofertilisers and lack of technical knowledge on the nutrients. Lack of suitable technological recommendations and non-availability of quality materials during the crop season were the other important constraints.

(ii) The most important constraints in the research system were effect of unfavourable soil and climatic condition, competition from native strain and compatibility with the host legume. The other important constraints were unavailability of appropriate and efficient strains and antagonistic effect of the soil microbes.

(iii) The major constraints experienced by the extension personnel were lack of adequate technical competence among the extension worker on biofertiliser technology, lack of training for extension worker on biofertiliser, inadequacy of field level demonstrations and lack of adequate awareness programmes for the farmers by the development agencies.

Implications of the study

From the study it emerged that the adoption of biofertiliser technology in Thrissur District was not upto the desirable extent.

The evaluative perception on the feasibility of biofertiliser technology was medium in case of majority of the three respondent categories, viz., farmers, scientists and extension personnel. This implies that the assessment of the technology by the respondents is based on the merits and demerits of the technology.

The constraints experienced at different level of transfer of technology throw light on the necessity for further systematic efforts on part of research, extension and service and support systems.

Future research should focus development of effective, competitive, stress tolerent and locally adaptable strains. The adoption of biofertiliser technology could be enhanced by effective popularisation and conviction of the technology and proper technical guidance from the extension agency. For this experients in farmer's field, compaigns, and suitable media packages are to be designed and carried out for effective dissemination of the technology. There is urgent need to work out aggressive potential and marketing strategies for giving momentum to biofertiliser use in the region.

Suggestions for future research

The study was confined to three panchayaths only. Therefore a comprehensive study including farmers of more number of panchayaths with diversified agroclimatic and soil conditions should be undertaken to draw more reliable and valid generalisations.

The present study had considered the extent of adoption of biofertiliser technology, giving importance to the distribution of adopter categories and the crops to which it was practised. But several variations may occur based on the adoption of different types of biofertiliser and practice-wise adoption of the technology. Research should also give emphasis on crop-wise variation with an element of economic analysis.

Action research studies should be designed for developing promotional strategies for efficient utilisation of this eco-friendly technology.

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* Orginals not seen

Appendices

APPENDIX-I

The statements selected for developing the scale for measuring the attitude towards biofertilizer technology

Statement		't' value
*1.	Biofertiliser can be easily adopted since it is a cheap source of plant nutrient availability	5.87
2.	Since the use of biofertiliser is restricted to certain crops and location, it is practically impossible to adopt the technology	0.57
*3.	Use of biofertiliser is a very useful practice	6.53
4.	The crop yield can easily be increased by the use of biofertilisers	0.53
*5.	It is difficult to obtain proper technical guidance for the efficient utilisation of biofertiliser technology	6.53
6.	Utilisation of biofertiliser technology will surely reduce the consumption of inorganic fertilisers	4.276
*7.	All the farmers should use biofertiliser to make farming profitable	6.57
8.	If a farmer wants to have a good crop he should apply biofertiliser	0.35
*9.	Performance of biofertiliser is highly unpredictable	9.0
*10.	Storage and handling of biofertiliser create problems and hence not a viable proposal	6.3
11.	Adoption of biofertiliser technology favours sustainable agricultural development	5.65
12.	Application of biofertilisers improves the quality of produce	1.0
13.	By continuous adoption of biofertilisers we can improve the soil properties	2.5
14.	It is highly cost effective technology	1.63
15.	Benefits from biofertiliser in terms of increased yield and economy in fertiliser use are not consistant	1.63
*16.	There is no need to adopt biofertiliser since inorganic fertilisers are easily available in the market	5.69
17.	Since we cannot see any immediate effect on the application of biofertiliser, it is better not to adopt for annual crops	3.13

*Statements selected

APPENDIX-II
ANALYSIS OF TRANSFER OF TECHNOLOGY WITH RESPECT TO BIOFERTILISERS

INTERVIEW SCHEDULE

PART-A

Panchayat :

Subdivision :

District :

1. Name of the farmer :

2. Address :

3. Age :

4. Education : Illiterate/can read/can read and write Primary school/Middle school/High school/College

5. Farming experience

For how many years you have been engaged in farming?

6. Farm size : (a) Wet land :
(b) Dry land :

Total

7. Cropping intensity

How many crops do you raise in an year? Give details.

(1) Wet land

(a) Single/double/triple cropped

(2) Dry land

(a) Single/double/more than 2 crops

8. Social participation

Sl. No.	Organisation	Nature of participation		Frequency of participation		
		As member	As office bearer	Whenever conducted	Occasionally	Never
1.	Panchayath					
2.	Co-operative societies					
3.	Agricultural advisory committee					
4.	Farmers organisation					
5.	Arts & sports club					
6.	Recreation club					
7.	Any other (specify)					

9. Extension participation

Sl. No.	Extension activities	Frequency of participation		
		Whenever conducted	Occasionally	Never
1.	Campaigns			
2.	Film shows			
3.	Seminars			
4.	Group meetings			
5.	Exhibitions			
6.	Demonstrations			
7.	Any other (specify)			

10. Innovativeness

	Always/Sometimes/Never
1. Have you cultivated HYVs of any cultivated crop?	
2. Do you collect information regarding new agricultural practices from the research station/universities?	
3. As soon as you get information regarding new agricultural practice, will you take immediate decision to put it into practice?	
4. Do you practice any improved recommendations after getting necessary information without any delay?	

11. Information source utilization

How often do you use the following information sources?
(Please indicate from which of the following sources you obtain technical information regarding new practices in farming)

Sources	Frequency			
	Most often (once in a week)	Often (once in a fortnight)	Sometime (once in a month)	Rarely (once in a year)
I. Mass media sources				
1. TV				
2. Films				
3. Newspaper				
5. Farm publication				
6. Agrl. Exhibition				
II. Personal cosmopolite sources				
1. Research scientists				
2. Agrl. Officers				
3. Agrl. Assistants				
4. Others (specify)				
III. Personal Localite sources				
1. Neighbour				
2. Friends				
3. Family members				
4. Relatives				

12. Scientific Orientation

	Agree/Undecided/Disagree
1. New methods of farming gives better results to a farmer than the old methods	
2. The way of farming of our forefathers is still the best way to farm to day	
3. Even a farmer with lot of farm experience should use new methods of farming	
4. A good farmer experiments with new ideas in farming	
5. Though it takes time for a farmer to learn new methods in farming it is worth the efforts	
6. Traditional methods of farming have to be changed in order to raise the living of a farmer	

13. Risk orientation

	Agree/Undecided/Disagree
1. A farmer should rather take more of a chance in making a big profit than to be content with a similar but less risky profits	
2. A farmer who is willing to take greater risks than the average farmer, usually does better financially	
3. It is good for a farmer to take risks when he knows his chance of success is fairly high	
4. It is better for a farmer not to try new farming unless most others have used them with success	
5. Trying an entirely new practice in farming by a farmer involves risks but it worth it	

14. Rationality in decision making
(Choose any one of the alternatives)

1. When you speak agricultural aspects with other farmers

   a) You speak only about the necessary and needed information

b) Sometimes some unnecessary matters also may come to the topic
c) Most of the time you are to get deviated from the main topic

2. When you realise that other farmers does not have much time to spare

a) You use to describe the matter briefly
b) Since that time is not suited, you will postpone the discussion to a latter occassion
c) Without bothering about his shortage of time, you will explain everything in that occasion itself

3. When the relevance of an agricultural topic is seemed to be lost

a) You use to speak about the topic though it is not relevant at that time
b) If the information is untimely or irrelevant, you won't utter even a single word about it
c) You will just mention about the topic and stop it since it is irrelevant

15. Economic motivation

Statements	Agree/Undecided/Disagree
1. A farmer should work towards large yields and economci profit	
2. The most successful farmer is one who makes the maximum profit	
3. A farmer should try any new farming idea which may earn him more money	
4. It is difficult for the farmers children to make good start unless he provides them with economic assistance	

16. Achievement Motivation
(Give your opinion about the following statements

Statements	Response				
	SA	A	UD	DA	SDA
1. Success brings relief of further determination and not just pleasant feelings					

2. How true it is to say that your efforts are directed towards avoiding failure

Quite untrue/Not very true/Untrue/Fairly true/Quite true

3. How often do you seek opportunity to exeel?

Hardly ever/Seldom/About half the time/Frequently/Nearly always

4. Would you hersistate to undertake something that might lead to your failure

Hardly ever/Seldom/About half the time/Frequently/Nearly always

5. In how many spheses do you think you will succeed in doing as well as you can?

Most/Many/Some/Few/Very few

17. Accessibility to the sales point

1. How much distance you have to travel for searching the sales point?

Upto 2 kms/2-4 kms/more than 4 kms

2. How often do you visit the sales point?

Once in a week/Once in a month/Whenever necessary/Never

18. Attitude towards biofertiliser use

1. Biofertiliser can be easily adopted since it is a cheap source of plant nutrient availability
2. Use of biofertiliser is a very useful practice
3. It is difficult to obtain proper technical guidance for the efficient utilisation of biofertiliser technology
4. All the farmers should use biofertiliser to make farming profitable
5. Performance of biofertiliser is highly unpredictable
6. Storage and handling of biofertiliser create problems and hence not a viable proposal
7. There is no need to adopt biofertiliser since inorganic fertilisers are easily available in the market

19. Knowledge on biofertiliser use

1. Name a biofertiliser which is widely used in paddy fields
2. Name a broad spectrum biofertiliser
3. Name the biofertiliser which is widely adopted in your area
4. What is the major nutrient which is not obtained from biofertiliser
5. Mention the name and cost of a biofertiliser
6. What is the shelf life of biofertiliser
7. Can we mix biofertiliser with inorganic fertiliser
8. Can we mix biofertiliser with organic manure
9. Can we replace inorganic fertiliser completely with biofertilisers

Evaluative perception

1. Biofertiliser is required in only smaller doses compared to other organic and inorganic fertilisers
2. Besides their effect on current crop, use of a biofertiliser also leaves considerable beneficial residual effect on soil fertility
3. Biofertilisers suppress the incidence of pathogens and control diseases
4. It increases the crop yield by 10-50%
5. Biofertilisers are cheaper compared to other nutrient sources
6. It improves the soil health
7. Microorganisms in the biofertilisers enhance the availability of plant hormone and thus quickens the growth
8. It promotes the absorption of major plant nutrients
9. By the application of biofertilisers, consumption of chemical fertilisers can be minimised
10. Adoption of biofertilisers helps to reduce the cost of cultivation

PART-B

Adoption of biofertiliser technology

1. Do you practise biofertiliser technology in crop husbandry?

Yes/No

(a) If yes, when did you start the application of biofertilisers?

(i) For which crops you are applying it?

Crops	Total area under the crop (or number)	Area applied (or number)	Quantity applied/ acre	Number of application per year
Rice				
Banana				
Coconut				
Vegetables				
Plantation crops				
Others (specify)				

(b) If not applying, what are the reasons?

1. Perceived incompatibility of the technology
2. Inaccessibility to the sales point
3. Lack of technical knowledge about the technology
4. Lack of technical guidance from the extension agency
5. Perceived nonprofitability of the technology
6. Financial constraints
7. Any other reasons

(c) If discontinued the adoption of technology, what are the reasons?

1. Non availability of suitable strain during the crop season
2. Short shelf life of the biofertilisers
3. Inaccessibility to the sales point

4. Lack of technical guidance from the extension agency

5. Lack of benefits as expected from the technology

6. Financial constraints

7. Lack of storage facilities

8. Supply of poor quality biofertilisers

(d) Client system constraints — Agree/Undecided/Disagree

1. Lack of awareness about biofertiliser

2. Lack of technical knowledge on the nutrients supplied by biofertiliser

3. Lack of suitable technological recommendations available to the farmers

4. Nonavailability of quality materials during the crop season

5. Financial constraints

6. Uneconomic size of holding

7. Inaccessibility to the selling point

8. Other constraints, if any

APPENDIX-III

EVALUATIVE PERCEPTION ON THE FEASIBILITY OF BIOFERTILISER TECHNOLOGY IN RESEARCHERS AND EXTENSION PERSONNEL

QUESTIONNAIRE

Evaluative perception of the feasibility of biofertiliser technology by researchers, extension personnel and farmers

Statements	Agree/Undecided/Disagree
1 Biofertiliser is required in only smaller doses compared to other organic and inorganic fertilisers	
2 Besides their effect on current crop, use of biofertiliser also leaves considerable beneficial residual effect on soil fertility	
3 Biofertilisers suppress the incidence of pathogens and control diseases	
4 It increases the crop yield by 10-50%	
5 Biofertilisers are cheaper compared to other nutrient sources	
6 It improves the soil health	
7 Microorganisms in the biofertilisers enhance the availability of plant hormone and this quickens the growth	
8 It promotes the absorption of major plant nutrients	
9 By the application of biofertilisers, consumption of chemical fertilisers can be minimised	
10 Adoption of biofertiliser helps to reduce the cost of cultivation	

Constraints in different systems of the transfer of biofertiliser technology*

I. Research system

	Agree/Undecided/Disagree
1 Unavailability of appropriate and efficient strains of biofertilisers	
2 Unavailability of suitable and standard carrier for biofertilisers	
3 Improper selection of suitable strain for a target legume	
4 Unfavourable soil and climatic conditions affects the efficiency of biofertilisers	
5 Competition from native strains and compatibility with the host legume	
6 Presence of numerous parasites and predators cause problems in the establishment of biofertilisers	
7 Antagonistic effect of the soil microbes leads to improper functioning of biofertilisers	
8 Unpredictability of the performance of biofertilisers	
9 Reduction in effectiveness of bioinoculants due to fermentation	
10 Lack of specific recommended doses for application	
11 Lack of immediate response of biofertiliser	
12 Inadequate shelf life	
13 Higher cost	
14 Others (specify)	

II. Extension system

	Agree/Undecided/Disagree
1 Inadequate knowledge on biofertiliser among the extension workers	
2 Lack of adequate technical competence among the extension workers on biofertiliser technology	
3 Lack of training for extension workers on biofertilisers	
4 Inadequacy of field level demonstration	
5 Lack of adequate promotional efforts by the agencies	
6 Lack of adequate awareness programmes for the farmers by the development agencies	
7 Other constraints, if any	
III. Client system	
1 Lack of awareness about biofertiliser	
2 Lack of technical knowledge on the nutrients supplied by biofertiliser	
3 Lack of suitable technological recommendations available to the farmers	
4 Nonavailability of quality materials during the crop season	
5 Financial constraints	
6 Uneconomic size of holding	
7 Inaccessibility to the selling point	
8 Other constraints, if any	

IV. Support and service system

	Agree/Undecided/Disagree
1 Lack of adequate storage facilities which can ensure longer shelf life	
2 Lack of interest on the part of dealer	
3 Lack of supply of the quality products in time	
4 Lack of adequate publicity	
5 Lack of standardisation of packaging	
6 Lack of standardisation of quality control measures	
7 Lack of adequate number of sales points for biofertiliser	
8 Other constraints, if any	

* In the questionnaire to respondents of Research system, the items on 'Extension system' were not included other items being common. Similarly, the items on 'Research system' were not included in the questionnaire to 'Extension system'.

APPENDIX-IV

Matrix of direct and indirect effect of selected personal, socio-economic and situational variables on the adoption of biofertiliser technology

	1	2	3	4	5	6	7	8	9	10	11	12
1	2.1756	-0.9895	10.7031	2.6547	-3.2223	-9.5831	3.5952	-1.4005	0.4855	2.1059	-6.4832	0.1722
2	1.3977	-1.5403	12.2237	3.7050	-3.3440	-8.5733	3.5115	-2.0100	0.4801	1.8079	-7.4121	0.2184
3	1.5263	-1.2341	15.2561	3.2540	-4.0818	-10.8830	4.6159	-2.0998	0.5389	2.6026	-9.1138	0.2267
4	1.5022	-1.4842	12.9116	3.8448	-3.6251	-9.5813	3.8067	-1.7879	0.5185	2.1059	-7.9117	0.2296
5	1.6607	-1.2201	14.7508	3.3016	-4.2216	-10.9701	4.6286	-1.9105	0.5501	2.6084	-8.8069	0.2359
6	1.8277	-1.1578	14.5578	3.2300	-4.0606	-11.4050	4.5685	-1.7809	0.5546	2.6950	-8.7038	0.2204
7	1.6267	-1.1248	14.6457	3.0439	-4.0638	-10.8364	4.8083	-1.9816	0.5259	2.6877	-8.9315	0.2284
8	1.2474	-1.2674	13.1144	2.8141	-3.3019	-8.8151	3.9007	-2.4427	0.4376	1.9421	-7.8819	0.1960
9	1.7866	-1.2508	13.9076	3.3723	-3.9277	-10.6988	4.2772	-1.8080	0.5912	2.4891	-8.4133	0.2079
10	1.6416	-0.9978	14.2270	2.9011	-3.9456	-11.0104	4.6306	-1.6998	0.5273	2.7909	-8.6743	0.2094
11	1.5281	-1.2369	15.0636	3.2956	-4.0279	-10.7545	4.6526	-2.0858	0.5389	2.6228	-9.2303	0.2296
12	1.4557	-1.3072	13.4389	3.4301	-3.8699	-9.7690	4.2669	-1.8609	0.4762	2.2716	-8.2347	0.2573

1 - Education (X_2)

2 - Social participation (X_6)

3 - Extension participation (X_7)

4 - Innovativeness (X_8)

5 - Information source utilisation (X_9)

6 - Scientific orientation (X_{10})

7 - Risk orientation (X_{11})

8 - Rationality in decision making (X_{12})

9 - Knowledge on biofertiliser use (X_{17})

10 - Attitude towards biofertilizer use (X_{16})

11 - Economic motivation (X_{13})

12 - Achievement motivation (X_{14})

ANALYSIS OF TRANSFER OF TECHNOLOGY WITH RESPECT TO BIOFERTILISERS

By

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ABSTRACT OF A THESIS

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ABSTRACT

The study was undertaken in selected three panchayaths of Thrissur district to analyse the transfer of technology with respect to biofertilisers. The sample selected for the study included 150 farmers, 30 scientists and 30 extension personnel.

The study revealed that the majority of the farmer respondents belonged to low category in their distribution based on the 17 selected independent variables. It was found that the evaluative perception on the feasibility of biofertiliser technology was medium in case of all the respondent categories viz., farmers, scientists and extension personnel.

Regarding the extent of adoption of biofertiliser technology, poor adoption was observed. Among the selected independent variables, age, education, farming experience, extension participation, risk orientation and accessibility to sales point were found significant in predicting the maximum variation in the extent of adoption of biofertiliser technology.

The higest direct and indirect effect on extent of adoption of biofertiliser was due to extension participation.

Different constraints experienced at different levels of transfer of technology were identified. Inadequate awareness and lack of technical knowledge on biofertiliser were found to be the most important client system constraints. Effect of unfavourable soil and climatic condition and inadequate awareness and lack of technical knowledge on biofertiliser were found to be the most important research

system and extension system constraints respectively. The most important constraint experienced in support and service system was lack of interest on the part of dealer. Perceived incompatibility of the technology and lack of technical knowledge about the technology were found to be the most important reason for non-adoption of the technology. The study drew attention to the emergent need of effective measures to overcome the prevailing constraints in the transfer of biofertiliser technology so as to enhance this eco-friendly farming strategy.