A STUDY ON THE TECHNOLOGY ADOPTION AND PRODUCTIVITY IN RAINFED FARMING SYSTEMS IN LOWER BRAHMAPUTRA VALLEY ZONE OF ASSAM

A
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IN
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by

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CERTIFICATE I

This is to certify that the thesis/dissertation entitled, "**A study on the technology adoption and productivity in rainfed farming systems in Lower Brahmaputra Valley Zone of Assam**" submitted to the Faculty of Agriculture, Assam Agricultural University, in partial fulfilment for the degree of **Doctor of Philosophy** in **Extension Education** is a record of research work carried out by **Sri Pabitra Kumar Das** under my personal supervision and guidance.

All help received by him have been duly acknowledged.

No part of this thesis has been reproduced elsewhere for any degree.

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This is to certify that the dissertation entitled, "**A study on the technology adoption and productivity in rainfed farming systems in Lower Brahmaputra Valley Zone of Assam**" submitted by **Sri Pabitra Kumar Das** to the Assam Agricultural University in partial fulfilment of the requirements for the degree of **Doctor of Philosophy** in the discipline of **Extension Education** has been examined and approved by the Student's Advisory Committee and the External Examiner, after Viva-Voce.

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ABBREVIATIONS USED

AAU	:	Assam Agricultural University
AEO	:	Agricultural Extension Officer
APAU	:	Andhra Pradesh Agricultural University
C.V.	:	Coefficient of variation
d.f.	:	Degrees of freedom
FA	:	Faculty of Agriculture
FAO	:	Food and Agriculture Organization of the United Nations
ha	:	Hectare
HYV	:	High Yielding Variety
ICAR	:	Indian Council of Agricultural Research
NARP	:	National Agricultural Research Project
PPS	:	Pathar Parichalana Samity
PAU	:	Punjab Agricultural University
SMS	:	Subject Matter Specialist
VLEW	:	Village Level Extension Worker

# ABSTRACT

The study entitled "**A study on the technology adoption and productivity in rainfed farming systems in lower Brahmaputra Valley Zone of Assam**" was conducted in Barpeta and Kamrup districts of Assam with the following objectives :

1. To identify different types of specific enterprise based farming systems in the study area across different size group of farms.
2. To asses the level of adoption of selected agricultural technologies and level of productivity in selected farming systems across different size group of farms.
3. To identify the variables which significantly contribute towards the level of adoption of selected agricultural technologies and level of productivity in selected farming systems across different size group of farms.
4. To determine the direct and indirect effects of selected variables on level of adoption of selected agricultural technologies and level of productivity in selected farming systems.
5. To find out farmers' perceptions of factors hindering adoption of improved agricultural technologies in selected farming system across different size group of farms.

A multistage purposive-cum-random sampling design was followed for selection of respondents. The sample of the study consisted of 208 farmers practicing rainfed farming. The data were collected with the help of a pre-tested structured schedule by personal interview method.

The two dependent variables included in the study were level of adoption of agricultural technology and level of productivity. All together twenty-one independent variables were included in the study.

The frequencies, percentage, arithmetic mean, standard deviation, coefficient of variation, zero order correlation coefficient, multiple regression analysis and interpretation of the data.

Findings revealed that 47.12 per cent of the respondents were marginal farmers, followed by 31.25 per cent small and 21.63 per cent medium farmers. While majority (60.20%) of the marginal farmers had low farm mechanisation, 49.23 per cent of small and majority (68.89%) of medium farmers had medium level of farm mechanisation. Majority of the respondents had medium cropping intensity (68.27%), medium degree of

commercialization (66.35%), medium utilization of family labour (69.71%) and medium level of working capital availability (70.19%). Majority of the respondents were middle aged (50.96%), and illiterate (49.52%) with single type (75.48%) but large size (68.27%) family. Around half (49.08%) of them had membership in one organization. Majority of the respondents had low innovation proneness (51.44%), medium economic motivation (70.19%), low scientific orientation (44,71%), medium risk orientation (67.79%), medium level of aspiration (54.80%), medium orientation towards competition (69.71%) and medium management orientation (57.21%). While 37.76 per cent of marginal farmers had less favourable attitude, 40.00 per cent of small and 44.44 per cent of medium farmers had moderately favourable attitude towards improved farm practices. Majority of the respondents had medium level of knowledge on agricultural technology (74.52%) and medium degree of information exposure (78.85%).

All the sampled farmers practised crop based farming system. All together 18 different types of crop based farming systems were identified among three size group of farms. Out of these 14 were common in three size group of farms. Highest percentage (19.71%) practised the system crop-dairy-goat-fish-duck followed by 16.82 per cent respondents with the system crop-dairy-fish-duck-pigeon. In all the farming systems, crop enterprise had the highest contribution towards the total gross margin.

More than 60.00 per cent of the respondents in each of the three farm size groups were adopters of high yielding variety seeds in *sali* and *ahu* rice and adopters of chemical fertilizers in *sali* rice, *ahu* rice and potato crop. Highest percentage of the respondents (39.90%) were adopters of chemical pesticides in mustard crop. As regards level of adoption, majority of the sampled farmers had medium level of adoption of high yielding variety seeds (68.75%) and chemical fertilizers (69.71%). While majority (63.27%) of the marginal farmers and 46.15 per cent of small farmers had low level of adoption of chemical pesticides, 48.89 per cent of medium farmers had medium level of adoption of chemical pesticides. The overall adoption scores revealed that while 44.90 per cent of the marginal farmers had low level of adoption, 40.00 per cent each of the small and medium farmers had medium level of adoption of three selected agricultural technologies. The highest overall mean adoption score (42.69%) was obtained for medium farmers.

As regards level of productivity, findings revealed that while majority of the marginal (73.47%) and small (70.77%) farmers had medium level of total gross margin, majority (53.33%) of the medium farmers had high level of total gross margin per annum. The highest average total gross margin was obtained from the system crop-dairy-fish-duck-pigeon. Out of the 21 independent variables, 13, 17 and 16 independent variables had positive significant correlation with level of adoption of marginal, small and medium farmers respectively. In the pooled sample, 17 independent variables had positive significant correlation with level of adoption. Of these knowledge level on agricultural technology (r = 0.661), working capital availability (r = 0.645), economic motivation (r = 0.592), attitude (r = 0.563), degree of information exposure (r = 0.561), and degree of commercialization (r = 0.521) had moderately strong correlation with level of adoption.

While 13 independent variables had positive significant correlation with level of productivity of marginal farmers, 17 independent variables had positive significant correlation with level of productivity of both small and medium farmers. In the pooled sample18 independent variables had positive significant correlation with level of productivity. Of these, economic motivation (r = 0.720), level of aspiration(r = 0.692), orientation towards competition (r = 0.660), cropping intensity (r = 0.643), working capital availability (r = 0.598), knowledge level (r = 0.562), and attitude (r = 0.505) had a moderately strong to strong correlation with level of productivity.

The variables knowledge level had the highest positive significant contribution towards the level of marginal farmers, followed by the variables working capital availability and attitude. As regards small farmers, the variable economic motivation had the highest positive significant contribution towards the level of adoption followed by the variables working capital availability and cropping intensity. As regards medium farmers, the variable knowledge level had the highest positive significant contribution towards the level of adoption followed by economic motivation and working capital availability. In the pooled sample, the variable knowledge level had the highest positive significant contribution towards the level of adoption followed by the variables working capital availability and economic motivation.

The variable knowledge level had the highest positive and substantial direct effect (0.267) on the level of adoption followed by the variables economic motivation (0.210) and working capital availability (0.206).

The variable orientation towards competition had the highest positive and significant direct effect (0.269) on the level of productivity followed by the variables level of aspiration (0.241) and cropping intensity (0.219).

'Lack of finance', 'non availability of high yielding variety seeds in time' and 'high cost of fertilizers and pesticides' were perceived by both the small and marginal farmers as three most important constraints in adoption of improved technology. 'Non availability of high yielding variety seeds in time', 'lack of irrigation facilities' and 'lack of knowledge about plant protection measures' were perceived by the medium farmers as three most important constraints in adoption of improved technology.

Introduction

Chapter I

INTRODUCTION

About 84.00 per cent of the world's cultivated area lies in rainfed environments and the vast majority of the world's rural poor both reside and try to derive their livelihood in such areas[1]. In India, the area under rainfed agriculture is 100.78 million hectares which constitute about 70.60 per cent of the 142.74 million hectares net shown area. More than half of the country's 98 million farm families operate their holdings in the rainfed areas. It has also been stated that even after full exploitation of irrigation potential in the country at least half of the total area under crop in the country will remain rainfed[2]. This indicates that rainfed agriculture shall continue to play a major role in improving Indian agrarian economy.

To a layman, agriculture that solely depends on rainfall for its growth is rainfed agriculture. Absolute conceptualization, however, demands that factors inter playing rainfed agriculture be made clear enough for the simple fact that agriculture varies from situation to situation. For instance, it has been defined as agriculture based on crop production in a farming system which depends entirely on rainfall on a particular holding. It excludes irrigation from streams and underground sources but may include supplementary irrigation from small dams or tanks fed from rainfall and associated runoff on a particular land holding[3]. For rainfed agriculture, the quantum of rainfall, its duration, its distribution over time and space, rates of precipitation and evapotranspiration, topography and soil type are primary determining factors for its growth. On the basis of the number of humid months, the rainfed farming area in India can be divided into three groups[4], *viz.*, (i) Humid and

1. Russell, J. (1991) in Prasad, C. and P. Das (1991), Pp.176-190.
2. Choudhary, B. N. (1991) in Prasad, C. and P. Das (1991), Pp.76-97.
3. Jha, S. C. and A. T. Perez (1989)
4. Kanwar, J. S. (1982)

sub humid tropics (with 4.5 to 7 humid months) (ii) Dry semi arid tropics (with 2 to 4.5 humid months) and (iii) Arid tropics (with less than 2 humid months). The North Eastern region of India is situated in the humid sub-tropical zone. Rainfed agriculture can also be categorised into three broad categories on the basis of the percentage of unirrigated area to net sown area, which is an index of dependence on rains[5]. The first category includes the areas with more than 70.00 per cent unirrigated area (high dependence on rains). Nearly 64.00 per cent of the farmers in this category are small and marginal farmers but operates one-fifth (20.00%) of the area under this category. The second category consists of the areas with 50.00 to 70.00 per cent unirrigated area (medium dependence on rains). An overwhelming majority of more than 85.00 per cent of the farmers in this category are small and marginal farmers but operates less than half (44.00%) of the area under this category. The third category includes the areas with 30.00 to 50.00 per cent unirrigated area. Almost all (95.00%) of farmers in this category are small and marginal farmers but operate less than half (45.00%) of the area under this category. Taken together, the three categories account for nearly 71.00 per cent of unirrigated area of the total net sown area in the country. About three-fourth of the farmers inhabiting this area are small and marginal farmers. The average size of holding in the rainfed area is 1.55 hectares against combined (irrigated and rainfed) average land holding size of 1.69 hectares. Another criterion for classifying rainfed agriculture can be precipitation. It is estimated that the total precipitation in the country is approximately 400 million hectare metres (mhm) annually, of which 70 mhm is lost through evaporation. Of the remaining 330 mhm, around 150 mhm enters the soil and 180 mhm constitutes the runoff[6]. There is extreme variation in annual rainfall in India ranging between 10cm (in Rajasthan) and 1000cm (in Meghalaya). Arial distribution of rainfall in India shows that 30.00 per cent of geographical area receives less than 75cm of annual rainfall[7].

5. Misra, D. C. (1991) in Prasad, C. and P. Das (1991), Pp.299-329.
6. Singh, R. P. (1990) in Kotler, N. G. (1990).
7. Misra, D. C. (1991) op. cit., Pp.307-311.

If two criteria of irrigation and rainfall are combined, then Indian agriculture can be classified in to three types of agriculture, *viz*., (i) Irrigated agriculture (with less than 30.00 per cent unirrigated area), (ii) Rainfed agriculture (with more than 30.00 per cent unirrigated area and annual rainfall above 1112mm) and (iii) Dry land agriculture (with more than 70.00 per cent unirrigated area and annual rainfall below 1112mm). Such a classification has important implications for agricultural extension work as the nature and content of the extension work will differ in these three types of agriculture warranting appropriate orientation and design of the extension strategy.

Although India has achieved outstanding agricultural progress in its more favourable, irrigated regions, there has been little effect of green revolution technologies in rainfed regions which contribute only 42 per cent of the total food grain production in the country. It indicates that the rainfed areas in the country are characterised by very low and instable productivity. This is mainly due to poor resource base, practically non-existent infrastructure, inadequate use of improved technology in farming and inadequate institutional support[8]. The trends in production of principal crops in the country clearly reveal that there has been marked positive relationship between increase in production and productivity with concomitant increase in irrigation. On the contrary, the production and productivity of crops grown in rainfed areas have lagged behind. This suggests that the rainfed agriculture needs detailed examination and ameliorative measures to boost agricultural production in the country.

As far as the state of Assam is concerned, more than 90 per cent of the area under agriculture is rainfed. It is situated in the humid sub-tropical region with high rainfall and humidity. The state belongs by and large to a high rainfall belt with annual rainfall ranging between 250cm (in the district of Goalpara) and more than 323cm (in the district of Cachar). Virtually, agriculture in the state is a

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8. Prasad, C. and H. N. B. Reddy (1991) in Prasad, C. and P. Das (1991), Pp.1-24.

combination of peasant and tenant farming with bulk of the cultivated land belonging to small and marginal farmers. While small and marginal farmers constitute 60.16 and 22.52 per cent respectively of the total farmers in the state, they own only 20.82 and 26.27 per cent respectively of the total operational holdings[9]. Moreover, inadequate use of improved technology by vast majority of small and marginal farmers have resulted in deterioration of both production and productivity of their holdings over years.

Despite strenuous efforts made in the recent past to augment the agricultural production in the state, still it cannot be claimed that the agricultural production and productivity in Assam leaves any room for complacency. A perusal of the current production statistics of the state reveals that the average productivity of most of the major crops grown in the state is quite low[10, 11]. For instance, the productivity of rice in the state is only 1359 kg per hectare which is less than the all India average of 1879 kg per hectare and far more below than the average yield of some other rice growing states of India such as Punjab, Haryana, Andhra Pradesh, Tamil Nadu and Jammu and Kashmir where average rice yield ranges between 2500 kg and 3500 kg per hectare[12]. Against the all India average of 2705 kg per hectare, the yield of wheat in Assam is only 1066 kg per hectare. The average yield of mustard in Assam is only 476 kg per hectare which is much lower than the national average yield of 907 kg per hectare. Similarly, the average yield of pulses in the state is only 547 kg per hectare against a national average of 600 kg per hectare. This indicate that, at the present level of technology, there is much scope for increasing the level of productivity of the principal crops grown in the state.

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9. Statistical Hand Book of Assam, (1994). Directorate of Economics and Statistics, Govt. of Assam, Guwahati.
10. Basic Agricultural Statistics, 1993-94 to 1997-98. Directorate of Agriculture, Govt. of Assam, Guwahati.
11. Agricultural Status of Assam, 1992-93. Directorate of Agriculture, Govt. of Assam, Guwahati.
12. Economic Survey, 1994-95. Ministry of Finance, Govt. of India, New Delhi.

The present study was primarily focussed on the farming systems prevalent in the rainfed areas. Farming system as a concept takes into account the component of soil, water, crops, livestock, labour and the resources with the farm family at the centre managing agricultural and related activities and non-farm avocations. The farm family functions within the limitations of its capability and resources, the socio-cultural setting and the interaction of these components with the physical, biological and economic factors. A farming system is defined as a unique and reasonably stable arrangement of enterprises that a household manages according to well defined practices in response to the physical, biological and socio-economic environments and in accordance with household's goals, preferences and resources[13]. Specifically, a farming system refers to a crop and livestock combination or enterprise mix in which the products or the by-products of one enterprise serve as the input for production of other enterprise(s)[14]. It takes in to account the consumption need of the family, the economic factors like relative contribution of the technically feasible enterprises, availability of farm resources, infrastructure and institutional factors besides the agro-biological considerations, namely, interdependence, if any, among enterprises and preference of the individual farmers.

The conventional transfer of technology approach during the last four decades has tried to develop and disseminate improved technology in a top-down fashion on a commodity basis with optimum recommendations that are relevant to the commercial or progressive farmers, who have broadly similar access to the factors of production as the researchers. It is with the hope that the technologies will gradually tickle down and diffuse to poor small farmers. However, little or no attention was paid to the lack of resources of the small scale farmers, his risk adverse nature, his farming system or his agro-climate and socio-economic situation. As a result the conventional development approach brought about many unintended

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13. Venugopalan, M. (1994), Pp.218-231.
14. Maji, C. C. (1991), P.505.

consequences by further widening the already existing gap in economic conditions of the farmers of the irrigated areas and rainfed areas. This is well supported by the crop production trends during the last four decades. There is, thus, an urgent need for an alternative approach to accelerate the productivity of the rainfed areas through appropriate technology generation and diffusion.

The Farming System Approach to research, extension and development emerges out of the recognition that discipline or commodity oriented top down approach to research and development lacks farmers' perspective. The farming system approach to research, extension and development attempts to deal more effectively with problems of complex, marginal, diverse, risk-prone agriculture and disadvantaged farmers operating in harsh environments. The approach entrails a holistic perspective in terms of households, farm and off-farm activities and their natural and socio-economic environments. In contrast to conventional approach, the farming system approach emphasizes a participatory process involving rural people in farming system analysis, planning, evaluation and implementation of improvements on farms. The primary objectives of farming system approach is to improve the well being of individual farm families by increasing the overall productivity of the farming system. It is based on the development of principles improving productivity, increasing profitability, ensuring sustainability and guaranteeing an equitable distribution of the results of production in the midst of diversity[15].

Being primarily biological with a high degree of dependence on weather variables and changing socio-cultural and political environments, farming is more complex and risky than any other system.[16] This is more so in case of rainfed farming systems. Most rainfed farming systems are complex internally, with diverse micro environments, enterprises, nutrient flows, seasonal changes and linkages. The resources of land, water, nutrients, vegetations, livestock, fish and plant genetic

15. FAO (1993), Pp. 1-70.

16. Chambers, R. (1991) in Prasad, C. and P. Das (1991), Pp.47-51.

material of any farm can vary widely. Rainfed farming systems also often differ over short distances and even between neighbours, so that feasible recommendation domains are small and often misfit standardized top-down transfer of technology.

Rainfed farming systems are risk prone and rainfed farm-families often seek to reduce risk by further complicating their farming systems[17]. In consequence, reducing risk is a more important objective for rainfed than for irrigated farm families. There are, however, many ways in which rainfed farmers complicate their farming systems to meet their objectives, including reducing risk. Some of these include- addition of new enterprises, use of mixed cropping, diversification through on-farm and off-farm activities, multiplying internal and external linkages, creating, maintaining and protecting micro-environments which harvest, concentrate and exploit water, soil and nutrients, preferring stress tolerant, stress avoiding and pest and disease resistant varieties of crops and livestock.

Farming is the main source of livelihood for over 80.00 per cent of the rural population in Assam. Around 90.00 per cent of these farmers operates their holdings in rainfed areas with a average holding size of 1.37 hectares. In general, the rainfed farming system of a farmer is characterised by a mixed type of farming consisting of several activities such as field crops, vegetable crops, livestock and fish besides activities in the homestead. There is however, wide variation in the type of farming systems followed by farmers depending upon their resource position, environmental conditions, combination of enterprises and other socio-cultural factors. Rice is the most important cereal occupying about 25.80 lakh hectares which constitutes 80.00 per cent of the total annual cropped area in the state. Other major crop activities include wheat, pulses like green gram, black gram, pea, lentil and arahar, oilseeds like rape and mustard and sesamum, fibre crops like jute and mesta, tuber crops like potato and topioca besides summer and winter vegetables. Horticultural crops such as arecanut, coconut, banana, pineapple, limes and lemons

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17. *ibid.*, P.48.

are grown more or less throughout the state[18]. The main animal activities include dairy cattle, buffalo, pig, goat, duck, poultry and pigeon besides fishery activities. A few studies conducted on identification of farming systems have revealed that the different types of rainfed farming systems prevalent in the state can be classified into six groups, viz. rice based, vegetable based, dairy based, pig based, poultry based and fishery based[19][20]. The most peculiar phenomenon is that all such farming system are seen within a village in Assam.

As a result of introduction various new or improved technologies in agriculture, there has been a revolution in agricultural productivity in the past in the country. But it has been confined to better endowed areas - having assured irrigation, better infrastructural development, land consolidation and easy access to inputs. The approach to concentrate on the resource-rich farmers of better endowed areas was appropriate in the context of the requirements for more food to vanquish hunger. This paid the dividends. But at the same time it was recognized that the cost intensive technologies that paved the way to green revolution were adopted only by the resource-rich farmers in the irrigated areas and the resource-poor farmers in the rainfed areas failed to integrate those technologies into their existing farming systems. Thus, an important question arises as to why the new technologies have not been adopted by the resource-poor farmers of rainfed areas ?

In a number of studies conducted during the recent past, the common reasons assigned for non-adoption of technologies are the conservativeness and ignorance of the farmers. In all such studies, one basic assumption has been that the technologies are good and appropriate and scale and resource neutral. It was seldom studied whether the technologies suited the variable environments prevailing with the rainfed farming community.[21] It has been realized only recently that rainfed

18. Agricultural Status of Assam, 1992-93. Directorate of Agriculture, Govt. of Assam, Guwahati.

19. Kalita, P. (1995), Pp.36-178.

20. Das, J. K.(1996), Pp.34-117.

21. Chambers, R. and B. P. Ghildyal (1985).

agriculture is highly complex and therefore evolving technology to suitably fit in the specific farming system is often difficult. This is now well understood that the technologies are relevant where they are generated and adopted in similar conditions and are mostly not adopted where conditions differ. The physio-biological and socio-economic conditions of resource-rich farmers of irrigated areas are much closer to the conditions of the research stations, thus result is quick adoption of these technologies. On the contrary, the conditions prevailing in rainfed areas are sharply different than the conditions of research stations, therefore, the adoption is poor. Another point of consideration is that improvement in rainfed farming system calls for both land saving as well as labour intensive farming practices. Farming practices having proportionate balance between these two traits are remote. Under such circumstances, farmers use those practices they evolve themselves and hence adoption of recommended technology will be poor.

A review of wide array of studies by FAO (1986) has revealed that the concept that traditional agriculture is static is misleading. Small farm families are receptive to change and small farming systems are dynamic. The review further revealed that no single attitude, trait, factor or farming condition explain the pattern of adoption of new technology by small farmers.[22]

Having said and done, it is not impossible to evolve technology suitable for rainfed farming systems. What is crucial here is approach made in evolving the technology. The only approach suitable for large scale adoption is participatory approach which has been mentioned earlier.

Summing up the foregoing discussion it can be said that an analysis of the farming system is quite important to the subject of development, because the farm is a major decision point in agricultural development. Choosing policies for agricultural development requires the use of information about the existing farming situation. Information on various facets, therefore, need to be gathered. What

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22. FAO (1986).

different types of farming systems are followed by the farmers in different size group of farms in rainfed areas ? What is the level of adoption of technology and level of productivity in different size group of farms in rainfed areas ? Do certain agro-economic, socio-personal, psychological and extension-communication factors influence the level of technology adoption and level of productivity in rainfed farming systems ? What are the constraints in adoption of improved technology by farmers in different size group of farms ? The answer to all these questions and many others are all the more important for the planned economic growth of small and marginal farmers operating in rainfed areas. With this mission in view, the present study was planned with the following specific objectives.

1.1 Objectives of the study

1. To identify different types of specific enterprise based farming systems in the study area across different size group of farms.
2. To assess the level of adoption of selected agricultural technologies and level of productivity in selected farming system across different size group of farms.
3. To identify the variables which significantly contribute towards the level of adoption of selected agricultural technologies and level of productivity in selected farming system across different size group of farms.
4. To determine the direct and indirect effects of selected variables on level of adoption of selected agricultural technologies and productivity in selected farming system.
5. To find out farmers' perceptions of the factors hindering adoption of improved agricultural technologies in selected farming system across different size group of farms.

1.2 Scope and importance of the study

Extension work in developing society is mostly concerned with the transfer of technology to the farmers. Technology and modern inputs, however efficient they may be, can not bring the desired level of success of the extension workers, unless the expected behaviour pattern of the farmers, who are the ultimate users of the technology and inputs, are precisely known and steps are taken to modify them in the desired direction.

The present study was focused on the adoption behaviour and level of productivity of different categories of farmers operating in the rainfed area. The relationship of some selected variables with the farmers' level of adoption and productivity were also examined in detail. The findings of the study shall add to the knowledge and insight of the extension worker about the adoption behaviour of different categories of farmers under rainfed condition which will provide useful guideline for designing effective extension strategies for transfer of technology work.

It is also expected that the findings of the study would be of some help to planners and policy makers in preparation of blue print for agricultural development under the rainfed condition.

1.3 Limitations of the study

The study had the following limitations :

1. The constraints of time, resource and current socio-political situation compelled the investigator to confine the study to two districts of the Lower Brahmaputra Valley Zone of Assam. Generalizations made from the findings, therefore, may be limited to those areas which have agro-climatic and socio-economic condition similar to the study area.
2. although an analysis of farming systems calls for an inter-disciplinary approach, the present study was conducted by the investigator alone basing on the expressed opinion of the respondents and hence the objectivity would be limited to the extent of the information received from the respondents.
3. In this study, to estimate the level of productivity of each farm only partial measures of productivity were used which include total production of a farm,

gross value of production and total gross margin over variable costs. While estimating total gross margin, both livestock and fishery activities were also taken into consideration besides crop activities. Hence, an estimation of productivity per unit of land input could not be incorporated. It is also worthmentioning that an activity gross margin is not a measure of profitability as it takes no account of fixed costs.

4. The study was conducted without the help of an appropriate farming system research model as such model was not available. Hence, some gaps in methodology might be existed. However, taking help of the methodology used in this study further improvements in the methodology can be made for doing research in similar situation.

1.4 Organization of the thesis

The text of this thesis has been arranged in five chapters. The chapter I includes introduction, objectives of the study, scope and importance and limitations of the study. A review of relevant literature is incorporated in chapter II. The research methodology adopted in the study is presented in chapter III. The findings and discussions are dealt in chapter IV. Finally chapter V contains the summary and conclusions. Bibliography and appendices are placed at the end of the thesis.

Review of Literature

Chapter II

REVIEW OF LITERATURE

A good number of research studies have been under taken in India by different researches on identification of specific enterprise based farming systems. A relatively large number of research studies have been conducted during the last five decades in India and abroad on adoption and diffusion of improved agricultural technologies. A good number of studies have also been undertaken to identify the factors hindering adoption of technologies by farmers. However, studies on productivity at farm level are relatively few in number. In order to develop a conceptual frame and appropriate design for the study, some of the available literature relevant to the present study have been reviewed in this chapter under the following heads.

2.1 Enterprise based farming systems

2.2 Concept of technology in agriculture

2.3 Concept of adoption of agricultural technology and indices used for its measurement

2.4 Relationship of adoption behaviour of farmers with selected agro-economic, socio-personal, psychological and extension-communication variables

2.5 Explanatory variables of adoption behaviour of farmers

2.6 Determinants of farmers' productivity

2.7 Factors hindering adoption of technology by farmers

2.1 ENTERPRISE BASED FARMING SYSTEMS

Balishter *et al.* (1985) examined the diversification of enterprises at farm level in Agra district of Uttar Pradesh. The results of the study revealed that the introduction of new farm technology and use of increased inputs led to a marked increase in income at the farm level.

Singh *et al.* (1985) studied the diversification of farming with crop cultivation and dairying in Punjab and revealed that with the adoption of dairy farming along with crop diversification, the farm increased sustainability. Dairy farming on unit area basis was found to be more profitable than crop farming.

Gupta and Tiwari (1985) in their study on the factors affecting crop diversification, observed that large and wealthier farms were relatively less diversified. Tenancy was found to discourage diversification.

Mukundan (1985) evaluated the cost, returns and resource use efficiency in rice-cum-pisciculture in Trichur district of Kerala. The results of the study revealed that the additional income that was obtained by rearing fish in paddy field was very attractive and such a diversification was worth trying on a large scale for the maximization of profit from an unit area of land.

Pal and Pal (1985) examined the nature, extent, causes and impact of both crop diversification and variety diversification in West Bengal. The results of the study revealed that the mode of farming, the degree of mechanization and farm size had been effective in enhancing diversification.

Singh and Sharma (1988) studied the income and employment increasing possibilities under different farming system on small farms in mid-western region of Uttar Pradesh and found that most of the small farms were adopting diversified farming system, combining livestock activities with crop enterprises.

Radha *et al.* (1988) conducted a study on economic analysis of rice based farming system in Krishna district of Andhra Pradesh. The economic analysis of rice-rice and rice-pulse farming systems indicated that the per hectare expenditure on all the inputs except seed was more on the rice-rice farming system.

Sain (1988) conducted a comparative study on wheat-paddy and wheat-cotton farming systems in the south-western Punjab. The results of the study revealed that 75 per cent of the total operational holding was put under paddy or wheat paddy farming system against 81 per cent under cotton or wheat -cotton farming system. Though per hectare operational expenditure did not differ significantly between the two farming systems, significant differences were noted in case of break-up of expenditure.

Thakur *et al.* (1989) compared the cropping patterns, cropping systems, production and income of farmers under the existing farming systems, improved farming systems and optimum farming systems in Himachal Pradesh. The results of the study revealed that under optimum farming systems, production and income of the farm increased nearly three times by intensification of farming.

Bhowmick *et al.* (1990) conducted a study on identification and optimization of resources in major farming systems in Sonitpur district of Assam. The study identified a total of 21 farming systems for different size of group of farms out of which 4 were common in all size group of farms and 6 were common in two size group of farms. The type of farming system identified varied from 14 in small size group to 10 in large size group. In the small size group, about 37.00 per cent of the farmers practised the system crop -dairy- goat- pigeon and duckery followed by the system crop-dairy-pigeon and duckery by 22.00 per cent of farmers. In medium size group of farms, the system crop - dairy-goat-pigeon was followed by 47.00 per cent of the farmers while the system crop-dairy-pigeon-duckery was followed by 16.00 per cent of the farmers. Out of the 12 types of farming system, 6 types were followed by only 3.00 per cent of the farmers and 4 types by only 5.00 per cent of the farmers. In the large size group of farms followed 27.00 per cent of the farmers followed the system crop- dairy-goat-pigeon-duckery and 23.00 per cent of them followed the system crop-dairy-pigeon-duckery. Out of the 10 types of farming systems identified in the large size group, 6 types were practised by only 4 per cent of the farmers. The study also revealed that capital was an important resource constraint and supply of human and bullock labour were in surplus.

Sharma *et al.* (1991) made an attempt to identify the farming systems followed in different agro-climatic zones of Himachal Pradesh and examined the farming system against 81 per cent under cotton or wheat -cotton farming system. Though per hectare operational expenditure did not differ significantly between the two farming systems, significant differences were noted in case of break-up of expenditure.

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Sharma *et al.* (1991) made an attempt to identify the farming systems followed in different agro-climatic zones of Himachal Pradesh and examined the changes in the farming system in the recent past and the strength and direction of the trend and their specific characteristics and features calling for adjustment in the policy response. The author concluded that different farming systems had emerged in the state due to the specific agro-climatic and techno-economic conditions. They were (a) remittance based traditional farming in low hills, (b) live stock based farming in mid hills, (c) vegetable based farming in well endowed pockets of mid hills and (d) fruit based farming system in high hills. The study indicated that vegetable based and fruit based farming systems emerged to be the most profitable for the farming community.

Dooghare *et al.* (1991) in their study on different farming systems in Haryana revealed that adoption of recommended technology even with restricted capital investment resulted in higher net farm income and better utilization of human labour.

Sivanarayana and Reddy (1993) made an critical analysis of the extent of adoption of recommended practices for different enterprises which included crop dairy, sheep and goat rearing among small and marginal farmers in Guntur district of Andhra Pradesh. The results of the study revealed that all the recommended practices related to different selected enterprises were not fully and uniformly adopted by the small and marginal farmers practising diversified farming.

Pradhan (1995) in his study on poultry farming in Tripura found that poultry farming as a self-employment programme was favourably adopted by the people having small land holding in villages as well as towns in the state.

Kalita (1995) in his study conducted in Sonitpur district of Assam revealed that farmers were diversifying crops with all types of locally available livestock activities such as dairy, goatery, poultry, piggery, duckery and pigeonnery which varied from farmer to farmer as per farming systems adopted by them. A total of 26 types of farming systems were identified in the study area. However, none of the farming systems except crop farming was dominant. The extent of diversification of crops with livestock in the study area was very low both from the level of input use as well as quality of breeds or varieties and size of livestock unit. The author pointed out that existing forms of diversification or farming systems failed to cover their basic purposes of augmenting income and employment of the farmers due to the fact that diversification was not because of interest but simply because of tradition.

Das (1996) in his study on viability and sustainability of specific enterprise based farming system in Jorhat district of Assam identified 27 types of farming systems across different size group of farms. These systems were brought under six specific enterprise based farming systems, viz, rice based, vegetable based, dairy based, pig based, poultry based and fish based. Of the total sampled farmers, percentage of farmers following the above enterprise based farming systems were 40.77, 14.62, 10.77, 16.15, 10.00 and 7.60 per cent respectively. Out of these 27 types, 4 types of farming systems were followed by more than 10.00 per cent of the farmers in marginal farm size group, 3 types were followed by more then 10.00 per cent of the farmers in small size group, 4 types were adopted by more them 10.00 per cent of farmers in medium size group while only I type was followed by large size group of farms.

2.2 Concept of technology in Agriculture

Any definition of technology encompasses a wide range of phenomena. According to Fairchild (1961), technology is the combination of totality of techniques employed by people at a given period for the purpose of adaptation to their bio-physical environments.

According to Theodorson and Theodorson (1969), in the broadest sense, technology is the translation of scientific laws into machines, tools, mechanical devices, instruments, innovations, procedures and techniques to accomplish tangible ends, attains specific needs, or manipulate the environment for practical purposes.

Rogers (1983) defined technology as a design for instrumental action that reduces the uncertainty in the cause-effect relationship involved in achieving a desired outcome. This definition implies that technology is a means of uncertainty reduction for individuals that is made possible by the information about cause-effect relationship on which the technology is based. A technology usually has two components- (i) a hardware aspect, consisting of the tool that embodies the technology as material or physical objects (e.g the equipment, product etc.) and (ii) a software aspect, consisting of the information base for the tool (e.g. the knowledge, skills, instructions, principles or procedures or other information aspects of the tool that allow us to use it). Even though the software component of a technology is often not so apparent to observation, technology always represents a mixture of hardware and software aspects (Rogers, 1983). Most innovations that have been studied by diffusion researchers are technological innovations and for this reason the term 'technology' is often used as a synonym for 'innovation'.

Rogers (1983) defined an innovation as an idea, practice or object that is perceived as new by an individual. Dasgupta (1989) mentioned that an innovation may represent a slight modification of, or a significant departure from, the existing ideas or practices. The 'idea' constitutes the central element of an innovation which often manifests itself in a material or behavioural form. Most agricultural innovations such as improved seeds, chemical fertilizers, pesticides, improved farm implements etc., manifest a material form. Chinnoy (1967) noted that technology involves the actual behaviour of men as well as both the scientific and practical knowledge and material implements used for instrumental purpose.

The majority of the diffusion studies in India have been concerned with the adoption and diffusion of several innovations, and only a few concentrated upon a single type of innovation. Improved or high yielding varieties of seed, chemical fertilizers, plant protection chemicals and improved implements have been the most frequent items of study. The studies on adoption of improved cultural practices such as green manuring, line sowing, composting, seed treatment are relatively few in number. A very few studies dealt with the adoption of improved management and marketing techniques. The studies concentrating on the adoption and diffusion of a single practice or a single type of practice dealt mainly with improved or high yielding varieties of wheat and rice, chemical fertilizers, farm mechanization, use of improved ploughs, artificial insemination and improved breeds of cattle (Dasgupta, 1989).

In the present study, the term 'agricultural technology' refers to three selected improved agricultural practices, namely, (i) high yielding variety seeds, (ii) chemical fertilizers and (iii) chemical plant protection measures with respect to seven selected crops viz., (i) *sali* (winter) rice, (ii) *ahu* (autumn) rice (iii) *boro* (summer) rice, (iv) wheat, (v) mustard (vi) potato and (vii) pea.

2.3 Concept adoption of agricultural technology and indices used for its measurement

Different researchers have conceived the term 'adoption' in different ways. Lionberger (1960) defined adoption as the integration of an innovation into a farmer's on going operation through repeated and continued use. Rogers and Shoemaker (1971) defined adoption as the use of a new idea continuously on a full scale. Pareek and Chattopadhyay (1966), however, argued that the idea of full scale adoption, that is, one hundred per cent adoption is impracticable, especially in the case of Indian farmers. They also preferred the concept of 'extended use', which may be both in time and extent, to the concept of continuity. Rogers (1983) defined adoption as a decision to make full use of an innovation as the best course of action available. Dasgupta (1989) defined adoption as the integration of an innovation into farmers' normal farming activity over an extended period of time.

Different researchers have developed and used several types of indices to measure adoption in operational terms at the individual level. They range from relatively simple to complex indices which take a number of dimensions, pertaining to adoption, into account. A number of such indices used by various researchers have been discussed in the following paragraphs.

Wilkening (1952) used an index of improved farm practices in which the notion of extent of adoption was introduced. He also stressed the importance on the concept of potentiality of adoption. Rogers (1958) developed a 'simple adoption scale in which the farmer received a score of one for adoption and zero for non-adoption of a practice. A number of studies have used such simple measure of adoption based on only the 'use' of a given practice or one or more of a number of selected practices without taking the 'period' and 'extent' of use of practice(s) into consideration (Chaukidar and George, 1972; Patel and Patel, 1973; Akhouri and Singh, 1974; Sharma and Nair, 1974; Joshi, 1977; Malik, 1979; Pathak and Majnmdar, 1981; Singh, 1982; Subramaniam *et al.* 1982; Singh, 1983; Tyagi and Sohal, 1984; Ramachandra and Sripal, 1990; Kher, 1992 and Khatik, 1997).

Adoption behaviour of farmers is also measured in terms of 'number of practices' adopted by them out of a given list of selected practices. This measure not only differentiate between adopters and non-adopters but also between adopters according to the degree of adoption behaviour. Bose (1966); Das and Sarkar (1970), Supe (1971), Tripathi and Mishra (1971), Reddy and Murthy (1973), Malhotra *et al.* (1974), Padheria and Patel (1975), Roy *et al.* (1984) and Nikhade *et al.*(1992) have used such index of adoption. In a number these studies, a farmer received an adoption score for each practice adopted. The sum of scores for all the adopted practices gave the total adoption score of a farmer (Tripathi and Mishra, 1971; Reddy and Murthy, 1973).

The indices of adoption mentioned above do not take the applicability of a practice to the farmers' operation into account. This problem is solved by an index based on the 'per cent of applicable practices' adopted by a farmer. Adoption score of a farmer in such method is found ont by expressing the number of adopted practices as percentage of the number of applicable practices (Dasguspta, 1966; Sengupta, 1963; Singh, 1973). Such measures of adoption, however, can make no distinction between an adopter who has been using a practice for several years and another who has started to use the practice only recently. This problem is solved by an index referred to as 'years of use of adopted practices' which take the number of years the farmer has been using each of the adopted practices into consideration. Such measures of adoption behaviour has been used by Reddy and Reddy, (1972), Aggrawal and Deb (1974); Shukla(1975); Bhowmik (1978) and Sinha and Verma(1979).With the basic assumption that farmers can be arranged in terms of the desire to which each of them is relatively early to adopt a new idea than other members of the social system, several researchers have used what Rogers and Shoemaker (1971) called the 'innovativeness scale'. Adopters, in such studies, are divided into a number of categories based on the level of their innovativeness. Since the distribution of adopters over time within a social system follows a bell-shaped curve and approaches normality, the two parameters of the normal curve, the mean and the standard deviation, are used to divide the curve into five areas. The adopters in each area are referred to respectively as innovators, early adopters, early majority, late majority, and laggards. This five fold classification of adopters, however, is arbitrary. Several Indian researchers have used three categories as innovators, early adopters and late adopters. (Bose, 1966; Shetty, 1968; Dasgupta, 1968; Deb and Sharma, 1969; Basran, 1970; Tripathi and Mishra, 1971 and Reddy and Reddy, 1972).

A few researchers such as Dasgupta (1968), and Kilvin *et al.* (1971) have used the 'Guttman's scale analysis' to constrnct an adoption scale. The construction of Guttman's scale of adoption first involves elimination of those practices which have been adopted by less than 20 per cent or more than 80 per cent of farmers. The remaining practices are arranged in descending order from the most to the least adopted ones. In such measure of adoption, farmers are given scale scores on the basis of the number of practices they adopt which indicate their degree of adoption behaviour.

Dasgupta (1967) have used the 'trace line scale' of adoption where each farmer was given a point score for each practice adopted and the sum of these scores constituted his raw score. These raw score is an approximation of the adoption behaviour of the farmer. The percentage of farmers in each of the raw score category adopting each practice are then plotted and a trace line for each practice is obtained. The trace lines of the practices which are consistently related to adoption behaviour of farmers not only increase monotonically with increasing raw scores but also run parallel to each other. The practices whose trace lines do not conform to these expectations are eliminated and an adoption scale is constructed with the remaining practices. Farmers are given adoption scores on the basis of the number of these practices adopted.

Pareek and Chattopadhyay (1966) developed the 'Adoption Quotient '(A.Q.) scale to measure the multi-practice adoption behaviour of farmers. It includes several dimensions such as potential, extent, time, consistency and weights. Potential refers to the maximum degree to which the farmer can extend his adoption. The extent of adoption is the degree to which a farmer has actually adopted a practice. When the extent of adoption equals the potential of use, the adoption is recognized as full at that time, and when the extent is nil, it is considered as non-adoption. The time element refers to how early a practice is adopted by a farmer and for how long he has been using it. Consistency is the continuity of adoption, with a trend toward maximization of adoption efforts and their maintenance through years. The practices are weighted according to the difficulty in adopting them. The 'Adoption Quotient' of an individual farmer may range from 0 to 100. This scale also have been used by several other researchers (Choudhury and Maharaja, 1966; Singh and Sing, 1970; Jha and Shaktawat, 1972; Sharma and Nair, 1974; Baruah, 1989; Haque, 1989 and Prasad, 1993).

Several other measures of adoption behaviour have been developed and used by the researchers. Many of these studies were found to deal with the adoption of a single practice rather than adoption of a number of practices. Singh and Chubey (1974) followed a different procedure for determining the extent of adoption of high yielding wheat technology. The proportion for each of the selected six practices were calculated and multiplied by corresponding weights. Proportions of all the six practices were summed up and divided by the total weights. The resulting value was expressed in terms of percentage indicating the extent of adoption. Malhotra *et al.* (1974), Veerasamy and Bahadur (979), Borpuzari (1987) and Singh (1988) have measured the extent of adoption of improved farm practices by assigning equal weightage to each practice and summed up the obtained weightage ever the practices to get the adoption score of an individual farmer. Bordoloi (1978) Sharma (1992) and Ray *et al.* (1995) measured adoption of selected crops cultivation practices in terms of deviation from recommendation.

The various measures of adoption discussed above show a wide range in complexity and methodological sophistication. The various dimensions of these measures included within the theoretical frames differ and the relative weightage assigned also varies from one another. In light of the above review, a simple index of adoption, as suggested by Sangle (1984) has been used in the present study to measure the level of adoption of three selected agricultural technologies by farmers. This measure of adoption takes into account three important dimensions, viz. number of technology, potentiality for use of technology and extent of actual use of technology by the farmer. This measure was considered suitable as it could give a clear picture of the level of adoption of each technology separately as well as in combination in terms of potential and directly showed the percentage area under the selected technologies.

2.4 Relationship of adoption behaviour of farmers with selected agro-economic, socio-personal, psychological and extension-communication variables

A relatively large number of research studies can be located in India and abroad which have focused on the factors related to adoption behaviour or innovativeness of farmers. A major goal of most of these studies is to isolated the factors which differentiate an adopter from a non-adopter, or between different categories of adopters. Various past researchers have found a number of personal, situational, socio-economic, communication and psychological factors to be related with the farmer's adoption behaviour.

A review of about 900 empirical publications dealing with the diffusion of innovations by Rogers and Shoemaker (1971) revealed that - (i) socioeconomic factors such as age, education literacy, farm size, social status, upward social mobility, economic orientation etc., (ii) personality factors such as empathy, dogmatism, rationality, intelligence, attitude towards change and science, achievement motivation etc., and (iii) factors related to communication behaviour such as social participation, interconnectedness with the social system, cosmopoliteness, mass media exposure, knowledge of innovation etc. were the principal factors associated either positively or negatively with the innovativeness.

Dasgupta (1989) reviewed 343 empirical studies conducted in India during the period between 1960 and 1985. The results of the study showed that of the large number of personal, situational and social factors associated with the adoption behaviour and innovativness of farmers, twelve appeared to be most frequently researched. These factors were age, literacy and education, size of holding, tenure status, literacy and education, size of holding, tenure status, income and economic status, availability of irrigation, commercialization, caste status, social participation, urban and out side contact and socio-economic status. All these variables were found to be related with adoption behaviour of farmers.

The findings of some of the available research studies regarding the relationship of adoption behaviour of farmers with the variables selected in the present study are reviewed hereunder.

Size of land holding : Size of land holding owned or operated by a farmer was found to have significant and positive relationship with adoption behaviour of farmers. Various researchers such as Dasgupta (1963), Basran (1970), Jaiswal *et al.* . (1971), Chaukidar and George (1972), Reddy and Reddy (1972), Patel and Patel (1973), Akhouri and Singh (1974), Sharma and Nair (1974), Singh (1973) Malhotra *et al.* (1974), Shukla (1975), Joshi (1977), Bezbora (1978), Mishra and Singh (1981), Singh (1983), Singh (1988), Gogoi (1989), Das (1991) and Veeraiah *al.* (1998) reported significant and positive relationship between size of land holdings and adoption behaviour of farmers. Nonsignificant relationship of land holding size with adoption was reported by Grewal and Sohal (1971), Jha and Bhaktawat (1972), Singh and Singh (1976), Hussain (1982), Pathak and Sasmal (1992) and Sujatha and Annamalai (1998).

Farm mechanization : Although a few researches had attempted to study the extent of adoption of farm mechanization by farmers (Singh and Sohal, 1976; Singh, 1982; Singh, 1983), but the studies which attempted to relate farm mechanization to the adoption behaviour of farmers is very few in number. In a study conducted by Singh (1989) in Haringhata block of Nadia district in West Bengal reported a non-significant relationship between farm mechanization and adoption behaviour of marginal farmers. However, a positive and significant relationship was found between farm mechanization and adoption behaviour of small and medium farmers.

Cropping Intensity : Hussain (1982) in his study conducted in Sibsagar district of Assam found non-significant relationship between cropping intensity and extent of adoption by farmers. A study conducted by Singh (1989) in Nadia district of West Bengal also found non-significant relationship between cropping intensity and adoption behaviour of small farmers. Kumar (1992) in his comparative study on extent of adoption of recommended agricultural technologies by the farmers of Manipur and Assam fonnd a non-significant relationship between the cropping intensity and extent of adoption by the farmers of both the state. Similar relationship was also reported by Ray *et al.* (1995) and Padmaiah *et al.* (1998).

Degree of commercialization : Studies conducted by Dasguspta (1963), Bose (1966), Moulik and Rao (1966), Kilvin *et al.* (1968), Sangle (1984) and Sharma (1992) found a positive relationship between degree of commercialization and adoption behaviour of farmers.

Sujatha and Annamalai (1998) in their study conducted in Vellore district of Tamil Nadu found non-significant relationship between degree of commercialization and adoption behaviour of marginal farmers but positive and significant relationship between degree of commercialization and adoption behaviour of small farmers.

Extent of Utilization of family labour : Although a few research studies have been conducted to examine the availability and utilization of family labour (Bhowmick *et .al.*, 1990 and Das, 1996), only one study could be located for review which have attempted to relate availability of family labour with adoption behaviour of farmer.

In a study conducted by Pathak and Sasmal (1992) in West Bengal found negative and non-significant relationship between family workforce and adoption behaviour of marginal and small farmers. In case of pooled sample of farmers, however, the study reported a negative but significant relationship between family workforce and adoption behaviour of farmers.

Availability of Working Capital : The working capital is required by the farmers to meet their expenses on day to day crop and livestock production activities in both cash and kind. Although a few research studies have been conducted to examine the availability and utilisation of working capital in different size group of farms (Bhowmick *et al*, 1990; Kalita, 1995 and Das, 1996), no study could be located for review which have attempted to relate availability of working capital with adoption behaviour of farmers. In the present study, to test the hypothesis that there is no relationship between the working capital availability and level of adoption of selected agricultural technologies by farmers, this variable was taken into consideration.

Age : Although the relationship between the age of individual farmers and their adoption behaviour has been studied by a number of researchers, the findings on the relationship between these two variables are somewhat inconsistent. While Supe (1971), Jha and Shaktawat (1972), Patel and Patel (1973), Rajendra (1973), Salunkhe and Thorat (1975), Subramaniam *et al.* (1982), Singh (1983), Katarya (1989), Das (1991) ,Pathak and Sasmal (1992), Saikia (1995), Yasmin (1996) and Deka (1997) reported a significant relationship between age and adoption of improved technologies by farmers. Singh and Reddy (1965), Bose (1966), Deb (1968), Basran (1970), Tripathi and Mishra (1971), Chaukidar and George (1972), Reddy and Reddy (1972), Malhotra et al. (1974), Bordoloi (1978). Hussain (1982), Singh (1988) ,Das (1996), Sumathi and Alagesan (1998) and Padmaiah *et al.* (1998) found non-significant relationship between the two variables. Most of the studies which reported a significant relationship between age and adoption, found a negative relationship between the two variables. Studies, which found no statistically significant relationship between age and adoption, even reported a tendency towards a negative relationship between them.

Education level : Education level of farmers have been found to play an important role in their adoption behaviour. Various researchers have reported a statistically significant relationship of education with adoption of agricultural practices by farmers. Education of farmers was found to be significantly and positively related to their adoption behaviour by Deb and Sharma (1969), Das (1970), Patel and Singh (1970), Singh and Singh (1970), Grewal and Sohal (1971), Chaukidar and George (1972), Jha and Shaktawat (1972), Rajendra (1973), Reddy and Murthy (1973), Kishor and Rai (1974), Sukhla (1975), Shankar (1979), Hussain (1982), Singh (1983), Katarya (1989), Gogoi (1989), Das (1991) Veeraiah *et al.* (1997) and Sujatha and Annamalai (1998). However Singh and Reddy (1965), Akhouri and Singh (1974), Bordoloi (1978), Sinha and Verma (1979), Singh (1988), Pathak and Sasmal (1992), Das (1996) and Padmaiah *et al.* (1998) reported a non-significant relationship between education and adoption behaviour of farmers.

Family type : Singh (1998) reported a non-significant positive relationship between family type and adoption behaviour of marginal and medium farmers. In case of small farmers, however, the study reported a positive and significant relationship between the two variables. A positive but non-significant relationship was also reported by Sangle (1984), Ray *et al.* (1995) and Mathiyalagan (1997). In a study conducted in Vellore district of Tamil Nadu, Sujatha and Annamalai (1998) found a positive but non-significant relationship between the type of family and adoption behaviour of marginal farmers. In case of small and big farmers, the study reported a negative and non-significant relationship between the two variables.

Family size : Singh (1989) found a positive and significant relationship between the size of family and adoption behaviour of marginal farmers. The study, however, reported non-significant relationship between the size of family and adoption behaviour of small and medium farmers.

Pathak and Sasmal (1992) found a non-significant but negative relationship between the size of family and adoption behaviour of marginal as well as small farmers.

Sangle (1984) reported a positive but non-significant relationship between the size of family and adoption behaviour of farmers. Similar findings were also reported by Ray *et al.* (1995).

Social participation : Wagh (1974), Hussain (1982), Singh (1983), Sangle (1984), Mahanta (1989), Kaur and Singh (1991), Sakharkar *et al.* (1992) and Sumathi and Alagesan (1998) found a positive and significant relationship between social participation and adoption behaviour of farmers.

Supe and Solude (1975), Reddy and Reddy (1988) and Singh (1989) reported non-significant relationship between social participation and adoption behaviour of farmers.

Sujatha and Annamalai (1998) reported positive but non-significant relationship between the social participation and adoption behaviour of marginal and big farmers. In case of small farmers, the study, however, found a positive and significant relationship between the two variables.

Innovation proneness : Another psychological variable affecting adoption behaviour of farmers is their innovation proneness. Moulik and Rao (1971) and Moulik (1975) found that innovation proneness was significantly and positively related to the adoption of agricultural technologies by farmers. Sangle (1984), Haque (1989), Das

(1991) and Juliana *et al.* (1991) also reported a significant and positive relationship between innovation proneness and adoption behaviour of farmers.

Economic motivation : Sharma and Nair (1974), Veerasamy and Bahadur (1979), Sangle (1984), Kumar (1992), Sumathi and Alagesan (1998) and Padmaiah *et al.* (1998) reported a positive and significant relationship between economic motivation and adoption behaviour of farmers.

Singh (1989) in his study conducted in Nadia district of West Bengal found a non-significant relationship between economic motivation and adoption behaviour of marginal farmers. The study, however, found a positive and significant relationship between economic motivation and adoption behaviour of small and medium farmers.

Pathak and Sasmal (1992) reported a non-significant relationship between economic motivation and adoption behaviour of both marginal and small farmers. Similar findings were reported by Narayana and Reddy (1994).

A non-significant relationship between the two variables was also reported by Mahanta (1989) and Sakharkar *et al.* (1992).

Juliana *et al.* (1992) and Sujatha and Annamalai (1998) found a positive and significant relationship between economic motivation and adoption behaviour of marginal, small and big farmers.

Scientific orientation : The degree of an individual's orientation to scientific techniques and ideas in farming influence his adoption behaviour. Only a few research studies, however, have emphasized the relationship of such psychological variable as scientific orientation with adoption behaviour of farmers. A statistically significant and positive relationship between scientific orientation and adoption was reported by Veerasamy and Bahadur (1979), Singh (1982), Sangle (1984), Singh (1988), Veeraiah *et al.* (1997) and Sujatha and Annamalai (1998).

Risk orientation : Risk orientation was found to have significant positive relationship with adoption behaviour of farmers by Sharma and Nair (1974), Sakharkar *et al.* (1992), Kumar (1992) and Veeraiah *et al.* (1997).

Singh (1989) found a non-significant relationship between risk orientation and adoption behaviour of marginal farmers but significant positive relationship between risk orientation and adoption behaviour of small and medium farmers.

Juliana *et al.* (1991) reported a significant positive relationship between risk orientation and adoption behaviour of marginal, small and big farmers.

Pathak and Sasmal (1992) found non-significant positive relationship between risk orientation and adoption behaviour of small farmers but significant relationship between risk orientation and adoption behaviour of marginal farmers.

Sujatha and Annamalai (1998) reported a significant positive relationship between risk orientation and adoption behaviour of marginal, small and big farmers. However, a non-significant relationship between the two variables was reported by Veerasamy and Bahadur (1979), Reddy and Reddy (1988), Mahanta (1989), Narayana and Reddy (1994) and Padmaiah *et al.* (1998).

Level of aspiration : Farmers with aspiration to improve their social and economic status have been found to have a relatively high level of adoption.

Choudhary and Maharaja (1966), Chattopadhyay (1967), Rajaguna and Satapathy (1973) and Veeraiah *et al.* (1997) found a positive and significant relationship between level of aspiration and adoption behaviour of farmers.

Orientation towards competition : Singh (1989) reported a non-significant relationship between orientation towards competition and adoption behaviour of marginal farmers. However, a positive and significant relationship was found between orientation towards competition and adoption behaviour of small and medium farmers.

Management orientation : Singh (1989) found a positive and significant relationship between management orientation and adoption behaviour of small and medium farmers. In case of marginal farmers, however, a non-significant relationship was found between the two variables.

Sakharkar *et al.* (1992) in their study conducted in Nagpur district of Maharashtra found a positively significant correlation between management orientation and adoption behaviour of farmers.

Narayana and Reddy (1994) in their study conducted in Guntur district of Andhra Pradesh found a negative and non-significant relationship between management orientation and adoption behaviour of marginal and small farmers.

Attitude towards improved farm practices : Sangle (1984) reported a positive and significant relationship between attitude of farmers towards improved farm practices and their adoption behaviour.

Singh (1989) found a positive and significant relationship between attitude of farmers towards fertilizer use and level of fertilizer use of the marginal, small and medium farmers.

Haque (1989) reported a positive and significant correlation between attitude of farmers and their adoption behaviour.

Das (1991) found a positive and significant correlation between attitude of small and marginal farmers towards improved farm practices and their extent of adoption of selected agricultural technologies.

Knowledge level : Farmers' knowledge level on agricultural technologies have been found to play an important role in their adoption behaviour. Several researchers have reported significant positive relationship between knowledge level of farmer and adoption of agricultural technologies by them (Choudhary and Maharaja, 1966; Rai, 1967; Singh, 1969; Malhotra *et al.* 1974; Sanoria and Sharma 1983; Pachori and Tripathi, 1983; Sethy *et al.* 1984; Tyagi and Sohal, 1984; Wilson and Chaturvedi, 1985; Singh, 1988; Haque, 1989; Das, 1991; Sharma, 1992; Pathak and Sasmal, 1992; Yasmin, 1996; Deka, 1997 and Mathiyalagan, 1997).

Degree of information exposure :Sangle (1984) found a positive and significant relationship between degree of information exposure and adoption behaviour of farmers in dry farming as well as irrigated farming systems.

Mass media use was found to have significant positive relationship with adoption behaviour of farmers by Sharma and Nair (1974), Hussain (1982), Kaur and Singh (1991), Juliana *et al.* (1991), Sakharkar *et al.* (1992) and Sumathi and Alagesan (1998). However, a non-significant relationship between mass media use with adoption behaviour was reported by Saxena *et al.* (1990) and Padmaiah *et al.* (1998).

Sujatha and Annamalai (1998) found a positive and significant correlation between information source utilization by marginal, small and big farmers and their adoption behaviour. However, a non-significant relationship between the two variables was reported by Narayana and Reddy (1994).

2.5 Explanatory variables of adoption behaviour of farmers

Several past researchers have emphasized the factors, which contribute to the variation in adoption behaviour or innovativeness of farmers. A number of studies have attempted to explain the variation in the adoption behaviour of farmers by relating it to a number of independent variables. Most of these studies have used the multiple correlation analysis to determine the relative contribution of each independent variables and also the combined effect of a set of independent variables in explaining the variation in the dependent variable, that is, adoption behaviour.

Singh and Reddy (1965) found that 61.70 per cent of variation in the adoption behaviour was explained by three independent variables *viz.* economic status, farm size and social participation.

A study conducted by Chattapadhyay and Pareek (1966) indicated that 56 per cent of the variance in the adoption behaviour of farmers could be explained y three independent variables *viz.* value orientation, change proneness and level of aspiration.

The result of the study conducted by Moulik (1966) showed that farmers' attitude towards innovation proneness, economic motivation and closeness with extension agents could explain 80 per cent of variation in the level of adoption of innovation.

The study conducted by Singh and Singh (1970) revealed that 82.75 per cent of the variation in adoption behaviour of farmers could be explained by size of farm, mass media use, risk orientation, economic motivation, educational level and knowledge level on improved agricultural practices.

Moulik and Rao (1971) found that innovation proneness, extension contact and attitude towards nitrogenous fertilizers accounted for 81.00 per cent of the variation in adoption behaviour.

A study conducted by Jaiswal *et al.* (1971) revealed that farm size, extension contact, risk orientation and change proneness could explain 69.86 per cent of variation in the adoption behaviour of farmers.

Singh *et al.* (1972) reported that age, education, urban contact, size of holding, social participation and non-farm income accounted for 38.88 per cent of the predictability of the adoption behaviour.

Sharma and Nair (1974) found that farm size, attitudes, risk orientation, market perception, and aspiration accounted for 84.14 per cent of the variation in the adoption behaviour of farmers.

A study made by Shukla (1980) showed that 84.64 per cent of the variance in the adoption behaviour was explained by irrigation potential, cropping intensity, socio-economic status, economic motivation, knowledge of innovation, mass media use and extension contact.

The study conducted by Singh (1982) showed that 71.00 per cent of variation in the adoption behaviour of farmers could be explained by such independent variables as risk orientation, scientific oriention, economic motivation, attitude towards hard work and individualism.

The study conducted by Gogoi (1989) revealed that age, education level, size of holding, income, mass media exposure, extension contact, economic motivation, knowledge and attitude towards plant protection chemicals could explain 69 per cent of variation in the adoption behaviour of farmers.

A study conducted by Nikhade *et al.* (1992) indicated that 28.65 per cent of the variation in the adoption behaviour of farmers was explained by fifteen independent variables, *viz.*, education, land holding, annual income, social participation, socio-economic status, economic motivation, scientific orientation, risk orientation, management orientation, innovation proneness, extension contact, mass media exposure, extension programme participation, cosmopoliteness and market availability.

A study conducted by Pathak and Sasmal (1992) indicated that nineteen independent variables, *viz.*, age, education, occupation, family size, family workforce, economic status, farm size, irrigation potentiality, cropping intensity, fragmentation index, mass media contact, use of personal cosmopolite sources, risk taking willingness, owning responsibility, economic motivation, farmer's goals, knowledge level, progressiveness and managerial skill could explain 65.75 per cent of the variation in the adoption behaviour of marginal farmers and 53.56 per cent of the variation in the adoption behaviour of small farmers. In the pooled sample of farmers, these variables could explain 52.14 per cent of the variation in the adoption behaviour of farmers.

Prasad (1993) in his study conducted in Karnal district of Haryana found that seven independent variables, *viz.*, age, education, social participation, extension contact, time lag, alkali affected area and knowledge level could explain 64.05 per cent of the variation in the adoption behaviour of farmers.

Mathiyalagan (1997) in his study conducted in Salem district of Tamil Nadu found that fourteen independent variables, *viz*., age, education, income, occupation, land holding, farm experience, nature of family, flock size, material possession, mass media exposure, extension contact, credit orientation, knowledge level and training need could explain 63.41 per cent of the variation in the adoption behaviour of farmers.

Padmaiah *et al*. (1998) in their study condncted in Mahabubnagar distinct of Andhra Pradesh found that sixteen independent variables, *viz*., age, experience, education, extension contact, mass media exposure, farm power, farm size, cropping intensity, annual income, development opportunity, employment generation, credit orientation, innovativeness, risk orientation, economic motivation and perception about watershed development could explain 51.10 per cent of the variation in the adoption behaviour of farmers in watershed area and 39.90 per cent of the variation in the adoption behaviour of farmers in the non-water shed area.

The findings of different research studies reviewed above indicate that while situational and economic factors make important contribution to the variation in the adoption behaviour of farmers, socio-personal, psychological and extension-communication variable also have important influence on the adoption behaviour of the farmers. The studies reviewed above indicate a wide range in the per cent of variation in the adoption behaviour explained, from 28.65 per cent to 84.64 per cent. A significant portion, about 15.00 per cent of the variation in the adoption behaviour still remains unexplained which suggests the need for further studies including more variables, defined and measured in more precise terms, for multiple correlation analysis.

2.6 Determinants of farmers' productivity

Although a good number of research studies have been conducted on identification, optimization, viability and sustainability of different farming systems (Singh and Sharma, 1988; Radha *et al*., 1989; Joshi and Tyagi, 1991; Sharma *et al*., 1991; Bhowmick *et al.*, 1992; Kalita, 1995 and Das, 1996) the studies attempting to identify the factors influencing productivity of farming systems are very few in number.

In a study conducted by Sagar (1989) in Nadia district of West Bengal an attempt was made to identify the variables, which significantly contribute towards farmers' productivity of major field crops. The technique of multiple regression analysis was employed to get the predictive abilities of 29 independent variables on the dependent variable. The result of the study revealed that three independent variables *viz.*, land ownership status, supervision of crop production and irrigation index contributed positively and significantly towards productivity in marginal farms. The 29 independent variables could explain 80.90 per cent of the variation in the productivity of marginal farms. In case of small farmers, six independent variables, *viz.*, index of high yielding varieties, knowledge level, supervision of crop production, orientation towards development of skill in farm workers, utilization of personal cosmopolite sources of information and innovation proneness were found to contribute significantly towards productivity. The 29 independent variables were found to explain 91.20 per cent of the variation in productivity of small farms.

In case of medium farmers, five independent variables, *viz.*, level of fertilizer use, index of high yielding varieties, orientation towards development of skill in farm workers, risk orientation and utilization of personal cosmopolite sources of information contributed significantly towards productivity. The 29 independent variables could explain 93.60 per cent of the variation in productivity of medium farms.

In the pooled sample of farmers, eight independent variables, namely, supervision of crop production, irrigation index, innovation proneness, knowledge level, land ownership status, level of fertilizer use, level of aspiration and farm mechanization were found to contribute positively and significantly towards productivity

The findings of the study indicated that for different categories of farmers, different independent variables were important in predicting the productivity. There were, however, some common variables also. Supervision of crop production was found to contribute positively and significant towards productivity of marginal, small and pooled sample of farmers. Land ownership status and irrigation index contributed positively and significantly towards productivity of marginal farmers and pooled sample of farmers. Index of high yielding varieties, utilization of cosmopolite sources of information and orientation towards development of skill in farm workers contributed positively and significantly to the prediction of productivity of small and medium farmers. Similarly, innovation proneness and knowledge level were found to contribute positively and significantly to the prediction of productivity of small farmers and pooled sample of farmers.

2.7 Factors hindering adoption of improved agricultural technology by farmers

A relatively large number of research studies have been undertaken in India to identify the constraints as perceived by the farmers in adoption of improved technology.

Singh and Jati (1975) found that inadequate and untimely supply of inputs, difficulties involved in getting the supplies through cooperatives, uncertainties of irrigation and high cost of cultivation were the major factors hindering adoption of high yielding seeds by farmers.

Hussain (1982) reported that the unavailability of certified seeds, lack of transport facilities, untimely release of loan, lack of irrigation facilities, non-availability of pesticides in the village area were the most serious constraints faced by the farmers in adoption of improved agricultural technologies.

Singh (1988) pointed out that non-availability of certified seeds, lack of irrigation facilities to use fertilizer, non-availability of plant protection chemicals in the village area, lack of credit facility and non-cooperative attitude of extension personnel were the major factor hindering adoption of improved technologies by paddy growing farmers of Imphal district of Manipur.

Oberoi and Moorti (1989) reported that inadequate and untimely supply of farm inputs, small and scattered holdings, inadequate irrigation facilities, lack of technical know-how and scarcity of capital were the major constraints in adoption of modern technologies by the farmers.

Venkataranga and Rao (1989) found that lack of supply and services, lack of specific extension efforts, lack of knowledge regarding fertilizers and plant protection chemicals were the major constraints in adoption of new or improved technologies by farmers.

Singh *et al.*(1992) reported that non-availability of HYV seeds, fertilizers and plant protection chemicals at proper time, high cost of fertilizers and plant protection chemicals, lack of knowledge about fertilizers and plant protection measures, lack of irrigation facilities, non-availability of sprayers and dusters and high cost of labour were the major factors responsible for low or no adoption of improved technology by farmers.

Sheikh(1993) found that low purchasing power of farmers, high cost of fertilizers and pesticides, lack of irrigation facilities, shortage of labour, and non-co-operative attitudes of bank officials were some of the major factors hindering adoption of improved technology y farmers.

Tewatia (1994) reported that rate of adoption of technology was affected by a number of environmental, technological and socio-economic constraints. Erratic rainfall, inadequate irrigation facilities, lack of finance, non-availability of inputs in time and inadequate knowledge of farm management were some o the very common and major constraints which did not allow farmers to adopt recommended package of practices.

Nath (1995) found that complicated procedure in obtaining loan, non-availability of inputs in time, high cost of inputs, and malpractices in input distribution were some of the serious constraints hindering adoption of improved technology by farmers.

Das (1996) reported that untimely supply of certified seeds, lack of knowledge about fertilizer use and plant protection measures, high cost of certified inputs like certified seeds, fertilizers and pesticides, lack of soil testing facility, lack of technical guidance and low purchasing power of farmers were some of the most serious constraints in adoption of improved rice production technology by farmers.

Trivedi and Patel (1996) reported that inadequate crop protection, non-availability inputs, lack of irrigation facilities, lack of finance, lack of information about new agricultural technology, lack of technical guidance were perceived by the farmers as major constraints associated with adoption of improved agricultural technology.

Sujatha and Annamalai (1998a) found that lack of adequate technical guidance, lack of awareness, high cost of inputs like fertilizers, pesticides and weedicides, non-availability of inputs in time were the major constraints as perceived by majority of the marginal, small and big farmers in better utilization of modern input

Research Methodology

Chapter III

RESEARCH METHODOLOGY

The research methods and procedures adopted in the study are laid down in this chapter under the following heads :

3.1 Locale of the study

3.2 Method of sampling

3.3 Identification and selection of farming systems

3.4 Selection of variables and their measurements

3.5 Tools and techniques of data collection

3.6 Formulation of hypotheses

3.7 Statistical analysis and interpretation of data

3.1 Locale of the study

The present study was conducted in Assam, one of the states in North-eastern region of India, lying between 24° to 28°18′ north latitudes and 89°50′ to 97°4′ east longitudes. The state has an area of 78,523 sq. km. (78,52300 ha) with a total population above 224 lakh (as per 1991 census).

Based on rainfall, terrain and soil characteristics, Assam State has been broadly delineated into six Agro- Climatic Zones (NARP document no. 39, 1981). A list of these Agro-Climatic Zones along with the districts covered, area and population under each zone is presented in Table 3.1.1. A map of Assam showing the six Agro-Climatic Zones may be seen in Fignre 3.1.1.

3.2 Method of Sampling

3.2.1 Selection of Agro-climatic zone

Of the six agro-climatic zones, the Lower Brahmaputra Valley Zone was selected purposively for the study on the basis of the following criteria:

Table 3.1.1 Agro-climatic zones of Assam with their area and population

Sl. No.	Agro-climatic zones	Districts covered	Total area (sq.km.)	Percentage of the state area (%)	Total population (Number)	Percentage of the state population (%)
1.	North Bank Plains	Dhemaji, North Lakhimpur, Sonitpur and Darrang	14,424	18.37	3,953,494	17.64
2.	Upper Brahmaputra Valley	Sibsagar, Jorhat, Tinsukia, Dibrugarh and Golaghat	16,078	20.48	4,612,040	20.57
3.	Central Brahmaputra Valley	Nagaon, Morigaon	5,561	7.08	2,532,853	11.30
4.	Lower Brahmaputra Valley	Kamrup, Nalbari, Barpeta, Kokrajhar, Dhubri, Goalpara and Bongaigaon	20,222	25.75	8,010,921	35.74
5.	Barak Valley	Cachar, Karimganj and Hailakandi	6,987	8.90	2,491,490	11.12
6.	Hills zone	Karbi Anglong and North Cachar hills	15,251	19.42	813,524	3.63
	Total		78523	100.00	22,414,322	100.00

Source : Agricultural Status of Assam, 1992-93. Directorate of Agriculture, Govt. of Assam, Guwahati.

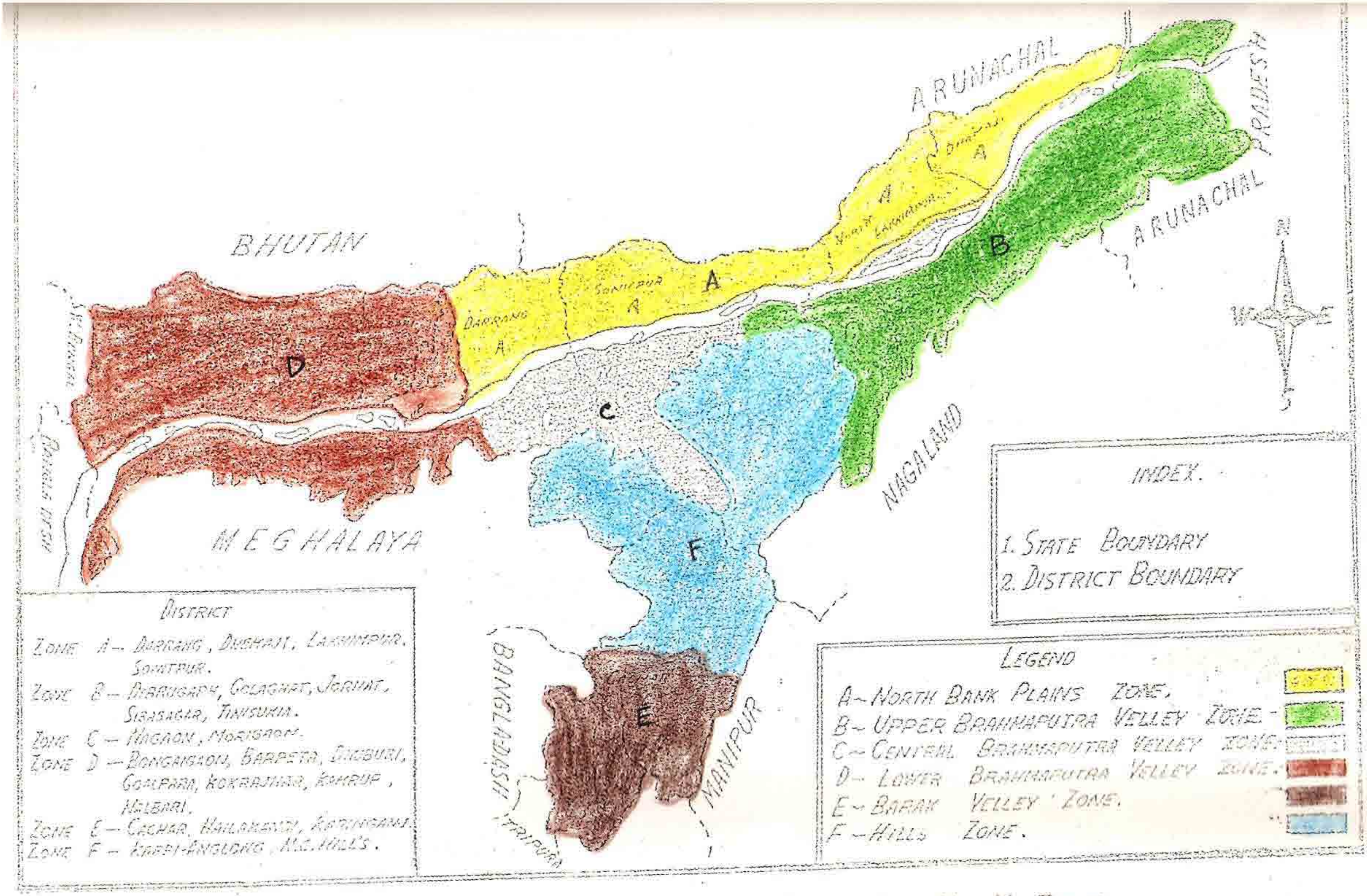

Figure 3.1.1 Map of Assam showing the Agro-Climatic Zones

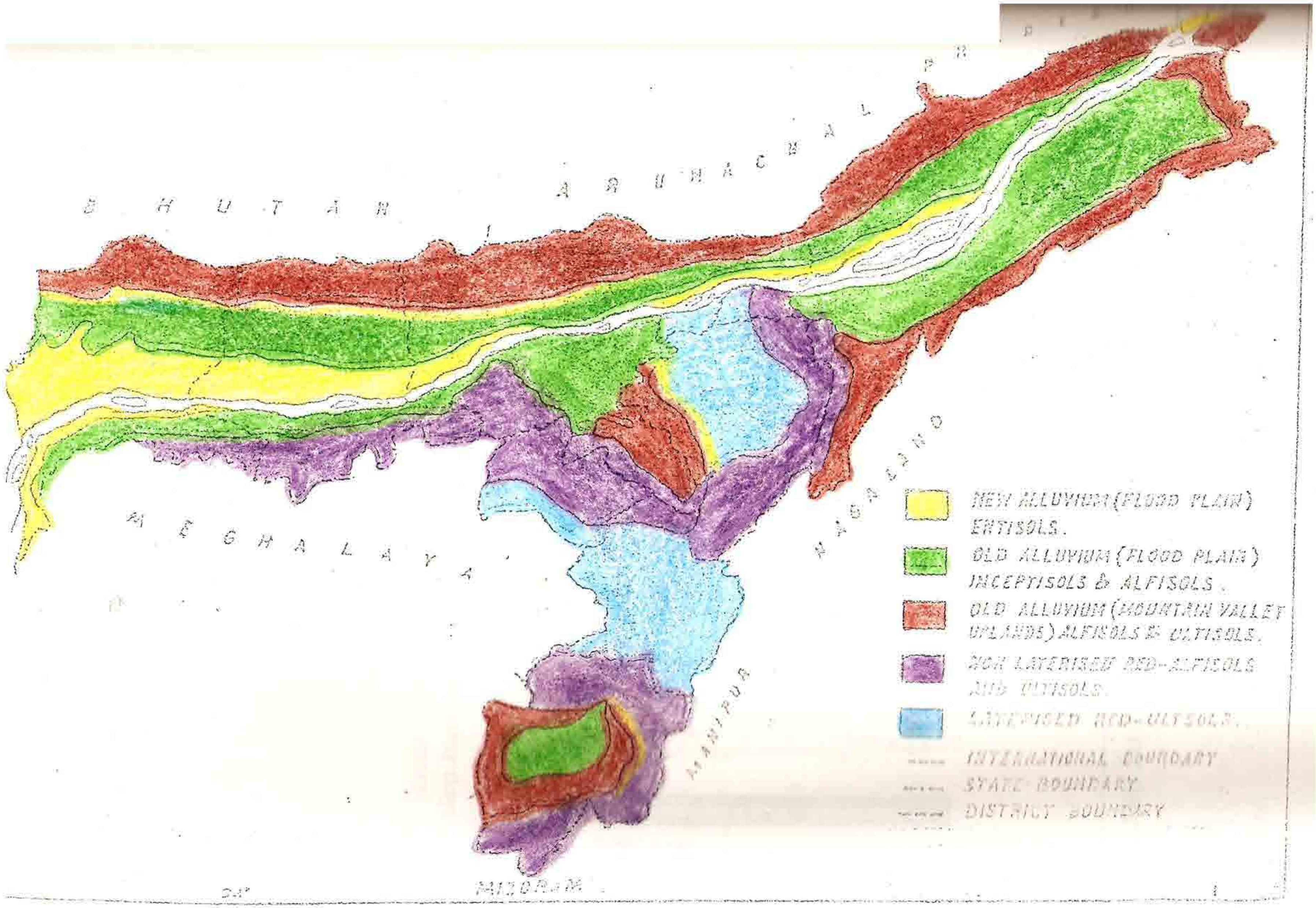

Figure 3.2.2 Map of Assam showing the major Soil Groups

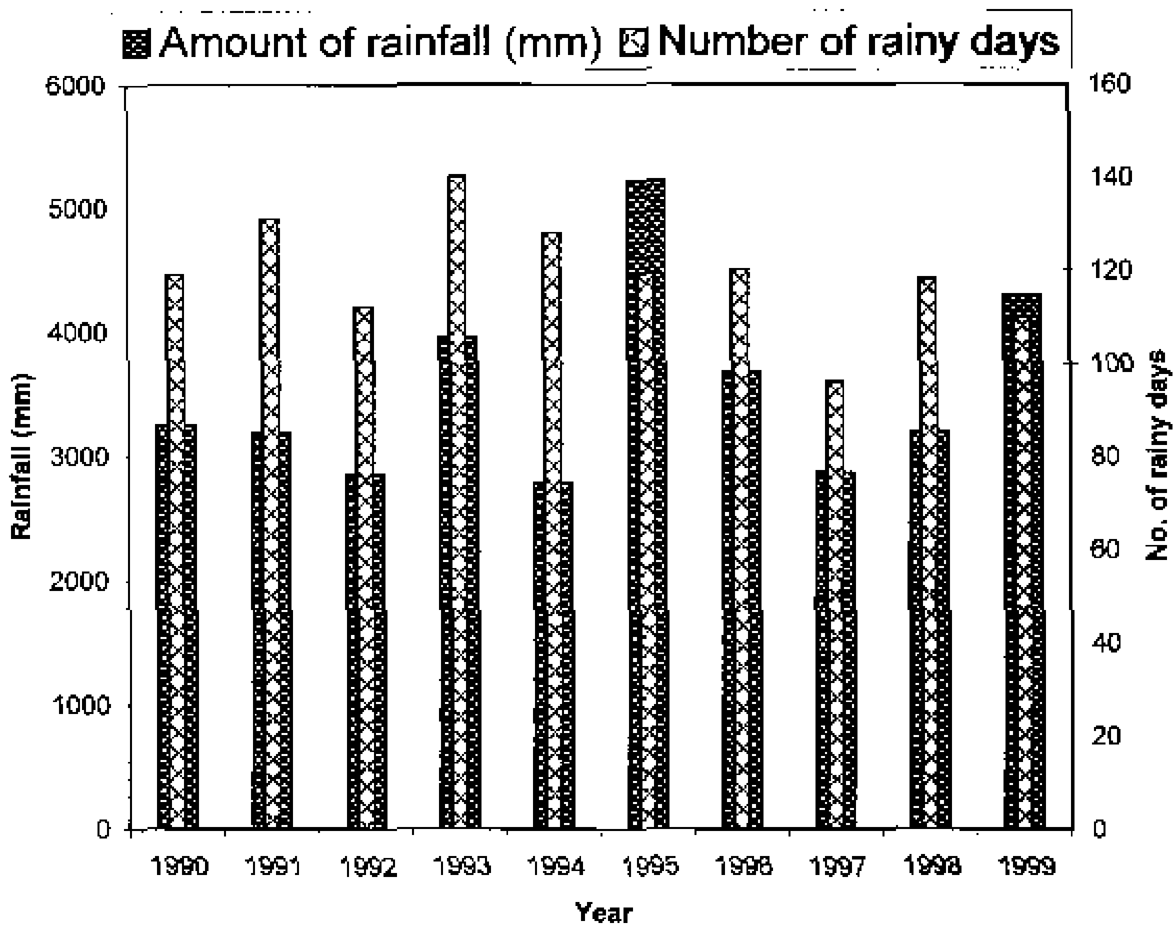

Fig.3.2.1 Amount of annual rainfall and number of rainy days in Lower Brahmaputra Valley Zone during last ten years (1990-1999)

i. The Lower Brahmaputra Valley Zone is the largest in terms of its geographical area. The total area of the zone is 20222 sq. km. which comprises of 25.75 per cent of the state area.

ii. The Lower Brahmaputra Valley Zone is the most populous zone with a total population of 8010921 persons comprising 35.74 per cent of the state population.

iii. Investigator was familiar with the socio-cultural situation of the zone which was helpful during collection of data required for the study.

The river Brahmaputra runs across the zone from east to west traversing every district in it. The zone has a gradual slope from east to west with altitude ranging from 35m to 50m above mean sea level. The zone enjoys a hot and humid climate with high rainfall and humidity as high as 85 to 90 per cent. While the mean annual maximum temperature (July-August) lies between 30°C to 33°C, the minimum temperature (December-January) ranges from 6°C to 12°C. The zone belongs by and large to a high rainfall belt with annual rainfall ranging from 2785 mm to as high as 5222.8 mm. The number of rainy days ranges from 96 days to as high as 140 days per annum. The amount of rainfall and number of rainy days during the last 10 years (1990-1999) are shown in Figure 3.2.1. The major soil groups found in the zone are new alluvial soils (Entisols), old alluvial soils (Inceptisols) and old mountain valley alluvial soils (Alfisols). A map of Assam showing the major soil groups are presented in Figure 3.2.2. The soils of the zone are acidic in reaction having pH between 4.5 and 6.5 except the new alluvial soils which are less acidic and often neutral in reaction. New alluvial soils are sandy loam-loam-silty loam in texture while old alluvial soils are sandy loam-loam-silty clay in texture. Old mountain valley alluvial soils are mainly heavy textured soil.

3.2.2 Selection of districts

The Lower Brahmaputra Valley Zone comprises of seven districts, viz. Kamrup, Nalbari, Barpeta, Kokrajhar, Dhuburi, Goalpara and Bongaigaon. Keeping in view the paucity of time, resources and current socio-political situation, the two districts, viz., Kamrup and Barpeta were selected randomly for the study .Lottery method was used to make random selection of the districts.

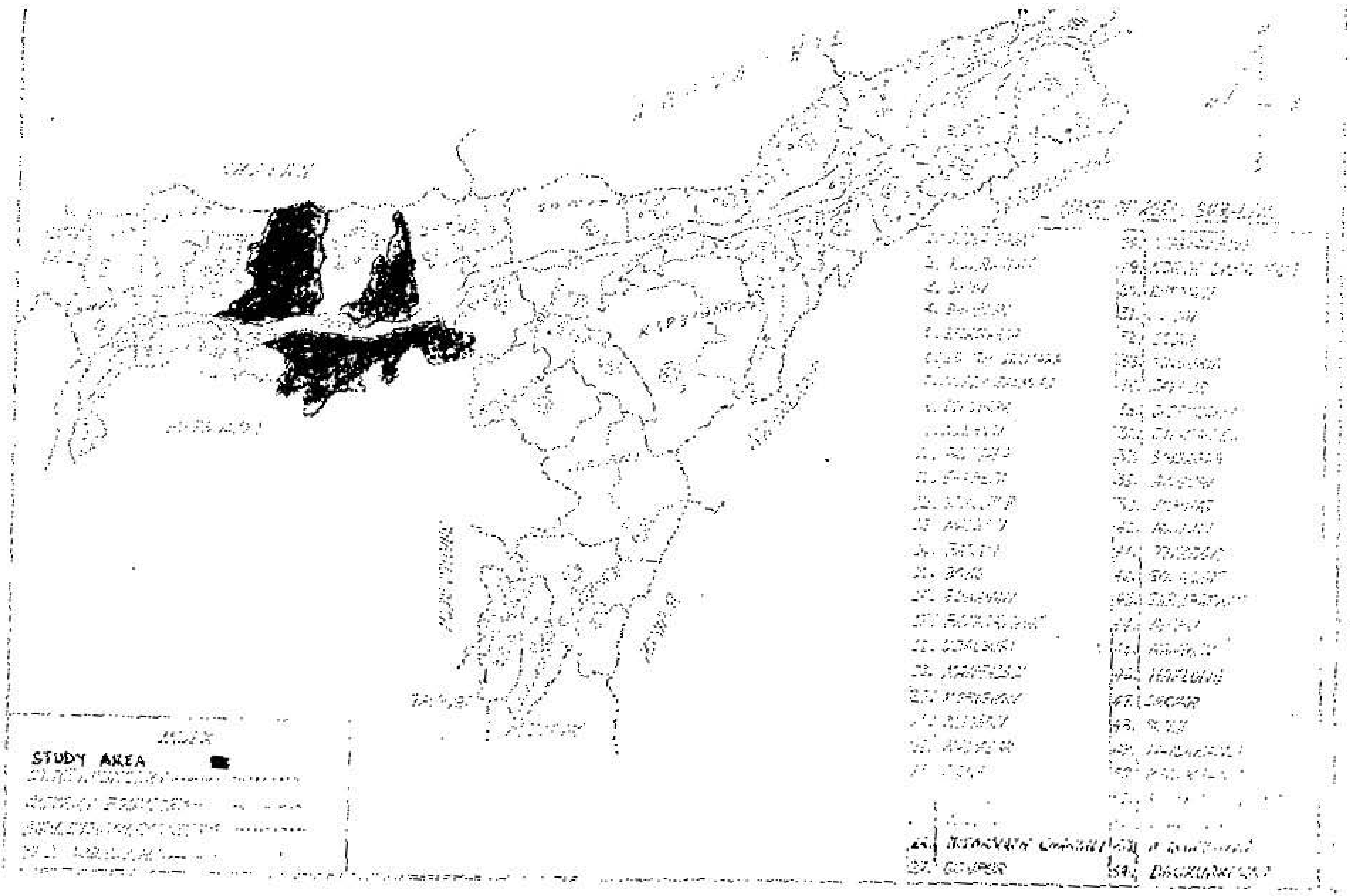

Figure ? .? Map of Assam showing Agricultural Districts and Sub divisions

3.2.3 Selection of agricultural sub-divisions

Kamrup district had three agricultural sub-divisions viz. Boko, Guwahati and Rangia, while Barpeta district had two agricultural subdivisions, *viz.*,Borpeta and Pathsala. From these, two agricultural subdivisions, one each from the two selected districts were randomly selected for the study. Thus, Guwahati agricultural sub-division from Kamrup district and Pathsala agricultural sub-division from Barpeta district were included in the study. A map Assam showing the agricultural districts and sub-divisions under study are presented in Figure 3.2.3.

3.2.4 Selection of AEO circles

Selection of the AEO circles from the two selected sub-divisions was based on the prevalence of the rainfed farming situation. Those circles where less than 30 per cent of the total cultivated area was under assured irrigation were considered as rainfed AEO circles. The circles with more than 30 per cent of the total cultivated area under assured irrigation were not considered for sampling. Guwahati agricultural sub-division had 12 AEO circles and Pathsala agricultural sub-division had 8 AEO circles. After threadbare discussion with the concerned extension personnel, 8 AEO circles in the Guwahati sub-division and 6 AEO circles in Pathsala sub-division were identified as rainfed AEO circles. From these AEO circles, four AEO circles, two each from two sub-divisions, were selected randomly for the study by using lottery method. Thus, Geruah and Hazo AEO circles from Guwahati agricultural sub-division and Pathsala and Patacharkuchi AEO circles from Pathsala agricultural sub-division were selected for the study.

3.2.5 Selection of VLEW circles

Considering the nature of the study, it was decided to select four VLEW circles, one each from the four AEO circles. The conditions laid on the selection of AEO circles were also applied in the selection of the VLEW circles. In this way, four VLEW circles, namely Japia VLEW circle from Geruah AEO circle, Bagta VLEW circle from Hazo AEO circle, Bar-Bairagi VLEW circle from Patarcharkuchi AEO circle and Bar-Bang VLEW circle from Pathsala AEO circle were selected randomly for the stndy.

3.2.6 Selection of villages

The investigation had a dialogue with the concerned AEO and vlew for locating the villages where less than 30 per cent of the total cultivated area were under assured irrigation. Based on the information and after further checking, 8 villages, two each from four vlew circles, were selected randomly for the study. The names of the selected villages are given in table 3.2.1.

Table 3.2.1 Names of the villages selected for the study

District	Agricultural Sub-division	AEO circle	VLEW circle	Villages
1. Kamrup	Guwahati	i. Geruah	Japia	i. West Japia ii. Dihina
		ii. Hazo	Bagta	i. Satdala ii Akadi
2. Barpeta	Pathsala	i. Patacharkuchi	Bar-Bairagi	i. Bar-Sahan ii. Bar-Nalikuchi
		ii. Pathsala	Bar-Bang	i. Bar-Bang ii. Ratanpur

3.2.7 Selection of respondents

The basic units of the study were the farm families having atleast 0.13 ha of cultivated land. Accordingly, a list of the farm families conforming this criterion was prepared for each sampled villages after consulting the concerned VLEW and the executive members of the *Pathar Parichalana Samity* (Field Management Committee). Considering the constraints of time, resources and number of variables involved in the study, the sample size was determined at 225. From the lists of farm families of eight selected villages, a total of 225 farm families were selected randomly with proportional allocation of sampling units in each selected village. Thus, 225 farm families from eight villages constituted the

Table 3.3.1 Types of farming systems across different size group of farms

Sl. No.	Types of farming system	Number of farmers			
		Marginal	Small	Medium	Total
1	Crop based	98 (43.56)	65 (28.89)	45 (20.00)	208 (92.45)
2	Dairy based	3 (1.33)	2 (0.89)	0 (-)	5 (2.22)
3	Pig based	4 (1.78)	3 (1.33)	0 (-)	7 (3.11)
4	Poultry based	2 (0.89)	0 (-)	0 (-)	2 (0.89)
5	Fish based	2 (0.89)	1 (0.44)	0 (-)	3 (1.33)
	Total	109 (48.44)	71 (31.56)	45 (20.00)	225 (100.00)

* Figures within the parentheses indicate percentage

sample of respondents for the study. The sampling plan adopted in the study is presented in Fig. 3.2.4.

3.3 Identification and selection of farming systems

For identification of different types of farming systems prevalent in the study area, various activities or enterprises taken up by each sampled farm family were considered. In order to identify the dominant enterprise of each farm family, the gross margin obtained from each enterprise was worked out. The enterprise that contributed the highest gross margin to a farm family with which other enterprise were taken up was considered in the present study as specific enterprise based farming system. This resulted in different types of specific enterprise based farming systems in each size group of sampled farms in the study area.

Different types of specific enterprise based farming systems identified in the study area are shown in Table 3.3.1. It is evident from the Table that there were five major types of specific enterprise based farming systems in three size group of farms, viz., crop based, dairy based, pig based, poultry based and fish based.

Keeping in view the objectives of the study, it was decided that those specific enterprise based farming systems which were followed by minimum 10 per cent of the sampled farm families will be included in the present study. On the basis of this condition, only crop based farming system was selkected for the study and other types were ommited from the preview of the study. When this condition was applied, only crop based farming system conformed to the criterion which was followed by 92.45 per cent of the sampled farm families. The percentages of farm families adopting other enterprise based farming systems were less than 10 per cent, the figures being 3.11, 2.22, 1.33 and 0.89 per cent for pig based, dairy based, fish based and poultry based farming systems respectively (Table 3.31). Hence, only those farm families which practised crop based farming system were retained for the study. The number of such farm families was 208. Other farm families were omited from the perview of the study Thus, out of 225 sampled farm families, 17

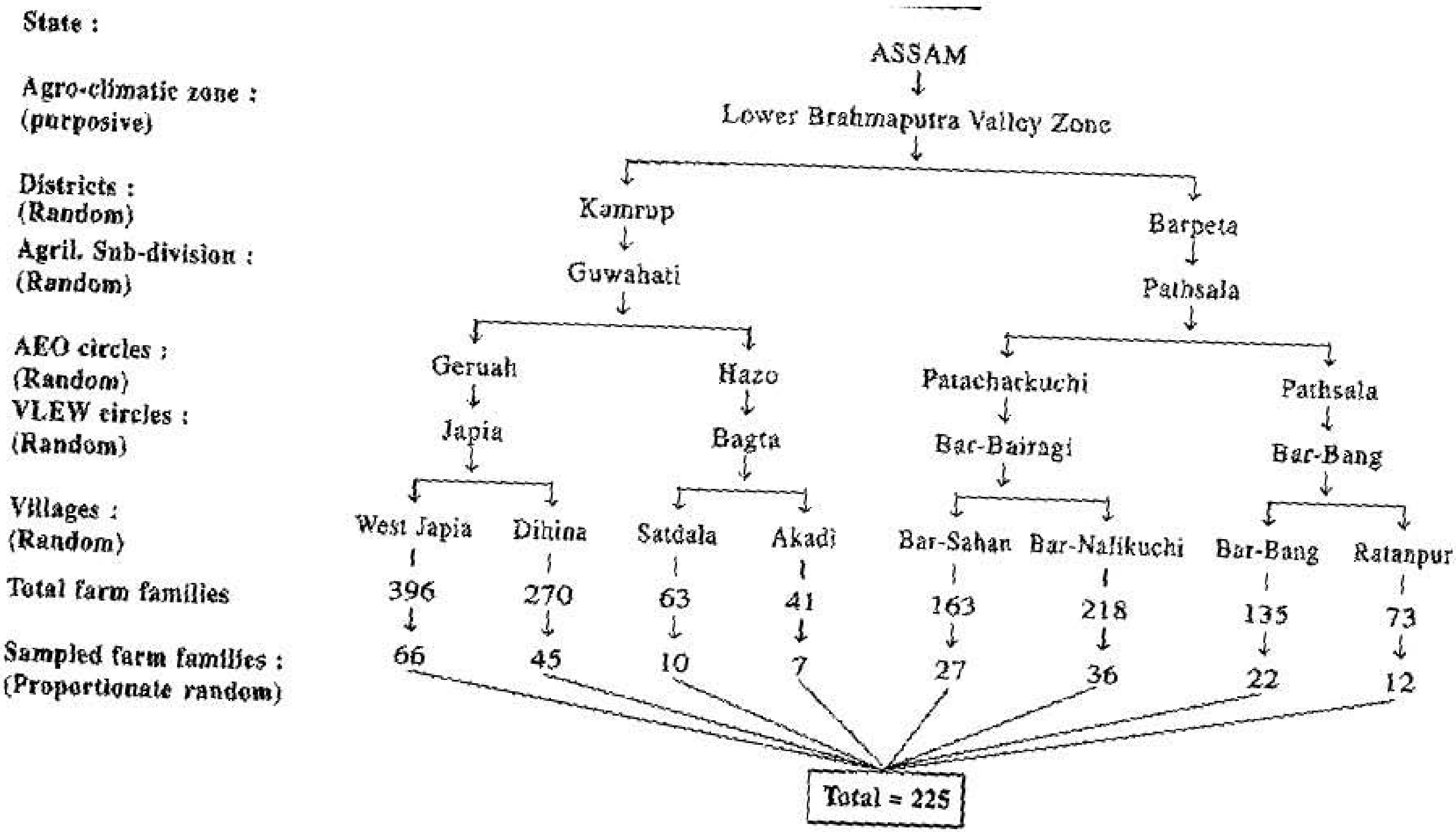

Fig. 3.2.4 Sampling plan of the study

were left out from the study and subsequent analysis was done for 208 farm families.

3.4 Selection of variables and their measurement

After review of relevant literature available to the investigaror and consulting a few extension scientists and economists of Assam Agricultural University, Jorhat, the following variables were selected for the study. The conceptual definitions and details of the procedures followed for measurement of the variables are described in the sub sections to follow. The list of selected variables and their empirical measures is presented in Table 3.4.1.

3.4.A Dependent variables

3.4.A.1 Level of technology adoption

The present study was concerned with improved farm practices recommended by the extension agency for crop, livestock, and fish production in the study area.

In order to obtain a valid measurement of the level of adoption of technologies the following procedure was followed.

After consulting Package of Practices for crops (*Rabi*, *Kharif* and Horticultural) and livestock production a checklist of 19 recommended technologies were prepared. In the first step, farmers were provided with the checklist asking them to identify the technologies adopted by them on their farms. Then the percentage of farmers adopting each of those technologies were determined. In the next step, those technologies which were adopted by less than 10 per cent or more than 90 per cent of farmers were eliminated from the list. By following this procedure, three recommended agricultural technologies, namely HYV seeds,, chemical fertilizers and plant protection chemicals were selected for inclusion in the scale for measuring level of adoption.

The level of adoption of the three selected agricultural technologies were measured by using a ratio scale developed by Sangle (1984). The concept of level of adoption of technology here comprises three dimensions : (i) number of technologies, (ii) potential area available for use of technology on the farm and (iii)

Table 3.4.1 Variables selected for the study and their measurement

Sl. No.	Selected variables	Empirical measures
A. Dependent variables		
1.	Level of technology adoption	Scale developed by Sangle (1984)
2.	Level of productivity	Structured schedule
B. Independent variables		
a. Agro-Economic variables :		
1.	Size of operational land holding	Structured schedule
2.	Farm mechanization	Farm mechanization index developed by Samanta (1977)
3.	Cropping intensity	Structured schedule
4.	Degree of commercialization	Formula developed by Singh (1966)
5.	Extent of utilization of family labour	Structured schedule
6.	Availability of working capital	Structured schedule
b. Socio-personal and psychological variables :		
7.	Age	Structured schedule
8.	Education level	SES scale-Rural developed by Trivedi and Pareek (1964)
9.	Family type	Structured schedule
10.	Family size	Structured schedule
11.	Social participation	Social Participation Scale developed by Trivedi and Pareek (1964)
12.	Innovation proneness	Innovation proneness scale developed by Moulik (1965)
13.	Economic motivation	Economic Motivation Scale developed by Supe (1969)
14.	Scientific orientation	Scientific Orientation Scale developed by Supe (1969)
15.	Risk orientation	Risk Orientation Scale developed by Supe (1969)
16.	Level of aspiration	Aspiration rating scale developed by Muthayya (1977)
17.	Orientation towards competition	Orientation towards Competition Scale developed by Singh (1981)
18.	Management orientation	Management Orientation Scale developed by Samanta (1977)
19.	Attitude towards improved farm practices	Attitude scale developed by Sangle (1984)
20.	Knowledge level on agricultural technology	Standardized knowledge test developed by Das (1991)
c. Extension-communication variables :		
21	Degree of information exposure	Procedure suggested by Sangle (1984)

actual area on which technology has been used. This concept, thus, refers to actual use of all the trhree selected agricultural technologies which is expressed as percentage of the total available potential. The level of adoption of the three selected technologies were measured in relation to seven selected crops , namely *sali* (winter rice), *ahu* rice (autumn rice), *boro* rice (summer rice), wheat, mustard, potato and pea. The procedure of data collection and transforming them intoadoption scores is described in the following paragraphs.

The respondent was asked to state the crops grown during the last agricultural year (1997-98) and the area under each crop. These areas were taken as the potential for using a selected agricultural technology in relation to crops grown. Then the respondent was further asked to state in how much area he had actually used a selected agricultural technology out of the total potential area under each crop. The actual area under a selected technology was expressed as percentage of the total available potential area for all the selected crops. These responses were quantified by assigning scores as follows.

Percentage of actual area under a selected technology	Score
Upto 10 per cent	1
Upto 20 per cent	2
Upto 30 per cent	3
Upto 40 per cent	4
Upto 50 per cent	5
Upto 60 per cent	6
Upto 70 per cent	7
Upto 80 per cent	8
Upto 90 per cent	9
Upto 100 per cent	10

For instance, if a farmer has 10 ha area under a particular crop, his potential for adopting particular technology is 10 ha. If he utilized the technology on only 2 ha then his level of adoption is only 20 per cent and thus he gets a score of 2. Accordingly, for all the selected crops, the technology adoption scores were calculated. Finally, the technology adoption score obtained by the respondent was expressed as percentage of the total potential scores in respect of each selected agricultural technology. In order to obtain the overall pattern of the adoption of all the three selected technologies, the technology adoption scores of the three selected technologies were summed up and the mean adoption score was calculated which was expressed as percentage of the total potential for adopting these technolofies.

Based on the mean ($\bar{x}$) and standard deviation (s.d.) of the obtained technology adoption scores, respondents were classified into three categories as follows.

Category	Score range
Low level of technology adoption	Upto $\bar{x}$ - 1 s.d.
Medium level of technology adoption	$\bar{x}$ - s.d. to $\bar{x}$ + 1 s.d.
High level of technology adoption	Above $\bar{x}$ + 1 s.d.

3.4.A.2 Level of productivity

Usually, productivity refers to the amount of output per unit of input, expressed in physical or value terms. The time span may refer to a year or to the length of a production cycle. The seasonal productivity of an enterprise in physical terms refers to the gross production (in kg or tons, etc.) per unit of land (ha or acre), per unit of labour (man day) or unit of capital in one particular season. Land productivity, for instance, could be in terms of kg per ha, per season. In value terms, productivity is defined as the gross value of production (in local currency) per unit of land, labour or capital. However, productivities are usually defined in value terms (FAO, 1993).

In farm economic studies, several partial measures of productivity are used for examining the performance of productivity at farm level. In partial measures of productivity, the output or net income is expressed per unit of single input, such as land, labour or capital. Hence, physical out put or value out put per unit of input and similar other measures may be used for estimating productivity at farm level (Saikia, 1996).

In the present study, the total gross margin over variable costs per annum was considered as partial measure of productivity of a farming system. The gross margin over variable cost was defined as the difference between the gross value of production of a farm activity and the variable costs incurred in the activity. The procedure for estimating the total gross margin over variable costs has been described in the following paragraphs.

The gross value of production for each farm activity in a year were computed by multiplying the total quantity of output (main product plus by-product) of the activity by their respective farm harvest prices. To compute the gross margin over variable costs for crop activity, the expenses on seeds, costs of manures and fertilizers, plant protection chemicals, cost of hired human labour and bullock labour, cost of hired machinery and imputed interest on working capital were deducted from the gross value of production per unit of the activity. Imputed interest on working capital was calculated by dividing the sum of all variable costs (except inputed interest) by two and multiplying it with the prevalent interest rate on short term capital (@ 12% per annum). The logic behind was that the farmers could, in theory, have set aside his money to earn interest instead of buying inputs for production.

In case of milch animal, gross value of production was computed by multiplying the quantity of milk produced by prevailing market prices of milk. Value of cowdung was also added to gross value. Gross value of poultry and duckery was derieved from the sale proceed of eggs and culled birds. In case of goats and pigs, the gross value of production was obtained from the sale value of animals. For fish, the sale proceed was added. Gross margin over variable costs for the livestock activities was calculated by deducting the expenses on medicine, costs of livestock and fish feed, costs of hired casual labour and imputed interest on working capital from respective gross value of production.

In case of products for which information on farm harvest prices was not available, the average output prices received by the farmers at the farm gate or market were taken into consideration. For inputs, the prices paid by the farmers were taken into account.

For valuation of by-prodicts which were not marketable or not marketed, the concept of opportunity cost was used. The opportunity cost refers to the cost to replace the by-product by another product of equal use that has market value. The value of hired human and bullock labour was determined by using the average wage rate prevalent in the study area.

Finally the gross margin of all activities expressed in rupee term were summed up to get the total gross margin over variable costs for a respondent's farm. For correlation analysis, a score of 1 was assigned per thousand rupees of a respondent's total gross margin over variable costs.

Based on mean ($\bar{x}$) and standard deviation (s.d.) of the obtained scores, respondents were classified into three categories as shown below.

Category	Score range
Low productivity level	Upto $\bar{x}$ - 1 s.d.
Medium productivity level	$\bar{x}$ - 1 s.d. to $\bar{x}$ + 1 s.d.
High productivity level	Above $\bar{x}$ + 1 s.d.

3.4.B Independent variables

All together 21 independent variables were selected for the study. Of these, 6 variables were classified as agro-economic, 14 variables as socio-personal and psychological and 1 variable as extension-communication. These are shown in the Table 3.4.1. The conceptual definitions and procedure followed for measurement of each of these variables are described hereunder.

3.4.B.1 Size of operational land holding

It refers to the land area operated by a farmer for cultivation expressed in hectare. Size of operational land holding in the present study includes the total of the owned cultivable land plus cultivable land leased in minus cultivable land leased out. It can be expressed as follows.

Size of operational land holding = (owned cultivable land + cultivable land leased in) - cultivable land leased out (in ha)

The data on size of operational land holding was collected in terms of 'bigha' (1 bigha = 0.13 ha) which were then converted to hectare.

The size of operational land holding expressed in hectare was taken as respondent's score for correlational analysis.

In this study, the land area operated by a respondent for cultivation was taken as a measure of his farm size. Thus, on the basis of their size of operational land holding, farmers were categotized into three farm size groups as shown below.

Category	Range
Marginal	Below 1.00 ha
Small	1.01 ha to 2.00 ha
Medium	2.01 ha to 4.00 ha

3.4.B.2 Farm mechanization

Farm mechanization has been defined as the use of labour saving (human and animal), time saving and efficient working devices for farm operations and was measured by Farm Mechanization Index developed by Samanta (1977).

For calculating farm mechanization index, the number of years each farm, machine/implements used by the farmer was multiplied by its weightage and was added up for all the farm machines/implements the farmer had used. The total score indicated the level of farm mechanization of the particular farmer.

Based on the mean ($\bar{x}$) and standard deviation (s.d.) of the obtained scores, respondents were categorized as follows.

Category	Score range
Low farm mechnization	Upto $\bar{x}$ - 1 s.d.
Medium farm mechanization	$\bar{x}$ - 1 s.d. to $\bar{x}$ + 1 s.d.
High farm mechanization	Above $\bar{x}$ + 1 s.d.

3.4.B.3 Cropping intensity

Cropping intensity refers to the proportion of acreage annually put under different crops to the total cropped area, expressed in percentage. The cropping intensity was calculated using the following formula :

$$\text{Cropping intensity} = \frac{\text{Total annual cropped area (ha)}}{\text{Size of holding (ha)}} \times 100$$

The actual cropping intenticity was taken as respondent's score for analysis Based on the mean ($\bar{x}$) and standard deviation (s.d.) of the obtained cropping intensity scores, respondents were grouped into three categories as follows :

Category	Score range
Low croppping intensity	Upto $\bar{x}$ - 1 s.d.
Medium cropping intensity	$\bar{x}$ - 1 s.d. to $\bar{x}$ + 1 s.d.
High cropping intensity	Above $\bar{x}$ + 1 s.d.

3.4.B.4. Degree of commercialization

Operationally, the degree of commercialization refers only to the fraction of the farm produce sold during the year (Singh, 1966).

In this study, the degree of commercialization was measured with the help of the following formula developed by Singh (1966) :

$$\text{Degree of commercialization} = \frac{\text{Value of farm produce sold annually}}{\text{Gross value of all production on the farm in that year}} \times 100$$

The values of the produce were calculated on the basis of prevelent rates of agricultural produce at the time of data collection. The actual degree of commercialization was taken as respondents score for analysis.Based on mean ($\bar{x}$) and standard deviation (s.d.)of the obtained degree of commercialization scores, respondents were categorised into three groups as follows :

Category	Score range
Low degree of commercialization	Upto $\bar{x}$ - 1 s.d.
Medium degtee of commercialization	$\bar{x}$ - 1 s.d. to $\bar{x}$ + 1 s.d.
High degree of commercialization	Above $\bar{x}$ + 1 s.d.

3.4.B.5 Extent of utilization family labour

It refers to the proportion of total human labour utilizatied for farm activities to the total human labour available in a respondent's family.

Total labour availability in each farm family was calculated for a year in terms of adult mandays of eight hours based on the ratio of 1:0.75:0.50 for man, woman and child respectively. While estimating the labour availability, the number of days of no work due to religious festivals, social needs, leisure, odd days during which farm operations were suspended, children school days, ilness and other purposes as reported by respondents were deducted from total number of calender days in the year. Thereafter, the extent of utilization of family labour of each farm family was calculated by using the following formula :

$$\text{Extent of utilization ofFamily labour} = \frac{\text{Total human labour available in mandays}}{\text{Total human labour utilized in mandays}} \times 100$$

On the basis of mean ($\bar{x}$) and standard deviation (s.d.) of the obtained scores, respondents were grouped into three categories as follows :

Category	score range
Low utilization	Upto $\bar{x}$ - 1 s.d.
Medium utilization	$\bar{x}$ - 1 s.d. to $\bar{x}$ + 1 s.d.
High utilization	Above $\bar{x}$ + 1 s.d.

3.4.B.6 Working capital availability

The working capital is meant to meet the expenses on day to day crop production and livestock rearing in terms of both cash and kind. The total working capital availabile in each farm family was estimated for different seasons which were added up to get the working capital available for a yaer. Since the direct estimatation of capital availabilty was not possible due to lack of records with the farmers, so the availability of capital at the farm level was estimated as the variable expenses incurred during different seasons. The following items were considered while calculating the working capital.

i. Value of seeds (both farm produced and purchased)

ii. Cost of manures (both farm produced and purchased)

iii. Cost of fertilizers

iv. Cost of plant protection chemicals and medicine livestocks

v. Purchase of livestock feeds

vi. Charges on hired human labour

vii. Charges on hired bullock labour

viii. Charges on hired machine

ix. Imputed interest on working capital (@ 12.00% per anum).

For correlational analysis a score of 1 was given per thousand rupees of working capital of a respondent.

On the basis of mean ($\bar{x}$) and standard deviation (s.d.) of obtained scores, respondents were classified into three categories as follows :

Category	score range
Low working capital availability	Upto $\bar{x}$ - 1 s.d.
Medium working capital availability	$\bar{x}$ - 1 s.d. to $\bar{x}$ + 1 s.d.
High working capital availability	Above $\bar{x}$ + 1 s.d.

3.4.B.7 Age

Age refers to the chronological age of a respondent at the time of interview rounded off to the nearest year.

Number of completed years was taken as the respondent's scoree on the variable. On the basis of their age, respondents were categorized as follows :

Category	Range
Young	18-35 years
Middle aged	36-50 years
Old	51 years and above

3.4.B.8 Education level

It refers to the formal education received by the respondents. Respondents were categorised on the basis of the Socio-Economic Status Scale (Rural) of Trivedi and Pareek (1964). Scores were assigned in ascending order of education received as shown below :

Category	Score
Illiterate	0
Can read only	1
Can read and write/Primary level	2
Middle school level (Upto 7th class)	3
High school level (Upto 10th class)	4
Higher secondary/PU level (Upto 12th class)	5
Graduate/Diploma or above	6

3.4.B.9 Family type

It refers to whether there is single or joint family in the respondent's family. A family was considered as single when it consisted of husband, wife and unmarried children. A joint family consisted of other blood-relations also. To quantity the family type, the scoring system developed by Trivedi and Pareek (1964) in their Socio-Economic Status Scale (Rural) was used which is given below :

Family type	Score
Single	1
Joint	2

3.4.B.10 Family size

It refers to the number of members present in the individual respondent's family. A family consisting upto 5 members was regarded as small family and a family with more than 5 members a large size family. To quantify the family size, actual number of members in the family was taken into consideration.

3.4.B.11 Social participation

Social participation refers to the voluntary sharing in person to person and group to group relationship beyond the immediate household (Hay, 1951). It shows the degree to which the respondents are involved in formal organizations as members or office-bearers. The scale developed by Trivedi and Pareek (1964) was used for measuring the social participation of the respondents and the scores were assigned as follows :

Items	Score
i. No membership	0
ii. Member of one organization	1
iii. Member of more than one organization	2
iv. Office bearers	3

3.4.B.12 Innovation proneness

it was conceptualized as the degree of individual's interest in and a desire to seek changes in farming techniques and to introduce such changes into their own operations, when practical and feasible (Moulik, 1965). This variable was measured with the help of self-rating scale developed by Moulik (1965) with slight modification in the scoring procedure. The scale comprised of three groups of statements each having three statements. Statements 1,2 and 3 were given 3, 2 and 1 score respectively, in each group. The respondent was asked to respond to only one statement out of the three in each group and state which was most like his thinking. The total score obtained on the scale indicated the respondent's degree of innovation proneness. The total score on the scale had a theoretical range of 3 to 9.

On the basis of mean ($\bar{x}$) and standard deviations (s.d.) of obtained, scores respondents were classified into three categories as follows :

Category	score range
Low innovation proneness	Upto $\bar{x}$ - 1 s.d.
Medium innovation proneness	$\bar{x}$ - 1 s.d. to $\bar{x}$ + 1 s.d.
High innovation proneness	Above $\bar{x}$ + 1 s.d.

3.4.B.13 Economic motivation

It was defined as the occupational success in terms of profit maximization and the relative value an individual places on economic ends (Supe, 1969). The scale consisted of five statements in positive direction and one statement in negative direction spread over five response categories. Scoring procedure for positive statements was as follows :

Response	Score
Strongly agree	7
Agree	5
Undecided	4
Disagree	3
Strongly disagree	1

Reverse of the above scoring was used in computation of statement in negative direction. The total sores on the scale had a theoretical range of 6 to 42. Each individual respondent was located in the scale by his total score.

On the basis of mean ($\bar{x}$) and standard deviation (s.d.) of the scores obtained, respondents were classified into three categories as follows :

Category	score range
Low economic motivation	Upto $\bar{x}$ - 1 s.d.
Medium economic motivation	$\bar{x}$ - 1 s.d. to $\bar{x}$ + 1 s.d.
High economic motivation	Above $\bar{x}$ + 1 s.d.

3.4.B.14 Scientific orientation

Scientific orientation was defined as the degree to which a farmer is oriented towards scientific techniques and thinking in his outlook (Supe, 1969). It was measured by using the scientific orientation scale developed by Supe (1969). The scale consisted of 5 statements in positive direction and one statement in negative direction spread over five response categories. Scoring procedure for positive statements was as follows :

Response	Score
Strongly agree	7
Agree	5
Undecided	4
Disagree	3
Strongly disagree	1

Reverse of the above scoring procedure was followed in computation of the negative statement. Each individual respondent was located in the scale by his total score. The total scores on the scale theoretically ranged from 6 to 42.

On the basis of mean ($\bar{x}$) and standard deviation (s.d.) of the scores obtained, respondents were classified into three categories as shown below :

Category	Score range
Low scientific orientation	Upto $\bar{x}$ - 1 s.d.
Medium scientific orientation	$\bar{x}$ - 1 s.d. to $\bar{x}$ + 1 s.d.
High scientific orientation	Above $\bar{x}$ + 1 s.d.

3.4.B.15 Risk orientation

It refers to the degree to which a farmer is oriented towards risk and uncertainty and had a courage to face the problems in farming. It was measured by using the scale developed by Supe (1969). The scale consisted of six statements of which five statements were in positive direction and one statement in negative direction spread over five response categories. Scoring procedure for positive statements was as follows :

Response	Score
Strongly agree	7
Agree	5
Undecided	4
Disagree	3
Strongly disagree	1

Reverse of the above scoring procedure was followed in computation of the negative statement. Each individual respondent was located in the scale by his total score. The total score on the scale theoretically ranged from 6 to 42.

Based on the mean ($\bar{x}$) and standard deviation (s.d.) of the scores obtained, respondents were classified into three categories as shown below :

Category	score range
Low risk orientation	Upto $\bar{x}$ - 1 s.d.
Medium risk orientation	$\bar{x}$ - 1 s.d. to $\bar{x}$ + 1 s.d.
High risk orientation	Above $\bar{x}$ + 1 s.d.

3.4.B.16 Level of aspiration

An aspiration usually refers to a person's or a group of person's orientation towards a goal (Haller, 1968). Goals can vary in kind and are usually described with reference to a particular social status or attributes. High and low level of aspiration were used to indicate relative level of goal specification (Muthayya, 1971). In this study, the level of aspiration was measured by using the aspiration-ratings for the present and the future developed by Muthayya (1971) with slight modification. The scale consisted of 11 items (statements) with 5 point response categories, indicating low to high levels of aspirations, which were assigned scores of 0, 1, 2, 3 and 4. The aspiration-rating of an individual respondent was done by his total score in the scale. The total scores on the scale had a theoretical range of 0 to 44.

Based on the mean ($\bar{X}$) and standard deviation (s.d.) of the obtained scores, respondents were classified into three categories as shown below :

Category	Score range
Low level of aspiration	Upto $\bar{X}$ - 1 s.d.
Medium level of aspiration	$\bar{X}$ - 1 s.d. to $\bar{X}$ + 1 s.d.
High level of aspiration	Above $\bar{X}$ + 1 s.d.

3.4.B.17 Orientation towards competition

Orientation towards competition was defined as the degree to which a farmer is oriented to place himself in a competitive situation in relation to other farmers for projecting his excellence in farming. It was measured by using the scale developed by Singh (1981). The scale consisted of 6 statements. Of these, four statements indicated positive orientation and the remaining two statements indicated negative orientation. Each statement was provided with 4 point response categories. The 4-points in the continuum were strongly agree, agree, disagree and strongly disagree with weights 4, 3, 2 and 1 respectively for the positive statements and weights 1, 2, 3 and 4 respectively for the negative statements. Each individual respondent was located in the scale by his total score. The total score on the scale had a theoretical range of 6 to 24.

Based on the mean ($\bar{X}$) and standard deviation (s. d.) of the obtained scores, respondents were classified into three categories as follows.

Category	Score range
Low orientation towards competition	Upto $\bar{X}$ - 1 s.d.
Medium orientation towards competition	$\bar{X}$ - 1 s.d. to $\bar{X}$ + 1 s.d.
High orientation towards competition	Above $\bar{X}$ + 1 s.d.

3.4.B.18 Management orientation

Management orientation has been defined as the degree to which a farmer is oriented towards scientific farm management comprising planning, production and marketing functions of his farm. It was measured by using the management orientation scale developed by Samanta (1977). The scale had three components, *viz*., planning orientation, production orientation and marketing orientation with 6 statements under each component. The statements with serial numbers (i), (iii), and (vi) related to planning, (i), (iii), (iv) and (v) related to production and (ii), (iii) and (vi) related to marketing indicated positive orientation, while the remaining statements indicated negative orientation. Each statement was provided with 4 point response categories. The positive statements were given scores for strongly agree-4, agree-3, disagree-2 and strongly disagree-1. Scoring was reversed for the negative statements. The theoretical range of scores on the scale was from 18 to 72. The management orientation score of an individual respondent was the sum of scores for all the statements in the scale.

Based on the mean ($\bar{X}$) and standard deviation (s. d.) of the obtained scores, respondents were classified into three categories as shown below :

Category	Score range
Low management orientation	Upto $\bar{X}$ - 1 s.d.
Medium management orientation	$\bar{X}$ - 1 s.d. to $\bar{X}$ + 1 s.d.
High management orientation	Above $\bar{X}$ + 1 s.d.

3.4.B.19 Attitude towards improved farm practices

Attitude was defined by Thurstone (1946) as the degree of positive or negative affect associated with some psychological objects. The attitude of the farmers towards improved farm practices was measured with the help of attitude scale developed by Sangle (1984). The scale consisted of seven statements indicating attitude towards improved farm practices. The farmers' responses were recorded on a 3-point continuum as agree, undecided and disagree. These responses were assigned weightage of 2, 1 and 0 respectively. The total scores obtained by the respondent on the scale indicated his degree of positive or negative affect associated with the use of improved farm practices. The total scores of the scale had a range from 0 to 14.

Based on the mean ($\bar{X}$) and standard deviation (s. d.) of the obtained attitude scores, respondents were classified into three attitude categories as follows:

Category	Score range
Less favourable	Upto $\bar{X}$ - 1 s.d.
Moderately favourable	$\bar{X}$ - 1 s.d. to $\bar{X}$ + 1 s.d.
Highly favourable	Above $\bar{X}$ + 1 s.d.

3.4.B.20 Knowledge level on agricultural technology

Agricultural knowledge was defined by Haverkort (1988) as the set of concepts, meanings and skills developed over time by individuals or groups through the processing of information. In the present study knowledge was conceptualized as those behaviour and test situations which emphasized the remembering either by recognition or by recall of ideas, material or phenomena (Bloom, 1956). The level of respondent's knowledge on agricultural technology was measured by using the knowledge test developed by Das (1991). The test consisted of 38 items (questions) relating to the major crops grown in the area of the study. The knowledge level of the respondents on agricultural technology was indicated by the total scores received by them on the test. The answer for the questions in the knowledge test were in dichotomous categories. In computing the knowledge scores of the respondents, correct answer to a question was given 1 score and the incorrect answer was given 0 score. The total scores on the test had a theoretical range of 0 to 38.

Taking into consideration the mean ($\bar{X}$) and standard deviation (s.d.) of the knowledge scores obtained by the respondents, they were classified into three categories as follows.

Category	Score range
Low level of knowledge	Upto $\bar{X}$ - 1 s.d.
Medium level of knowledge	$\bar{X}$ - 1 s.d. to $\bar{X}$ + 1 s.d.
High level of knowledge	Above $\bar{X}$ + 1 s.d.

3.4.B.21 Degree of information exposure

It refers to the degree to which a respondent utilized various sources for getting information relating to farming. The procedure suggested by Sangle (1984) was followed for measuring the degree of information exposure of the farmers.

All together 11 sources of information were considered in the study which were categorized as personal cosmopolite, personal localite and mass media sources. These were relevant for the study area and were finalised after discussion with the change agents and pre-testing of the schedule.

To measure the degree of information exposure, each respondent was first asked to state various sources which he utilized for getting information on improved farm practices. Then the respondent was further asked to indicate on a 3-point continuum as to how often he got information about improved farm practices from each of the sources indicated by him at the first step. The scoring procedures was as follows :

Category	Score range
Often	2
Sometimes	1
Never	0

The score for an individual respondent was obtained by adding the scores over different sources. This total score indicated the respondent's degree of information exposure. The range of scores was from 0 to 22.

On the basis of mean ($\bar{X}$) and standard deviation (s.d.) of the scores obtained by the respondents, they were categorized as high, medium and low users *of information sources as follows :*

Category	Score range
Low information exposure	Upto $\bar{X}$ - 1 s.d.
Medium information exposure	$\bar{X}$ - 1 s.d. to $\bar{X}$ + 1 s.d.
High information exposure	Above $\bar{X}$ + 1 s.d.

3.4.C Farmers' perceptions of factors hindering adoption of improved agricultural technology

The respondents were asked through an open question to mention three important factors which, in their opinion, were the major obstacle to adoption of improved agricultural technology in their farms. They were further asked to rank these factors according to their degree of importance. The factors ranked first, second and third were assigned weight (scores) 3, 2 and 1 respectively. the total rank score for each factor was obtained by multiplying the frequency the factors was ranked first, second or third by the farmers with the respective weightage and adding them up. The factors were then arranged on the basis of their total rank score and finally ranked. However, only those factors which were mentioned by at least 20 per cent of the respondents in each category were considered as major factors hindering their adoption of technology and were incorporated in the findings. The factors which were mentioned by less than 20 per cent of the respondents in each category were left out from the analysis and hence not incorporated in the findings. The total rank score and rank order of each major factor was computed separately for the marginal, small and medium farmers.

3.5 TOOLS AND TECHNIQUES OF DATA COLLECTION

3.5.1 Tools of data collection

The major tool used for collection of primary data in the study was a structural schedule as given in Appendix 1. The schedule consisted of three parts.

The Part I of the schedule was designed to collect data on farm enterprises, selected agro-economic, socio-personal, psychological and extension-communication characteristics and farmers' level of productivity. Part II of the schedule was structured to measure the level of adoption of technology by the respondents. Part III of the schedule was structured to collect information regarding farmers' perceptions of factors hindering adoption of improved technology in their farms.

3.5.2 Pre testing of the schedule

The schedule prepared for the present investigation was pretested in a non sampled area of Barpeta District. For pre-testing a group of 30 farmers were interviewed. On the basis of information obtained through pre-testing, necessary modifications were made in the body of the interview schedule so as to make it more convenient.

3.5.3 Technique of data collection

The primary data in the present study were collected directly from the farmers with the help of the structured schedule, through personal interview method. Only the functional heads of the household were taken as respondents of the study.

The interview schednle was taken to each of the respondents by the investigator. After establishing rapport, questions contained in the schedule were explained to each respondent and the responses received were recorded by the investigator. Every effort was made to clarify the qnestions by repetition in local language to get an objective and correct response. All the interviews were conducted at the respondents' place of residence. Thus, the interview situation in almost all the cases were similar. all the data collected from the sampled farmers pertain to the agricultural year 1997-98.

The secondary data were collected from the records of Subdivisional Agricultural Offices, Pathsala and Guwahati and Regional Agricultural Research Station, Gossaigaon.

3.6 Formulation of hypotheses

Two sets of hypotheses were formulated for testing which are mentioned below. The hypotheses presented here are the verbal statements of null hypotheses along with their alternative forms. The verbal statements are presented *in the form of null hypotheses (H_0) and the statistical versions are given both in null* and alternative form(H_1).

Hypothesis 1 : The selected agro-economic, socio-personal and psychological and extension-communication variables have no significant relationship with the level of adoption of selected agricultural technology by farmers in different size groups of farms.

$$H_0 \quad : \quad r_i = 0$$

$$H_1 \quad : \quad r_i \neq 0$$

where, r_i = Coefficients of correlation between selected independent variables and level of adoption of selected agricultural technology by farmers.

$i = 1, 2, \ldots n$

n = Number of selected independent variables

Hypothesis 2 : The selected agro-economic, socio-personal and psychological and extension-communication variables have no significant relationship with the level of productivity of farmers in different size groups of farms.

$$H_0 \quad : \quad r_i = 0$$

$$H_1 \quad : \quad r_i \neq 0$$

where, r_i = Coefficients of correlation between selected independent variables and level of productivity of farmers.

$i = 1, 2, \ldots n$

n = Number of selected independent variables

3.7 Statistical analysis and interpretation of data

Various descriptive and inferential statistical methods were used to analyse the data in the present study. The statistical techniques and tests used are listed hereunder.

1. Percentages
2. Mean scores
3. Standard deviations
4. Co-efficient of variation
5. Zero-order correlation of coefficients
6. Linear multiple regression analysis
8. Path analysis

The analytical relevance of some of the important statistical techniques are described below.

3.7.1 Co-efficient of variation (C.V.)

This index was used to find out the relative variability or dispersion of a given set of scores. The C. V. of a given distribution was worked out as follows (Garrett, 1979).

$$\text{Co-efficient of variation (C.V.)} = \frac{\text{S.D.}}{\bar{X}} \times 100$$

Where, S.D. = standard deviation

$\bar{X}$ = mean of the distribution

3.7.2 Zero-order correlation of coefficients

To find out the relationship between two given variables, the Pearson Product-Moment correlation co-efficient (zero-order) was worked out by using the following formula (Welkowitz *et al.*, 1982).

$$r_{xy} = \frac{\Sigma xy - \frac{\Sigma x . \Sigma y}{n}}{\sqrt{\left[\Sigma x^2 - \frac{(\Sigma x)^2}{n}\right]\left[\Sigma y^2 - \frac{(\Sigma y)^2}{n}\right]}}$$

Where, r_{xy} = Correlation co-efficient between x and y variables

x = Original scores in variable x

y = Original scores in variable y

Σ = "Summation of"

n = Total number of pairs of observations

3.7.3 Multiple regression analysis :

The technique of multiple regression analysis was used to determine the contributory effects of the selected independent variables in predicting the variation in the dependent variables. Only those variable which were significantly correlated with the dependent variables were selected for multiple regression analysis. The analysis was done with the help of electronic computer employing the following linear regression equation (Vaus, 1986).

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

where,

Y = Dependent variable

a = constant

$x_1, x_2 \ldots x_n$ = independent variables

$b_1, b_2 \ldots b_n$ = regression coefficient for respective independent variables

n = Number of independent variables fitted into regression equation

The predicted power of the multiple regression analysis was evaluated with the help of the co-efficient of multiple determination (R^2).

The independent variables have their own units of measurement which do not permit a comparison of the partial regression values. To facilitate comparison, the partial regression values were converted to standard partial regression values which were free from the units of measurement. This standardisation was done by multiplying the partial regression (b) values by the ratio of the standard deviation in the independent variable to the standard deviation in the dependent variable (Pine, 1977).

3.7.4 t-tests

i. In order to test the significance of observed correlation co-efficients, the Fisher's 't' ratio was found out by using the followinmg formula (Guilford and Fruchter, 1978).

$$t = \frac{r \times \sqrt{n - 2}}{\sqrt{1 - r^2}} \qquad \text{with } (n - 2) \text{ d.f}$$

Where, r = observed correlation co-efficient

n = Number of observation

d.f. = Degrees of freedom

ii. The significance of partial regression co-efficients (b) was tested with the help of the 't' values. The following formula (Chandel, 1964) was used.

$$t = \frac{b_i}{S.E.(b_i)} \qquad \text{with } (N - K) \text{ d.f}$$

Where, b_i = Regression co-efficients for respective independent variables

i = 1, 2, ... K

K = Number of independent variables

S.E. (b_i) = Standard error of b_i

N = Number of observations

The calculated values of 't' were compared with table value of 't' at 0.05 and 0.01 level of probability.

3.7.8 Path analysis

Path analysis is a technique that aims at determining the direct and indirect effects among number of variables and thereby helps to give a quantitative interpretation to the interrelationships within a known or an assumed causal systems that exists in some specific population. The basic theorem of path analysis states that the zero order correlation between any two variables is equal to the sum of the products of the paths and correlations between all the variables in the system. In this technique the direct and indirect effects are measured by a quantity (standardised partial regression) called the path coefficient. A path coefficient is an absolute number without any physical unit, whatever the actual units of measurement for the variables. It indicates the extent to which the variance in a dependent variable is determined by the variance of the independent variable. It also has direction (Li, 1958; Pine, 1977).

The objective of doing path analysis in the present study was to get a clear picture of the direct and indirect effects of selected independent variables on the dependent variable. Only those independent variables whose partial regression values were significant in the multiple regression analysis were included in the path analysis. Variables through which substantial indirect effects were channeled were also found out. The path analysis was done with the help of electronic computer following the procedure suggested by Singh and Choudhary (1985).

Findings and Discussion

Chapter IV

FINDINGS AND DISCUSSION

The findings of the study and relevant discussions thereon are presented in this chapter under the following heads :

4.1 Characteristics of the respondents

4.2 Enterprise mix in selected farming systems across different size group of farms

4.3 Level of adoption of selected agricultural technologies across different size group of farms

4.4 Level of productivity across different size group of farms

4.5 Relationship of level of adoption with selected independent variables

4.6 Relationship of level of productivity with selected independent variables

4.7 Contributory effects of selected independent variables on level of adoption

4.8 Contributory effects of selected independent variables on level of productivity

4.9 Direct and indirect effects of selected independent variables on level of adoption

4.10 Direct and indirect effects of selected independent variables on level of productivity

4.11 Farmers' perceptions of the factors hindering adoption of improved agricultural technology

4.1 Characteristics of the respondents

A total of 21 characteristics of the respondents were considered in the study. On each variable, respondents were categorized and their frequency and percentages were worked out. The mean and standard deviation were calculated and relative extent of homogeneity and heterogeneity among respondents with respect to each variable were examined with the help of co-efficient of variation.

4.1.1 Size of operational land holding

Table 4.1.1 reveals that 47.12 per cent of the respondents were marginal farmers with an average land holding size of 0.61 ha. The percentage of small farmers was 31.25 per cent with an average land holding size of 1.53 ha. Only 21.63 per cent of the respondents were in medium farmer category with an average land holding size of 2.65 ha. In the pooled sample, the respondents had an average land holding size of 1.34 ha which is slightly lower than the average size of operational land holding in the state which is 1.37 ha. The values of coefficient of variation indicated that marginal farmers had relatively more variability as compared to the small and medium farmers with respect to their land holding size. The highest value of coefficient of variation (56.72) was obtained in the pooled sample of farmers indicating considerable heterogeneity amongst the farmer respondents with respect to their size of operational land holding. The inter-category differences in average size of operational land holding were relatively higher, which were 0.92 ha between marginal and small farmers, 1.53 ha between small and medium farmers and 2.04 ha between marginal and medium farmers.

4.1.2 Farm mechanization

A perusal of the Table 4.1.2 reveals that majority (60.20%) of the marginal farmers were in low farm mechanization category followed by 39.80 per cent in the medium farm mechanization category. No marginal farmers were found in high farm mechanization category.

As regards small farmers, 49.23 per cent of them were in medium farm mechanization category followed by 47.69 per cent in low farm mechanization category. Only 3.08 per cent of them were in high farm mechanization category.

In case of medium farmers, majority of them (68.89%) were in medium farm mechanization category followed by 24.44 per cent in low farm mechanization category. Only 6.67 per cent of them were in high farm mechanization category.

In the pooled example of farmers, 49.04 per cent of the respondents were in medium farm mechanization category followed by 48.56 per cent in low farm mechanization category. Only 2.40 per cent of the respondents were in high farm mechanization category. The values of coefficients of variation revealed that there was

Table 4.1.1 Distribution of respondents according to their size of operational land holding

Category	Range	Number (%)	Average size of holding in ha	Standard deviation	C.V.
Marginal	Upto 1.00 ha	98 (47.12)	0.61	0.19	31.15
Small	1.01-2.00 ha	65 (31.25)	1.53	0.24	15.69
Medium	2.01-4.00 ha	45 (21.63)	2.65	0.34	12.83
Total		208 (100.00)	1.34	0.76	56.72

* Figures within parentheses indicate percentage

Table 4.1.2 Distribution of respondents according to their farm mechanization

Category	Score range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Low	0-1	59 (60.20)	31 (47.69)	11 (24.44)	101 (48.56)
Medium	2-3	39 (39.80)	32 (49.23)	31 (68.89)	102 (49.04)
High	4-12	0 (-)	2 (3.08)	3 (6.67)	5 (2.40)
Mean score		1.06	1.73	2.49	1.59
S.d.		1.03	1.56	2.01	1.54
C.V.		97.17	90.17	80.72	96.86

* Figures within parentheses indicate percentage

high variability among the respondents in all the farm size groups with respect to their farm mechanization. Marginal farmers were relatively more heterogeneous (97.17) as compared to small (90.17) and medium (80.72) farmers with respect to their farm mechanization.

4.1.3 Cropping intensity

Table 4.1.3 reveals that majority of the marginal farmers (71.43%) were in medium category of cropping intensity. Only a small portion of them (17.35%) was in low category of cropping intensity followed by 11.22 per cent in high category of cropping intensity.

In case of small farmers, majority of the respondents (69.24%) were in medium category of cropping intensity. An equal percentage (15.38%) of them were in low and high category of cropping intensity.

As regards medium farmers, majority of them (60.00%) were in medium category of cropping intensity. The percentage of medium farmers in the high category of cropping intensity was, however, higher (22.22%) than their percentage (17.78%) in the low category of cropping intensity.

In the pooled sample of farmers, majority of them (68.27%) were in medium category of cropping intensity followed by 16.83 per cent in low and 14.90 per cent in high category of cropping intensity.

The average cropping intensity of marginal farmers (143.31%) was higher than the average cropping intensity of small (142.37%), medium (141.26%) and pooled sample (142.61%) of farmers. Average cropping intensity was lowest (141.31%) in case of medium farmers.

The values of coefficients of variation indicated that respondents were relatively homogeneous with respect to their cropping intensity.

4.1.4 Degree of Commercialization

A perusal of the Table 4.1.4 reveals that almost equal proportion of the respondents had medium degree of commercialization, the figures being 67.35, 67.79, 67.22 per cent for marginal, small and medium farmers respectively. In case of marginal

Table 4.1.3 Distribution of respondents according to their cropping intensity

Category	Range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Low	Upto 115%	17 (17.35)	10 (15.38)	8 (17.78)	35 (16.83)
Medium	116-170%	70 (71.43)	45 (69.24)	27 (60.00)	142 (68.27)
High	Above 170%	11 (11.22)	10 (15.38)	10 (22.22)	31 (14.90)
Mean score		143.31	142.37	141.26	142.61
S.d.		26.41	27.01	25.33	26.92
C.V.		18.43	18.97	17.93	18.88

* Figures within parentheses indicate percentage

Table 4.1.4 Distribution of respondents according to their degree of commercialization

Category	Score range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Low	0-30.00	18 (18.37)	13 (20.00)	8 (17.78)	39 (18.75)
Medium	30.01-60.00	66 (67.35)	44 (67.79)	28 (67.22)	138 (66.35)
High	60.01-100.00	14 (14.28)	8 (12.31)	9 (20.00)	31 (14.90)
Mean score		41.18	42.25	51.35	44.80
S.d.		16.21	15.07	13.26	15.01
C.V.		39.36	35.57	25.82	33.50

* Figures within parentheses indicate percentage

farmers, 18.37 per cent had low degree of commercialization followed by 14.29 per cent with high degree of commercialization.

As regards small farmers, one-fifth (20.00%) of them were with low degree of commercialization followed by 12.31 per cent with high degree of commercialization.

In case of medium farmers, however, one-fifth (20.00%) were with high degree of commercialization followed by 17.78 per cent with low degree of commercialization. The mean degree of commercialization scores were less than 50.00 per cent for marginal (41.18%) and small (42.25%) farmers but more than 50.00 per cent for medium farmers (51.35%). This indicates that more than 50.00 per cent of the total annual produce of medium farmers were sold in the market. The values of coefficient of variation indicated that marginal (39.36) farmers were relatively more heterogeneous as compared to small (35.57) and medium farmers (25.82) with respect to their degree of commercialization. However degree of homogeneity was more among the medium farmers.

4.1.5 Extent of utilization of family labour

The findings presented in Table 4.1.5 reveal that majority of the respondents had medium extent of utilization of family labour in all the categories of farmers. In case of marginal farmers, 70.41 per cent did medium utilization of their available family labour followed by 17.35 per cent with high utilization and 12.24 per cent with low utilization of their available family labour.

As regards small farmers, 67.69 per cent were found with medium level of utilization of their available family labour followed by 18.46 per cent with high utilization and 13.85 per cent with low utilization of their available family labour.

In case of medium farmers 71.11 per cent of them were found with medium extent of utilization of their available family labour followed by 17.78 per cent with low extent of utilization and 11.11 per cent with high extent of utilization of their available family labour.

In the pooled sample of farmers, 69.71 per cent of the respondents were found with medium extent of utilization of their available family labour followed by 16.35

Table 4.1.5 Distribution of respondents according to their extent of utilization of family labour

Category	Score range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Low	Upto 48.99	12 (12.24)	9 (13.85)	8 (17.78)	29 (13.94)
Medium	49.00-73.33	69 (70.41)	44 (67.69)	32 (71.11)	145 (69.71)
High	73.34-100.00	17 (17.35)	12 (18.46)	5 (11.11)	34 (16.35)
Mean score		59.21	61.69	64.18	61.16
S.d.		14.01	15.14	15.65	12.17
C.V.		23.66	24.54	24.24	19.90

* Figures within parentheses indicate percentage

Table 4.1.6 Distribution of respondents according to their availability of working capital

Category	Range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Low	Upto Rs. 1880.00	21 (21.43)	6 (9.23)	1 (2.22)	28 (13.46)
Medium	Rs. 1881.00-3760.00	74 (75.51)	46 (70.77)	26 (57.78)	146 (70.19)
High	Above Rs. 3760.00	3 (3.06)	13 (20.00)	18 (40.00)	34 (16.35)
Mean		1798.02	3462.65	4117.96	2820.35
S.d.		551.28	862.63	1439.82	940.59
C.V.		30.66	25.03	34.96	33.35

* Figures within parentheses indicate percentage

per cent with high utilization and 13.94 per cent with low utilization of their available family labour.

The mean extent of utilization of family labour was highest by medium farmers (64.18%) category followed by small (61.69%) and marginal (59.21%) farmers category.

The values of coefficients of variation indicated that all farmers were relatively more homogeneous with respect to utilization of their available family labour.

The findings indicated that a considerable portion of the available family labour remained unutilized in all the categories of farmers. In case of marginal farmers, about 40.79 per cent of their available family labour remained unutilized followed by 38.31 per cent in small farmers and 35.82 per cent in medium farmers.

4.1.6 Availability of working capital

A perusal of the Table 4.1.6 reveals that 75.51 per cent of the marginal farmers had a medium level of working capital availability in the range of Rs. 1881.00 to Rs.3760.00 per annum, followed by 21.43 per cent with low level of working capital availability i.e. Rs. 1880.00 per annum. Only 3.06 per cent of the marginal farmers had high level of working capital availability i.e. Rs. 3760.00 per annum.

In case of small farmers, 70.77 per cent had medium level of working capital availability followed by 20.00 per cent with high and 9.23 per cent with low level of working capital availability.

As regards medium farmers, 57.78 per cent respondents had medium level of working capital availability. While 40.00 per cent had high level of working capital availability, only 2.22 per cent were found with low level of working capital availability.

The mean annual working capital availability was highest in medium farmers category (Rs. 4117.96) followed by small (Rs.3462.65) and marginal (Rs.1798.02) farmers category. In the pooled sample of farmers the mean annual working capital availability was Rs. 2820.35

The values of coefficients of variation indicated that medium farmers (34.96) were relatively more heterogeneous as compared to marginal (30.66) and small (25.03) farmers with respect to their availability of working capital.

4.1.7 Age

Table 4.1.7 reveals that majority of the farmer respondents in all the categories belonged to the middle age category the figures being 47.96, 58.46 and 46.67 per cent for marginal, small and medium farmers respectively. In case of marginal and small farmers, a sizeable proportion of them were in young age category, i.e. 34.69 and 33.85 per cent respectively. In case of medium farmers, one third (33.33%) of them were in old age category followed by one-fifth (20.00%) in the young age category. In the pooled sample of farmers, majority of them (50.96%) were in middle age category followed by 31.25 per cent in young age and 17.79 per cent in old age category.

The mean age values indicated that on an average the farmer respondents belonged to middle age category. The values of coefficients of variation indicated that l farmer respondents were relatively homogeneous with respect to their age.

4.1.8 Education level

A perusal of the Table 4.1.8 reveals that majority (59.18%) of the marginal farmer respondents were illiterate meaning thereby they did not have any formal education followed by 12.25 per cent with middle school level of education and 11.23 per cent with primary level of education. Nine respondents (9.18%) were in can read only category indicating little exposure to formal education. Only 4.08 per cent of the marginal farmer respondents were found with high school level of education followed by 3.06 per cent with higher secondary level of education. A negligible 1.02 per cent of them had degree level of education.

As regards small farmers, majority of them (52.31%) were illiterate followed by 10.77 per cent with middle school level of education. The proportions of small farmer respondents with primary level and high school level education were equal, the figure being 9.23 per cent. An equal percentage of them were in can read only category. Only 6.15 per cent of them were found with higher secondary level of education followed by 3.08 per cent with degree level of education

Table 4.1.7 Distribution of respondents according to their age

Category	Range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Young	18-35 years	34 (34.69)	22 (33.85)	9 (20.00)	65 (31.25)
Middle aged	36-50 years	47 (47.96)	38 (58.46)	21 (46.67)	106 (50.96)
Old aged	51-70 years	17 (17.85)	5 (7.69)	15 (33.33)	37 (17.79)
Mean score		47.67	46.86	48.95	47.70
S.d.		12.85	11.15	12.82	11.86
C.V.		26.96	23.79	26.19	24.86

* *Figures within parentheses indicate percentage*

Table 4.1.8 Distribution of respondents according to their level of education

Category	Score	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Illiterate	0	58 (59.18)	34 (52.31)	11 (24.44)	103 (49.52)
Can read only	1	9 (9.18)	6 (9.23)	2 (4.44)	17 (8.17)
Can read and write or priming level	2	11 (11.23)	6 (9.23)	7 (15.56)	24 (11.54)
Middle school level	3	12 (12.25)	7 (10.77)	8 (17.78)	27 (12.98)
High school level	4	4 (4.08)	6 (9.23)	6 (13.33)	16 (7.69)
Higher Secondary/ PU level	5	3 (3.06)	4 (6.15)	7 (15.56)	14 (6.73)
Graduate/Diploma and above	6	1 (1.02)	2 (3.08)	4 (8.89)	7 (3.37)
Mean score		1.06	1.46	2.73	1.55
S.d.		1.51	1.84	2.00	1.85
C.V.		142.45	126.03	73.26	119.35

* Figures within parentheses indicate percentage

In case of medium farmers, 24.44 per cent of them were illiterate, followed by 17.78 per cent with middle school level of education. The proportion of respondents with primary level of education and higher secondary level education were equal, the figure being 15.56 per cent. However, percentages of medium farmers with the high school level education and degree level education were higher as compared to marginal and small farmers the figures being 13.33 per cent and 8.89 per cent respectively.

The mean education scores were very low in all the categories of farmers, the figures being 1.06, 1.46 and 2.73 for marginal, small and medium farmers, indicating a very low exposure of the respondents to formal education.

The values of coefficients of variation indicated that farmer respondents were highly heterogeneous with respect to their education level. The highest value of coefficients of variation (142.45) was found in marginal farmers category followed by small (126.03) and medium (73.26) farmers category.

4.1.9 Type of family

The distribution of respondents according to their family type can be seen in Table 4.1.9. It is evident from the table that majority of the farmer respondents in all the categories had single family, the figures being 79.59, 80.00 and 60.00 per cent for marginal, small and medium farmers respectively. The remaining proportions of them were found to have joint family, the figures being 20.41, 20.00 and 40.00 per cent for marginal, small and medium farmers respectively.

In the pooled sample also, majority of the farmer respondents (75.48%) were found to have single family and rest (24.52%) had joint family.

The values of coefficients of variation indicated that medium farmers were relatively heterogeneous (34.29) as compared to marginal (33.33) and small (33.33) farmers with respect to their type of family.

4.1.10 Size of family

Table 4.1.10 reveals that majority of the respondents in all the categories had large size of family, the figures being 64.29, 67.69 and 77.78 per cent for marginal, small and medium farmers respectively. The remaining proportions of them had small

Table 4.1.9 Distribution of respondents according to their type of family

Category	Score	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Single	1	78 (79.59)	52 (80.00)	27 (60.00)	157 (75.48)
Joint	2	20 (20.41)	13 (20.00)	18 (40.00)	51 (24.52)
Mean score		1.20	1.20	1.40	1.25
S.d.		0.40	0.40	0.48	0.43
C.V.		33.33	33.33	34.29	34.40

* Figures within parentheses indicate percentage

Table 4.1.10 Distribution of respondents according to their size of family

Category	Range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Small	Upto 5 members	35 (35.71)	21 (32.31)	10 (22.22)	66 (31.73)
Large	More than 5 members	63 (64.29)	44 (67.69)	35 (77.78)	142 (68.27)
Mean score		6.18	6.40	6.46	6.31
S.d.		2.22	2.42	2.50	2.35
C.V.		35.92	37.81	38.70	37.24

* Figures within parentheses indicate percentage

size family, the figures being 35.71, 32.31 and 22.22 per cent for marginal, small and medium farmers respectively. In the pooled sample of farmers, majority (68.27%) of the respondents had large size family and rest (31.73%) had small size family.

The averages of family size were 6.18, 6.40 and 6.46 for marginal, small and medium farmers respectively. The overall mean family size was 6.31.

The values of coefficients of variation indicated that medium farmers were relatively more heterogeneous (38.70) as compared to marginal (35.92) and small (37.81) farmers with respect to their family size.

4.1.11 Social participation

It is clear from the Table 4.1.11 that majority of the marginal farmer respondents (57.15%) were member of one organization followed by 11.22 per cent with membership in more than one organization. A sizeable proportion of them (29.59%), however, had no membership in any organization. Only 2.04 per cent of them were office bearers of Village Development Committee.

As regards small farmers, 43.08 per cent were member of one organization followed by 21.54 per cent with membership in more than one organization. A sizeable proportion of them (29.23%) had no membership in any organization. Only 6.15 per cent of them were office bearers of such organization as Village Development Committee and *Pathar Parichalana Samity* (Field Management Committee).

As regards medium farmers, 37.78 per cent had membership in more than one organization followed by 35.56 per cent with membership in one organization. A sizeable proportion of them (13.33%) were office bearers of such organization as Village Development Committee, *Pathar Parichalana Samity* and Village Panchayat.

The values of coefficients of variation indicated that small farmers (43.92) were relatively more heterogeneous as compared to marginal (38.84) and medium (40.23) farmers with respect to their social participation. The highest value of coefficient of variation (79.05) was obtained in the pooled sample of framers indicating considerable heterogeneity amongst the farmer respondents with respect to their social participation.

Table 4.1.11 Distribution of respondents according to their social participation

Category	Score	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
No membership	0	29 (29.59)	19 (29.23)	6 (13.33)	54 (25.96)
Membership in one organization	1	56 (57.15)	28 (43.08)	16 (35.56)	100 (48.08)
Membership in more than one organization	2	11 (11.22)	14 (21.54)	17 (37.78)	42 (20.19)
Office bearers	3	2 (2.04)	4 (6.15)	6 (13.33)	12 (5.77)
Mean score		1.21	1.48	1.74	1.05
S.d.		0.47	0.65	0.70	0.83
C.V.		38.84	43.92	40.23	79.05

* Figures within parentheses indicate percentage

4.1.12 Innovation proneness

A perusal of the Table 4.1.12 reveals that majority of the marginal farmer respondents (55.10%) had low innovation proneness followed by 37.76 per cent with medium innovation proneness. Only 7.14 per cent of them were found with high innovation proneness.

As regards small farmers, majority of them (53.85%) were with low innovation proneness followed by 35.38 per cent with medium innovation proneness and 10.77 per cent with high innovation proneness.

In case of medium farmers, equal proportion of them (40.00%) were found with low and high innovation proneness followed by 20.00 per cent with medium innovation proneness.

In the pooled sample of farmers, majority of the respondents (51.44%) were in the low innovation proneness category followed by 33.17 per cent with medium innovation proneness and 15.38 per cent with high innovation proneness. The lowest mean innovation proneness score (4.61) was obtained in marginal farmers category and highest (6.03) in medium farmers category. All the mean scores, however, indicated medium innovation proneness.

The values of coefficients of variation indicated that respondents were relatively homogeneous with respect to their innovation proneness. However, medium farmers were relatively less homogeneous (30.18) as compared to small (27.54) and marginal (26.25) farmers with respect to their innovation proneness.

4.1.13 Economic motivation

Table 4.1.13 reveals that majority of the respondents in all the categories had medium economic motivation. In case of marginal farmers, 79.59 per cent were found to have medium economic motivation followed by 14.29 per cent with low economic motivation. Only 6.12 per cent of them had high economic motivation.

As regards small farmers, 64.62 per cent of them had medium economic motivation followed by 24.61 per cent with high and 10.77 per cent with low economic motivation.

Table 4.1.12 Distribution of respondents according to their innovation proneness

Category	Score range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Low	3-4	54 (55.10)	35 (53.85)	18 (40.00)	107 (51.44)
Medium	5-7	37 (37.76)	23 (35.38)	9 (20.00)	69 (33.17)
High	8-9	7 (7.14)	7 (10.77)	18 (40.00)	32 (15.38)
Mean score		4.61	5.12	6.03	5.08
S.d.		1.21	1.41	1.82	1.51
C.V.		26.25	27.54	30.18	29.72

* Figures within parentheses indicate percentage

Table 4.1.13 Distribution of respondents according to their economic motivation

Category	Score range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Low	6-26	14 (14.29)	7 (10.77)	3 (6.67)	24 (11.54)
Medium	27-34	78 (79.59)	42 (64.62)	26 (57.78)	146 (70.19)
High	35-42	6 (6.12)	16 (24.61)	16 (35.55)	38 (18.27)
Mean score		28.17	30.81	32.18	29.86
S.d.		5.31	4.97	3.82	3.71
C.V.		18.85	16.13	11.87	12.42

* Figures within parentheses indicate percentage

Table 4.1.14 Distribution of respondents according to their scientific orientation

Category	Score range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Low	6-19	49 (50.00)	26 (40.00)	18 (40.00)	93 (44.71)
Medium	20-37	39 (39.80)	20 (30.77)	8 (17.78)	67 (32.21)
High	38-42	10 (10.20)	19 (29.23)	19 (42.22)	48 (23.08)
Mean score		27.45	28.01	30.54	28.22
S.d.		9.06	8.71	9.01	8.96
C.V.		33.01	31.10	29.50	31.75

* Figures within parentheses indicate percentage

In case of medium farmers, 57.78 per cent of them were found to have medium level of economic motivation followed by 35.55 per cent with high and 6.67 per cent with low economic motivation.

The highest mean economic motivation score (32.18) was obtained in medium farmers category and lowest (28.17) in marginal farmers category. But all the mean scores came in the medium category of economic motivation.

The values of coefficients of variation indicated that marginal farmers were relatively homogeneous (18.85) as compared to small (16.13) and medium (11.87) farmers with respect to their economic motivation. However, the degree of homogeneity was more among the medium farmers.

4.1.14 Scientific orientation

Table 4.1.14 reveals that half of the marginal farmer respondents (50.00%) had low scientific orientation followed by 39.80 per cent with medium scientific orientation. Only 10.20 per cent of them were found to have high scientific orientation.

As regards small farmers, 40.00 per cent of them were with low scientific orientation followed by 30.77 per cent with medium and 29.23 pr cent with high scientific orientation.

In case of medium farmers, 42.22 per cent of them had high scientific orientation followed by 40.00 per cent with low and 17.78 per cent with medium scientific orientation.

The highest mean scientific orientation score (30.54) was obtained for medium farmers and lowest (27.45) for marginal farmers. All the mean scores indicated medium level of scientific orientation.

The values of coefficients of variation indicated that marginal farmers had more variability (33.01) as compared to small (31.10) and medium (29.50) farmers with respect to their scientific orientation.

4.1.15 Risk orientation

A perusal of the Table 4.1.15 reveals that majority of the farmer respondents in all the categories had medium risk orientation, the figures being 70.41,

Table 4.1.15 Distribution of respondents according to their risk orientation

Category	Score range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Low	6-20	24 (24.49)	15 (23.08)	5 (11.11)	44 (21.15)
Medium	21-28	69 (70.41)	44 (67.69)	28 (62.22)	141 (67.79)
High	29-42	5 (5.10)	6 (9.23)	12 (26.67)	38 (11.06)
Mean score		23.53	24.92	27.31	24.74
S.d.		4.52	4.61	3.98	3.83
C.V.		19.21	18.50	14.57	15.48

* Figures within parentheses indicate percentage

Table 4.1.16 Distribution of respondents according to their level of aspiration

Category	Score range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Low	0-21	20 (20.40)	10 (15.38)	5 (11.11)	35 (16.83)
Medium	22-37	60 (61.22)	37 (56.93)	17 (37.78)	114 (54.80)
High	38-44	18 (18.37)	18 (27.69)	23 (51.11)	59 (28.37)
Mean score		28.61	28.92	32.73	29.60
S.d.		7.31	7.68	7.81	7.98
C.V.		25.55	26.56	23.86	26.96

* Figures within parentheses indicate percentage

67.69 and 62.22 per cent for marginal, small and medium farmers respectively. In the pooled sample also, 67.79 per cent of the respondents were found with medium risk orientation.

In case of marginal farmers 24.49 per cent of them had low risk orientation followed by only 5.10 per cent with high risk orientation.

As regards small farmers, 23.08 per cent of them were with low risk orientation followed by 9.23 per cent with high risk orientation.

In case of medium farmers, however, the percentage of respondents in the high risk orientation category (26.67%) was higher than their percentage in the low risk orientation category (11.11%).

In the pooled sample of farmers, 21.15 per cent of the respondents were found with low risk orientation followed by 11.06 per cent with high risk orientation.

The highest mean risk orientation score (27.31) was obtained for medium farmers and lowest (23.53) for marginal farmers. All the mean scores indicated medium level of risk orientation. However, an increase in risk orientation score was observed with increase in land holding size.

The values of coefficients of variation indicated that respondents were relatively more homogeneous with respect to their risk orientation. Rainfed farming systems are complex and less reliable. So reducing risk is an important objective for farmers of rainfed areas, particularly the small and marginal farmers. This risk averse nature may be attributed to low and medium risk orientation of the respondents.

4.1.16 Level of aspiration

Table 4.1.16 reveals that majority (61.22%) of the marginal farmers had medium level of aspiration followed by 20.40 per cent with low level and 18.37 per cent with high level of aspiration.

As regards small farmers, majority of them (56.93%) had medium level of aspiration followed by 27.69 per cent with high and 15.38 per cent with low level of aspiration.

In case of medium farmers, majority of them (51.11%) had high level of aspiration followed by 37.78 per cent with medium and 11.11 per cent with low level of aspiration.

In the pooled sample of farmers, majority of the respondents (54.80%) were found to have medium level of aspiration followed by 28.37 per cent with high and 16.83 per cent with low level of aspiration.

The highest mean aspiration score (32.73) was obtained for medium farmers and lowest (28.61) for marginal farmers.

The values of coefficients of variation indicated homogeneity among the respondents with respect to their level of aspiration.

4.1.17 Orientation towards competition

Table 4.1.17 reveals that majority of the farmer respondents in all the categories had medium orientation towards competition, the figures being 75.52, 63.08 and 66.67 per cent for marginal, small and medium farmers, respectively. In the pooled sample also, majority of the respondents (69.71%) were found with medium orientation towards competition.

In case of marginal farmers, the percentage of respondents with low orientation towards competition was equal with their percentage in the high orientation towards competition category, the figures being 12.24 per cent.

As regards small farmers, 24.61 per cent of them had high orientation towards competition followed by 12.31 per cent with low orientation towards competition.

In case of medium farmers, 22.22 per cent of them were with high orientation towards competition followed by 11.11 per cent with low orientation towards competition. In the pooled sample too, the percentage of respondents (18.27%) with high orientation towards competition was higher than their percentage (12.02%) in the low orientation towards competition category.

The highest mean score (15.91) with respect to this variable was obtained for medium farmers and lowest (14.62) for marginal farmers.

Table 4.1.17 Distribution of respondents according to their orientation towards competition

Category	Score range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Low	6-12	12 (12.24)	8 (12.31)	5 (11.11)	25 (12.02)
Medium	13-18	74 (75.52)	41 (63.08)	30 (66.67)	145 (69.71)
High	19-24	12 (12.24)	16 (24.61)	10 (22.22)	38 (18.27)
Mean score		14.62	15.87	15.91	15.28
S.d.		3.21	3.61	3.08	3.31
C.V.		21.96	22.75	19.36	21.66

* Figures within parentheses indicate percentage

Table 4.1.18 Distribution of respondents according to their management orientation

Category	Score range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Low	18-26	25 (25.51)	14 (21.54)	10 (22.22)	49 (23.56)
Medium	27-54	63 (64.29)	38 (58.46)	18 (40.00)	119 (57.21)
High	55-72	10 (10.20)	13 (20.00)	17 (37.78)	40 (19.23)
Mean score		36.92	39.01	44.95	40.26
S.d.		14.28	13.89	16.46	13.92
C.V.		38.68	35.61	36.62	34.58

* Figures within parentheses indicate percentage

Table 4.1.19 Distribution of respondents according to their [redacted] towards improved farm practices

Category	Score range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	**Total (N = 208)**
Less favourable	0-8	37 (37.76)	22 (33.85)	10 (22.22)	**69 (33.17)**
Moderately favourable	9-12	32 (32.45)	26 (40.00)	20 (44.44)	78 (37.50)
Highly favourable	13-14	29 (29.59)	17 (26.15)	15 (33.34)	61 (29.33)
Mean score		10.21	10.81	10.77	10.51
S.d.		2.81	2.47	2.51	2.48
C.V.		27.52	22.85	23.31	23.60

* Figures within parentheses indicate percentage

The values of coefficients of variation revealed that farmer respondents in all the farm size groups were relatively homogeneous with respect to their orientation towards competition.

4.1.18 Management orientation

A perusal of the Table 4.1.18 reveals that majority of the marginal farmer (64.29%) respondents had medium level of orientation towards management, followed by 25.51 per cent with low orientation and 10.20 per cent with high orientation towards management.

As regards small farmers, majority of them (58.46%) had medium orientation towards management followed by 21.54 per cent with low and 20.00 per cent with high management orientation.

In case of medium farmers, 40.00 per cent of them were found with medium level of orientation towards management followed by 37.78 per cent with high and 22.22 per cent with low management orientation.

In the pooled sample also, majority of the respondents had medium level of orientation towards management followed by 23.56 per cent with low and 19.23 per cent with high level of management orientation.

The highest mean score (44.95) was obtained for medium farmers and the lowest (36.92) for marginal farmers. All the mean scores indicated medium level of management orientation of the respondents. However, an increase in management orientation score was observed with increase in land holding size.

The values of coefficients of the variation revealed that marginal farmers (38.68) were relatively heterogeneous as compared to small (35.61) and medium (36.62) farmers with respect to their management orientation.

4.1.19 Attitude towards improved farm practices

A perusal of the Table 4.1.19 reveals that 37.76 per cent of the marginal farmer respondents had less favourable attitude towards improved farm practices, followed by 32.45 per cent with moderately favourable and 29.59 per cent with highly favourable attitude towards improved farm practices.

As regards small farmers, 40.00 per cent of them had moderately favourable attitude towards improved farm practices followed by 33.85 per cent with less favourable and 26.15 per cent with highly favourable attitude towards improved farm practices.

In case of medium farmers, 44.44 per cent of them were found to have moderately favourable attitude towards improved farm practices. However, one-third of them (33.34%) were found to have highly favourable attitude followed by 22.22 per cent with less favourable attitude towards improved farm practices.

In the pooled sample, 37.50 per cent had moderately favourable attitude towards improved farm practices followed by 33.17 per cent with less favourable and 29.33 per cent with highly favourable attitude towards improved farm practices.

The highest mean attitude score (10.81) was obtained for small farmers and lowest (10.21) for marginal farmers.

The values of coefficients of variation revealed that respondents in all the farm size groups were relatively homogeneous with respect to their attitude towards improved farm practices.

4.1.20 Knowledge level on improved agricultural technology

A perusal of the Table 4.1.20 reveals that majority of the respondents in all the farm size groups had medium level of knowledge on improved agricultural technology, the figures being 82.66, 67.69 and 66.67 per cent for marginal small and medium farmers, respectively. In the pooled sample of farmers, majority of the respondents (74.52%) were found to have medium level of knowledge on improved agricultural technology.

In case of marginal farmers 9.18 per cent of them were found to have low level of knowledge on improved agricultural technology. Only 8.16 per cent of them were found with high level of knowledge on improved agricultural technology.

As regards small farmers, a sizeable proportion of them (24.62%) had high level of knowledge on improved agricultural technology followed by 7.69 per cent with low level of knowledge on improved agricultural technology.

Table 4.1.20 Distribution of respondents according to their level of knowledge on agricultural technology

Category	Score range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Low	0-7	9 (9.18)	5 (7.69)	3 (6.67)	17 (8.17)
Medium	8-19	81 (82.66)	44 (67.69)	30 (66.67)	155 (74.52)
High	20-38	8 (8.16)	16 (24.62)	12 (26.66)	36 (17.31)
Mean score		11.21	13.52	14.64	12.75
S.d.		4.68	6.92	7.44	6.20
C.V.		41.75	51.18	50.82	48.63

* Figures within parentheses indicate percentage

In case of medium farmers a sizeable proportion of them (26.66%) were found to have high level of knowledge on improved agricultural technology followed by only 6.67 per cent with low level of knowledge on improved agricultural technology.

The highest mean knowledge score (14.64) was obtained for medium farmers and lowest (11.21) for marginal farmers. The overall mean knowledge score was 12.75.

The values of coefficients of variation indicated that small farmers (51.18) were relatively heterogeneous as compared to marginal (41.75) and medium (50.82) farmers with respect to their knowledge level on improved agricultural technology.

4.1.21 Degree of information exposure

Table 4.1.21A shows the distribution of respondents according to their use of different sources of information. Amongst the personal cosmopolite sources of information, input dealer was used often by majority of the respondents in all the categories, the figures being 76.54, 80.00 and 77.78 per cent for marginal, small and medium farmers, respectively. In the pooled sample also, majority of the respondents (78.37%) used input dealers often for getting information about the use of improved farming practices.

Amongst the personal localite sources, fellow farmers, neighbours or relatives emerged to be the next important source of information for the respondents. A sizeable proportion of the respondents in all the categories utilized fellow farmers, neighbours or relatives often for getting information about the use of improved farm practices, the figures being 33.67, 30.77 and 33.33 per cent for marginal, small and medium farmers respectively.

Amongst the mass media sources, newspaper was used often by a sizeable proportion of respondents in all the categories, the figures being 15.31, 15.38 and 22.22 per cent for marginal, small and medium farmers respectively.

It is clear from the table that majority of the farmer respondents utilized Village Level Extension Worker sometimes as their source of information, the figures being 57.14, 61.54 and 77.78 per cent for marginal, small and medium farmers,

Table 4.1.21A Distribution of respondents according to their use of different sources of information

Sl. No.	Sources of information	Frequency of use											
		Marginal (n = 98)			Small (n = 65)			Medium (n = 45)			Total (N = 208)		
		Often	Sometimes	Never	Often	Sometimes	Never	Often	Sometimes	Never	Often	Sometimes	Never
Personal cosmopolite													
1	VLEW	4 (4.08)	56 (57.14)	38 (38.78)	16 (24.61)	40 (61.54)	9 (13.85)	9 (20.00)	35 (77.78)	1 (2.22)	29 (13.94)	131 (62.98)	48 (23.08)
2	AEO	0 (-)	4 (4.08)	94 (95.92)	0 (-)	6 (9.23)	59 (90.77)	0 (-)	11 (24.44)	34 (75.56)	0 (-)	21 (10.10)	187 (89.90)
3	Block Extension Personnel	0 (-)	4 (4.08)	94 (95.92)	0 (-)	6 (9.23)	59 (90.77)	0 (-)	9 (20.00)	36 (80.00)	0 (-)	19 (9.13)	189 (90.87)
4	Agril. Scientist	0 (-)	0 (-)	98 (100.00)	0 (-)	2 (3.08)	63 (96.92)	0 (-)	3 (6.67)	42 (93.33)	0 (-)	5 (2.40)	203 (97.60)
5	Input dealers	75 (76.54)	19 (19.39)	3 (3.07)	52 (80.00)	12 (18.46)	1 (1.54)	35 (77.78)	9 (20.00)	1 (2.22)	163 (78.37)	40 (19.23)	5 (2.40)
Personal localite													
6	Family members	0 (-)	24 (24.49)	74 (75.51)	0 (-)	15 (23.07)	50 (76.93)	0 (-)	9 (20.00)	36 (80.00)	0 (-)	48 (23.08)	160 (76.92)
7	Fellow farmers/ Neighbours/ Relatives	33 (33.67)	65 (66.33)	0 (-)	20 (30.77)	45 (69.23)	0 (-)	15 (33.33)	30 (66.67)	0 (-)	68 (32.69)	140 (67.31)	0 (-)
Mass media													
8	Radio	8 (8.16)	20 (20.41)	70 (71.43)	8 (12.31)	18 (27.69)	39 (60.00)	7 (15.56)	23 (51.11)	15 (33.33)	23 (11.06)	61 (29.33)	124 (59.62)
9	Television	7 (7.14)	26 (26.53)	65 (66.33)	6 (9.23)	17 (26.15)	42 (64.62)	6 (13.33)	15 (33.33)	24 (53.34)	19 (9.13)	58 (27.88)	131 (62.99)
10	Newspaper	15 (15.31)	29 (29.59)	54 (55.10)	10 (15.38)	17 (26.15)	38 (58.46)	10 (22.22)	18 (40.00)	17 (37.78)	35 (16.83)	64 (30.77)	109 (52.40)
11	Farm publication	4 (4.08)	14 (14.29)	80 (81.63)	6 (9.23)	11 (16.92)	48 (73.85)	4 (8.89)	13 (28.89)	28 (62.22)	14 (6.73)	38 (18.27)	156 (75.00)

* Multiple responses were obtained

** Figures within parentheses indicate percentage respectively. The proportions of respondents who utilized Village Level Extension Worker often as their source of information were relatively low, the figures being 4.08, 24.61 and 20.00 per cent for marginal, small and medium farmers, respectively.

Although a few marginal (4.08%), small (9.23%) and medium (24.44%) farmers utilized Agricultural Extension Officer sometimes as their source of information, no respondent was found to utilize Agricultural Extension Officer often as their source of information. Similar was the case with Block Extension Personnel and Agricultural Scientists.

The findings reveal that most frequently used sources of information for marginal farmers were input dealers, fellow farmers, newspapers and radio. For small farmers, the most frequently used sources were input dealers, fellow farmers, Village Level Extension Worker, newspaper and radio. For medium farmers, the most frequently used sources were input dealers, fellow farmers, newspapers, Village Level Extension Worker, radio and television.

On the basis of frequency of use of different sources of information by farmers, their scores on degree of information exposure were calculated and they were categorized as low, medium and high users of information sources. The distribution of the respondents according to their degree of information exposure is presented in Table 4.1.21B.

A perusal of the Table 4.1.21B reveals that majority of the respondents in all the categories had medium degree of information exposure, the figures being 81.63, 73.85 and 80.00 per cent for marginal, small and medium farmers respectively. In the pooled sample too, majority of them (78.65%) had medium degree of information exposure.

In case of marginal farmers 13.26 per cent of them had low degree of information exposure followed by only 5.11 per cent with high degree of information exposure. As regards small farmers, however, the proportion of respondents with high degree of information exposure (18.46%) was higher than their proportion (7.69%) in the low degree of information exposure category. Similar was the case for medium farmers

Table 4.1.21B Distribution of respondents according to their degree of information exposure

Category	Score range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Low	0-9	13 (13.26)	5 (7.69)	2 (4.44)	20 (9.62)
Medium	10-15	80 (81.63)	48 (73.85)	36 (80.00)	164 (78.85)
High	16-22	5 (5.11)	12 (18.46)	7 (15.56)	24 (11.53)
Mean score		11.28	11.61	12.01	11.54
S.d.		2.97	3.01	3.14	2.91
C.V.		26.33	25.93	26.14	25.22

* Figures within parentheses indicate percentage

also, where 15.56 per cent had high degree of information exposure and only 4.44 per cent had low degree o information exposure.

The mean degree of information exposure score was highest (12.01) for medium farmers and lowest (11.28) for marginal farmers.

The values of coefficients of variations revealed that respondents were relatively homogeneous with respect to their degree of information exposure.

4.2 Enterprise mix in selected farming system across different size group of farms

It was observed that in general the farming system of a farmer consisted of several enterprises which include crops, livestock, fishery besides homestead activities. Although, it is typically a case of mixed farming yet the farming systems differed from farmer to farmer with respect to their combination of enterprises. The main crop activities identified in the study area were rice (*sali, ahu* and *boro*), wheat, mustard, potato, pea and summer and winter vegetables. Some of the crops which were grown in small scale were jute, sugarcane, lentil, maize, black gram, green gram, sesamum and arahar. Data collected revealed that among the crop activities rice was the principal crop which accounted for more than 50 per cent of the total cropped area. *Sali* was the most important of the three rice crops grown in the study area occupying about 71 per cent of the total rice area. *Ahu* rice was the next important rice crop occupying about 19 per cent of the total rice area. *Boro* was the third rice crop occupying about less than 10 per cent of the total rice area. Wheat was found to occupy about 3.10 per cent of the total cropped area. Mustard was found to occupy about 5.75 per cent of the total cropped area, followed by potato and pea occupying about 5.15 and 1.90 per cent of the total cropped area, respectively.

In this study, farming systems were identified based on the enterprises included in each farm family. Dominant enterprises were identified based on their contribution towards the total gross margin realized by a farm family from different enterprises. In the farming systems selected for this study, crop enterprise was found to contribute most towards the total gross margin obtained from each farming system. It was found that with crop as dominant enterprise, a number of other enterprises were also taken np by the sampled farm families. This resulted in several variation in the crop based farming systems selected for this study. The enterprise mix in different types of crop based

Table 4.2.1 Enterprise mix in different types of crop based farming system across different size group of farms

SL No.	Enterprise mix	Number of farmers: Marginal (n = 98)	Small (n=65)	Medium (n=45)	Total (N=208)	Average of total gross margin (Rs.)
1	2	3	4	5	6	7
1	Crop + Dairy + Fish + Duck + Pigeon	16	11	8	35	24315.01
	(78.20) (12.01) (6.80) (2.51) (0.48)	(16.32)	(16.92)	(17.77)	(16.82)	(I)
2	Crop + Dairy + Goat + Duck + Pigeon	11	6	6	23	22993.41
	(79.29) (12.75) (4.73) (2.72) (0.51)	(11.22)	(9.23)	(13.33)	(11.05)	(III)
3	Crop + Dairy + Goat + Fish + Duck	15	13	13	41	23006.20
	(83.16) (9.35) (3.86) (2.97) (0.66)	(15.31)	(20.00)	(28.89)	(19.71)	(II)
4	Crop + Dairy + Poultry + Duck + Pigeon	3	3	3	9	20956.42
	(78.10) (17.59) (2.01) (1.76) (0.54)	(3.06)	(4.61)	(6.66)	(4.32)	(VI)
5	Crop + Dairy + Poultry + Fish + Duck	5	2	2	9	21158.66
	(83.25) (15.70) (2.89) (2.25) (0.91)	(5.10)	(3.07)	(4.44)	(4.32)	(V)
6	Crop + Dairy + Goat + Poultry + Duck	4	3	1	8	20043.91
	(80.95) (13.30) (4.18) (1.01) (0.56)	(4.08)	(4.61)	2.22)	(3.84)	(X)
7	Crop + Dairy + Fish + Duck	3	4	1	8	20922.11
	(79.81) (14.06) (5.12) (1.01)	(3.06)	(6.15)	(6.66)	(4.80)	(VII)
8	Crop + Dairy + Goat	7	6	2	15	19607.41
	(78.65) (16.34) (5.01)	(7.14)	(9.23)	(4.44)	(7.21)	(XI)
9	Crop + Dairy	8	2	0	10	17631.66
	(82.04) (17.96)	(8.16)	(3.07)	(-)	(4.80)	(XVI)
10	Crop + Goat + Fish + Duck + Pigeon	3	2	0	5	18348.81
	(83.61) (8.77) (6.10) (0.91) (0.61)	(3.06)	(3.07)	(-)	(2.40)	(XIV)
11	Crop + Pig + Dairy + Poultry + Fish + Duck	3	2	1	6	20488.66
	(55.77) (31.58) (7.17) (2.21) (2.15) (1.12)	(3.06)	(3.07)	(2.22)	(2.88)	(IX)
12	Crop + Pig + Poultry + Fish + Pigeon	5	3	1	9	20663.41
	(60.30) (32.60) (3.14) (2.98) (0.98)	(5.10)	(4.61)	(2.22)	(4.32)	(VIII)
13	Crop + Pig + Fish + Poultry + Duck	3	1	2	6	21178.66
	(58.52) (26.58) (11.39) (2.31) (1.20)	(3.10)	(1.53)	(4.44)	(2.88)	(IV)
14	Crop + Pig + Goat + Fish + Poultry	3	1	1	5	19284.21
	(57.15) (30.41) (4.95) (4.85) (2.64)	(3.10)	(1.53)	(2.22)	(2.40)	(XII)
15	Crop + Fish + Poultry + Duck	3	1	1	5	18843.91
	(62.63) (29.82) (6.45) (1.10)	(3.10)	(1.53)	(2.22)	(2.40)	(XIII)
16	Crop + Pig + Fish	2	1	1	4	18057.91
	(54.30) (29.35) (16.34)	(2.04)	(1.53)	(2.22)	(1.92)	(XV)
17	Crop + Fish + Duck	2	2	0	4	16848.71
	(68.14) (26.73) (5.13)	(2.04)	(3.07)	(-)	(1.92)	(XVII)
18	Crop + Fish	2	2	0	4	16449.66
	(64.96) (35.04)	(2.04)	(3.07)	(-)	(1.92)	(XVIII)
	Mean					21470.90

* Figures within parentheses in column 2 indicate percentage contribution made by each enterprise towards average total gross margin

** Figures within parentheses in column 3,4,5 and 6 indicate percentage of farmers

*** Figures within parentheses in column 7 indicate ranks assigned based on average total gross margin farming systems across different size group of farms along with their contribution towards total gross margin are presented in Table 4.2.1.

A perusal of the Table 4.2.1 reveals that there were 18 different types of crop based farming systems among three size group of farms. The type of farming systems identified varied from 18 in marginal and small size groups to 14 in medium size group. Out of 18 farming systems identified, 14 were common in all the size group of farms and 18 were common in two size group of farms (marginal and small).

In the marginal size group of farms, 16.32 per cent of the farmers practised the system crop-diary-fish-duck-pigeon followed by the system crop-dairy-goat-fish-duck by 15.31 per cent and the system crop-dairy-goat-duck-pigeon by 11.22 per cent of the farmers. Out of the 18 farming systems identified, 7 types were practised by only 3 farmers each (3.10%) and 3 types were followed by 2 farmers each (2.04%).

In the small size group of farms, 20.00 per cent of the farmers practised the system crop-dairy-goat-fish-duck followed by the system crop-dairy-fish-duck-pigeon by 16.92 per cent of the farmers. The system crop-dairy-goat-duck-pigeon was practised by 9.23 per cent of the farmers. An equal proportion (9.23%) of the farmers were found to follow the system crop-dairy-goat. Out of the 18 farming systems identified, 6 types were practised by only two farmers (3.07%) and 4 types by only one farmer (1.53%).

In the medium size group of farms, 28.89 per cent of the respondent farmers practised the system crop-dairy-goat-fish-duck followed by the system crop-dairy-fish-duck-pigeon by 17.77 per cent of the farmers. The system crop-dairy-goat-duck-pigeon was followed by 13.33 per cent of the farmers. Out of 14 farming systems identified, 3 types were practised by only two (4.44%) farmers and 7 types by only one (2.22%) farmer.

The pooled data revealed that the highest percentage of the respondent farmers (19.71%) practised the system crop-dairy-goat-fish-duck followed by the system crop-dairy-fish-duck-pigeon by 16.82 per cent of the farmers and the system crop-dairy-goat-duck-pigeon by 11.05 per cent of the farmers.

The highest average total gross margin (Rs. 24315.01) was obtained from the sysrtem crop-dairy-fish-duck-pigeon followed by Rs. 23006.20 from the system crop-dairy-goat-fish-duck and Rs. 22993.40 from the system crop-dairy-goat-duck-pigeon. The lowest average total gross margin (Rs 16449.66) was obtained from the system crop-fish.

The contribution of crop enterprise towards total gross margin varied from 83.61 per cent (in the system crop-goat-fish-duck-pigeon) to 54.30 per cent (in the system crop-pig-fish).

The contribution of dairy enterprise towards total gross margin varied from 17.96 per cent (in the system crop-dairy) to 7.17 per cent (in the system crop-pig-dairy-poultry-fish-duck).

The contribution of fishery enterprise towards total gross margin varied from 35.04 per cent (in the system crop-fish) to 2.15 per cent (in the system crop-pig-dairy-poultry-fish-duck).

The contribution of goat enterprise towards total gross margin ranged between 8.77 per cent (in the system crop-goat-fish-duck-pigeon) and 3.86 per cent (in the system crop-dairy-goat-fish-duck).

The highest contribution towards total gross margin by duck enterprise (5.13%) was found in the system crop-fish-duck and lowest (0.56%) in the system crop-dairy-goat-poultry-duck.

The contribution of pigeon enterprise towards total gross margin was less than 1.00 per cent. The highest contribution towards total gross margin by pigeon enterprise (0.98%) was obtained in the system crop-pig-poultry-fish-pigeon and lowest (0.48%) in the system crop-dairy-fish-duck-pigeon.

The contribution of poultry enterprise towards total gross margin ranged between 6.45 per cent (in the system crop-fish-poultry-duck) and 1.01 per cent (in the system crop-dairy-goat-poultry-duck).

Pig enterprise was found to make a substantial contribution towards total gross margin of the farmers. The highest contribution towards total gross margin by pig enterprise (32.60%) was obtained in the system crop-pig-poultry-fish-pigeon and lowest (26.58%) in the system crop-pig-fish-poultry-duck.

4.3 Level of adoption of selected agricultural technology across different size group of farms

The level of adoption in the present study was measured for three selected agricultural technologies, *viz.*, high yielding variety seeds, chemical fertilizers and plant protection chemicals in respect of seven selected crops, *viz.*, *sali* rice, *ahu* rice, *boro* rice, wheat, mustard, potato and pea. Besides classifying the respondents as adopters and non-adopters, the measurement technique employed in this study gives an estimate of the level of adoption of each technology separately and also the overall pattern of extent of adoption for all the three technologies. The data regarding distribution of respondents as adopters of each technology with their distribution on various categories of level of adoption are presented in the following sub-sections.

4.3.1 Distribution of respondents as adopters of three selected agricultural technologies

The distribution of respondents as adopters of three selected agricultural technologies are shown in Table 4.3.1. It can be seen from the table that although the percentage of respondents adopting high yielding variety seeds and chemical fertilizers were relatively high in all the categories of farmers, the proportion of respondents adopting plant protection chemicals were relatively low.

In respect of high yielding variety seeds 83.67 per cent of the marginal farmers, 90.77 per cent of the small farmers and 100.00 per cent of the medium farmers were adopters of high yielding varieties with respect to seven selected crops.

In case of chemical fertilizers, 88.77 per cent of the marginal farmers, 90.77 per cent of the small farmers and 100.00 per cent of the medium farmers were found as adopters of chemical fertilizers.

In respect of plant protection chemicals, 39.80 per cent of the marginal farmers, 63.08 per cent of the small farmers and 61.54 per cent of the medium farmers were adopters of plant protection chemicals in seven selected crops. A sizeable proportion of the respondents were found as non-adopters of plant protection chemicals, figures being 60.20, 36.92 and 38.46 per cent for marginal, small and medium farmers, respectively.

Table 4.3.1 Distribution of respondents as adopters of three selected agricultural technologies

Sl. No.	Selected agricultural technology	Number of adopters			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
1	HYV seeds	82 (83.67)	59 (90.77)	45 (100.00)	193 (92.79)
2	*Chemical* fertilizers	87 (88.77)	59 (90.77)	45 (100.00)	191 (91.83)
3	Plant protection chemicals	39 (39.80)	41 (63.08)	40 (61.54)	120 (57.69)

* Figures within parentheses indicate percentage

The pooled data revealed a sizeable proportion of the respondents (42.31%) were non-adopters of plant protection chemicals followed by 8.17 per cent as non-adopters of chemical fertilizers and 7.21 per cent as non-adopters of high yielding varieties.

4.3.2 Distribution of respondents as adopters of HYV seeds in selected crops

Table 4.3.2 reveals that majority of the respondents farmers in all the farm size groups adopted high yielding variety seeds in *sali* rice, the figures being 83.67, 90.77 and 90.77 for marginal, small and medium farmers respectively. In case of *ahu* rice, 68.89 per cent of the medium farmers adopted high yielding variety seeds followed by 67.69 per cent of the small farmers and 60.20 per cent of the marginal farmers. As regards *boro* rice, majority of the medium farmers (66.67%) adopted high yielding variety seeds. The percentages of marginal and small farmers adopting high yielding variety seeds in *boro* rice were relatively low, the figures being 41.54 and 31.63 per cent for small and marginal farmers respectively.

In case of wheat cultivation, one-third of the medium farmers (33.33%) adopted high yielding variety seeds. However, less than one-fourth of the small (24.62%) and marginal (22.45%) farmers were adopters of high yielding variety seeds in wheat cultivation.

Although 60.00 per cent of the medium farmers were found to adopt high yielding variety seeds in mustard cultivation, the percentages of marginal and small farmers adopting high yielding variety mustard seeds were relatively low, the figures being 29.59 and 36.92 per cent for marginal and small farmers respectively.

A high majority of the medium farmers (88.89%) were found to use high yielding variety in potato cultivation followed by 47.69 per cent small and 39.80 per cent marginal farmers adopting high yielding potato variety.

The percentage of respondents adopting high yielding pea variety were very low, the figures being 26.66, 9.23 and 2.04 per cent for medium, small and marginal farmers respectively.

The pooled data revealed that highest percentage of respondents were adopters of high yielding variety seeds in *sali* rice (89.42%) followed by *ahu* rice

Table 4.3.2 Distribution of respondents as adopters of HYV seeds of selected crops

Sl. No.	Selected crops	Number of adopters				Mean adoption score
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)	
1	*Sali* rice	82 (83.67)	59 (90.77)	45 ~~(90.77)~~ 100.00	186 (89.42)	48.09
2	*Ahu* rice	59 (60.20)	44 (67.69)	31 (68.89)	134 (64.42)	47.85
3	*Boro* rice	31 (31.63)	27 (41.54)	30 (66.67)	88 (42.31)	46.36
4	Wheat	22 (22.45)	16 (24.62)	15 (33.33)	53 (25.48)	33.41
5	Mustard	29 (29.59)	24 (36.92)	27 (60.00)	80 (38.75)	38.17
6	Potato	39 (39.80)	31 (47.69)	40 (88.89)	110 (52.88)	36.10
7	Pea	2 (2.04)	6 (9.23)	12 (26.66)	20 (9.62)	44.20

* Figures in the parentheses indicate percentage

(64.42%), potato (52.88%), *boro* rice (42.31%), mustard 38.75%), wheat (25.48%) and pea (9.62%).

The highest mean adoption score was obtained in *sali* rice (48.09%) followed by *ahu* rice (47.85), *boro* rice (46.36), pea (44.20), mustard (38.1), potato (36.10) and wheat (33.41). The mean adoption scores indicated that all the respondents adopted high yielding varieties in less than fifty per cent of their areas having potential for use of high yielding varieties with respect to seven selected crops.

4.3.3 Distribution of respondents as adopters of chemical fertilizers in selected crops

Table 4.3.3 reveals that all the medium farmers (100.00%) and majority of the marginal (87.76%) and small (90.76%) farmers used chemical fertilizers in *sali* rice cultivation. As regards *ahu* rice, majority of the farmer respondents in three farm size groups used chemical fertilizers, the figures being 60.20, 70.77 and 68.89 per cent for marginal, small and medium farmers, respectively. In case of *boro* rice, although majority of the medium farmers (66.67%) used chemical fertilizers, the percentage of small and marginal farmers using chemical fertilizers in *boro* rice were relatively low, the figures being 41.54 and 34.69 per cent for small and marginal farmers rspectively.

As regards wheat, one-third of the medium farmers (33.33%) were found as adopters of chemical fertilizers, followed by 32.31 per cent small and 26.53 per cent marginal farmers. In case of mustard, majority of the medium farmers (60.00%) used chemical fertilizers followed by 44.61 per cent small and 39.79 per cent marginal farmers.

A high majority (88.89%) of the medium farmers were found to use chemical fertilizers in potato cultivation followed by 67.69 per cent small and 67.35 per cent marginal farmers.

In case of pea cultivation, the proportion of respondents using chemical fertilizers was negligible, the figures being 2.04, 4.62 and 4.44 per cent for marginal, small and medium farmers respectively.

The highest mean adoption score was obtained in *boro* rice (47.36%) followed by *ahu* rice (46.92), *sali* rice (43.68), wheat (41.67), potato (41.41), mustard (40.30) and pea (39.45). The mean adoption scores indicated that all the respondents used

Table 4.3.3 Distribution of respondents as adopters of chemical fertilizers in selected crops

Sl. No.	Selected crops	Number of adopters				Mean adoption score
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)	
1	*Sali* rice	86 (87.76)	59 (90.76)	45 (100.00)	190 (91.35)	43.68
2	*Ahu* rice	59 (60.20)	46 (70.77)	31 (68.89)	136 (65.38)	46.92
3	*Boro* rice	34 (34.69)	27 (41.54)	30 (66.67)	91 (43.75)	47.36
4	Wheat	26 (26.53)	21 (32.31)	15 (33.33)	62 (29.81)	41.67
5	Mustard	39 (39.79)	29 (44.61)	27 (60.00)	95 (45.67)	40.30
6	Potato	66 (67.35)	44 (67.69)	40 (88.89)	150 (72.12)	41.41
7	Pea	2 (2.04)	3 (4.62)	2 (4.44)	7 (3.37)	39.45

* Figures within parentheses indicate percentage

chemical fertilizers in less than fifty per cent of their areas having potential for using chemical fertilizers with respect to seven selected crops.

4.3.4 Distribution of respondents as adopters of plant protection chemicals in selected crops

A perusal of the Table 4.3.4 reveals that the proportions of respondents adopting plant protection chemicals in seven selected crops were relatively low in all the size group farms.

In respect of marginal farmers, the highest percentage of respondents (31.63%) used chemical pesticides in mustard crop, followed by 26.53 per cent in *sali* rice and potato each, 17.35 per cent in *boro* rice, 12.24 per cent in *ahu* rice and 6.12 per cent in wheat. No marginal farmer respondent used chemical pesticides in the pea crop.

As regards small farmers highest percentage of them (43.08%) used chemical pesticides in *sali* rice, followed by 33.85 per cent in potato, 32.31 pr cent in mustard, 24.62 per cent in *ahu* rice and 20.00 per cent in *boro* rice. Less than twenty per cent of them were found to use chemical pesticides in wheat (16.92%). Only one small farmer respondent (1.54%) was found to use chemical pesticides in pea crop.

In respect of medium farmers, majority of them (68.89%) used chemical pesticides in mustard crop followed by 48.89 per cent in *sali* rice, 46.67 per cent in potato and 40.00 per cent in *ahu* rice. An equal proportion of them (31.11%) used chemical pesticides in *boro* rice and wheat. Only three medium farmers (6.67%) were found to use chemical pesticides in pea crop.

The pooled data revealed that highest proportion of the respondents (39.90%) used chemical pesticides in mustard crop followed by 36.54 per cent in *sali* rice and 33.17 per cent in potato crop. During data collection, it was reported by a few mustard growing farmers that there was high infestation of their mustard crops by aphid (*Lipaphis erysimi*) which may be attributed to the higher percentage of respondents using chemical pesticides in mustard crop. It was also reported by a few rice growing farmers that severe damage to their rice crop was caused by hispa (*Dicladispa armigera*) at early and mid tillering stage which may be a cause of relatively high percentage of adopters of pesticides in rice crops, particularly in *sali* rice crop. Infestation of potato crop by late blight disease

Table 4.3.4 Distribution of respondents as adopters of plant protection chemicals in selected crops

Sl. No.	Selected crops	Number of adopters				Mean adoption score
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)	
1	*Sali* rice	26 (26.53)	28 (43.08)	22 (48.89)	76 (36.54)	24.38
2	*Ahu* rice	12 (12.24)	16 (24.62)	18 (40.00)	46 (22.12)	23.19
3	*Boro* rice	17 (17.35)	13 (20.00)	14 (31.11)	44 (21.15)	18.78
4	Wheat	6 (6.12)	11 (16.92)	14 (31.11)	31 (14.90)	12.76
5	Mustard	31 (31.63)	21 (32.31)	31 (68.89)	83 (39.90)	21.18
6	Potato	26 (26.53)	22 (33.85)	21 (46.67)	69 (33.17)	18.81
7	Pea	0 (-)	1 (1.54)	3 (6.67)	4 (1.92)	16.73

in the study area might be a cause for relatively higher percentage of adopters of chemical pesticides in potato crop.

The mean adoption score was highest (24.38%) in *sali* rice followed by *ahu* rice (23.19), mustard (21.18), potato (18.81), *boro* rice (18.78), pea (16.73) and wheat (12.76). The mean adoption scores indicated that all the respondents used chemical pesticides in less than 25 per cent of their areas having potential for using chemical pesticides with respect to seven selected crops.

4.3.5 Distribution of respondents according to their level of adoption of HYV seeds

Besides classifying respondents as adopters of three selected agricultural technologies as shown in the preceding sub-sections, the level of adoption of these selected agricultural technology was estimated separately for each technology. The distribution of respondents according to their level of adoption of high yielding variety seeds is presented in Table 4.3.5.

A perusal of the Table 4.3.5 reveals that majority of the respondents in all the three farm size groups had medium level of adoption of high yielding variety seeds, the figures being 69.39, 70.77 and 66.66 per cent for marginal, small and medium farmers respectively.

In case of marginal farmers 25.51 per cent of them had low level of adoption of high yielding variety seeds. Only 5.10 per cent of them were found to have high level of adoption of high yielding variety seeds.

In respect of small farmers, 18.46per cent were in low category of level of adoption of high yielding variety seeds followed by 10.77 per cent with high level of adoption of high yielding variety seeds.

As regards medium farmers, the proportion of respondents in the high level of adoption category (17.78%) was slightly higher than their proportion in the low category of level of adoption (15.56%).

The pooled data revealed that majority of the respondents (68.75%) had medium level of adoption of high yielding variety seeds followed by 21.15 per cent with low and 10.10 per cent with high level of adoption.

Table 4.3.5 Distribution of respondents according to their level of adoption of HYV seeds

Category	Adoption score range	Number of farmers			
		Marginal (n = 98)	*Small* (n = 65)	*Medium* (n = 45)	Total (N = 208)
Low	Upto 31.00	25 *(25.51)*	12 *(18.46)*	7 (15.56)	44 (21.15)
Medium	31.01 - 61.00	68 (69.39)	46 (70.77)	30 (66.66)	144 (68.75)
High	61.01 - 100.00	5 (5.10)	7 (10.77)	8 (17.78)	20 (10.10)
Mean adoption score		43.09	48.62	49.37	46.18
S.d.		15.18	14.63	14.71	14.98
C.V.		35.23	30.09	29.80	32.44

* Figures within parentheses indicate percentage

The highest mean adoption score (49.37) obtained for medium farmers and lowest (43.09) for marginal farmers.

The values of coefficients of variation indicated that marginal farmers were relatively more heterogeneous (35.23) as compared to small (30.09) and medium (29.80) farmers with respect to their level of adoption of high yielding variety seeds.

4.3.6 Distribution of respondents according to their level of adoption of chemical fertilizers

Table 4.3.6 reveals that majority of the respondents in all the three farm size groups had medium level of adoption of chemical fertilizers, the figures being 67.37, 72.31 and 71.11 per cent for marginal, small and medium farmers respectively.

A sizeable proportion of the marginal farmers (27.55%) had low level of adoption of chemical fertilizers. Only 5.10 per cent of them were found to have high level of adoption of chemical fertilizers.

As regards small farmers, 20.00 per cent of them were found to have low level of adoption followed by only 7.69 per cent with high level of adoption of chemical fertilizers.

As regards, medium farmers, 15.56 per cent of them were found to have low level of adoption of chemical fertilizers followed by 13.33 per cent with high level of adoption.

The pooled data revealed that majority of the farmer respondents were with medium level of adoption followed by 22.60 per cent low and only 7.69 per cent with high level of adoption.

The highest mean adoption score (49.21) was obtained for medium farmers and lowest (42.29) for marginal farmers.

The values of coefficients of variation indicated that marginal farmers were relatively more heterogeneous (34.71) as compared to small (31.69) and medium (28.73) farmers with respect to their level of adoption of chemical fertilizers.

Table 4.3.6 Distribution of respondents according to their level of adoption of chemical fertilizers

Category	Adoption score range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Low	Upto 30.00	27 (27.55)	13 (20.00)	7 (15.56)	47 (22.60)
Medium	30.01 - 60.00	66 (67.35)	47 (72.31)	32 (71.11)	145 (69.71)
High	60.01 - 100.00	5 (5.10)	5 (7.69)	6 (13.33)	16 (7.69)
Mean adoption score		42.29	45.95	49.21	44.91
S.d.		14.68	14.56	14.14	14.77
C.V.		34.71	31.69	28.73	32.89

* Figures within parentheses indicate percentage

4.3.7 Distribution of respondents according to their level of adoption of plant protection chemicals

Table 4.3.7 reveals that majority of the marginal farmers (63.27%) had low level of adoption of chemical pesticides followed by 30.61 per cent with medium and only 6.12 per cent with high level of adoption of chemical pesticides.

As regards small farmers, 46.15 per cent of them were with low level of adoption followed by 43.08 per cent with medium and 10.77 per cent with high level of adoption of chemical pesticides.

In case of medium farmers, 48.89 per cent of them were found with medium level of adoption of chemical pesticides.

Unlike marginal and small farmers, the proportion of medium farmers with high level of adoption (31.11%) was higher than their proportion in the low level of adoption (20.00%) category.

The pooled data indicated that highest percentage of the respondents (48.56%) had low level of adoption of chemicals pesticides followed by 38.46 per cent with medium and 12.98 per cent with high level of adoption.

The highest mean level of adoption score (29.44) was obtained for medium farmers and the lowest (16.38) for marginal farmers.

Among the three farm size groups, highest coefficient of variation was obtained for marginal (59.58) farmers indicating that marginal farmers were relatively more heterogeneous as compared to small (55.72) and medium (55.13) farmers with respect to their level of adoption of chemical pesticides.

4.3.8 Distribution of respondents according to their overall level of adoption of three selected agricultural technologies

In order to obtain the overall level of adoption score of a respondent for all the three selected agricultural technologies, level of adoption scores of three technologies were summed up and the mean level of adoption score was calculated which was expressed as percentage of the total potential for adopting those three technologies. The findings obtained thereby are presented in Table 4.3.8.

Table 4.3.7 Distribution of respondents according to their level of adoption of plant protection chemicals

Category	Adoption score range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Low	Upto 10.00	62 (63.27)	30 (46.15)	9 (20.00)	101 (48.56)
Medium	*10.01 - 33.00*	30 (30.61)	28 (43.08)	22 (48.89)	80 (38.46)
High	*33.01 - 100.00*	6 (6.12)	7 (10.77)	14 (31.11)	27 (12.98)
Mean adoption score		16.38	19.92	29.44	20.32
S.d.		9.76	11.07	16.23	12.78
C.V.		59.58	55.72	55.13	62.89

* Figures within parentheses indicate percentage

Table 4.3.8 Distribution of respondents according to their overall level of adoption of three selected agricultural technologies

Category	Adoption score range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Low	Upto 25.00	44 (44.90)	25 (38.46)	16 (35.56)	85 (40.87)
Medium	25.01 - 50.00	34 (34.69)	26 (40.00)	18 (40.00)	78 (37.50)
High	50.01 - 100.00	20 (20.41)	14 (21.54)	11 (24.44)	45 (21.63)
Mean adoption score		33.73	38.16	42.69	37.16
S.d.		13.15	13.37	14.56	12.37
C.V.		38.99	35.04	34.12	33.29

* Figures within parentheses indicate percentage

A perusal of the Table 4.3.8 reveals that highest percentage of the marginal farmers (44.90%) had low level of adoption of three selected agricultural technologies followed by 34.69 per cent with medium and 20.41 per cent with high level of adoption.

As regards small farmers, highest percentage of them (40.00%) had medium level of adoption of three selected agricultural technologies followed by 38.46 per cent with low and 21.54 per cent with high level of adoption.

A similar trend was observed with medium farmers also. The highest percentage of medium farmer respondents (40.00%) were found to have medium level of adoption of three selected agricultural technologies followed by 35.56 per cent with low and 24.24 per cent with high level of adoption of three selected agricultural technologies.

The pooled data revealed that highest proportion of the respondents (40.87%) were with low level of adoption followed by 37.50 per cent with medium level and 21.36 per cent with high level of adoption of three agricultural technologies.

The highest mean adoption score (42.69) was obtained for medium farmers and lowest (33.73) for marginal farmers.

The values of coefficients of variation indicated that marginal farmers were relatively more heterogeneous (38.99) as compared to small (35.04) and medium (34.12) farmers with respect to their level of adoption of three selected agricultural technologies.

4.4 Level of productivity across different size group of farms

In the present study, the level of productivity of each farm was estimated in terms of total gross margin over variable costs per annum expressed in rupee term. The average total gross margin generated under each farming system identified is presented in Table 4.2.1. The distribution of respondents according to their total gross margin over variable costs is shown in Table 4.4.1.

A perusal of the table 4.4.1 reveals that majority of the marginal (73.47%) and small (70.70%) farmers had a medium level of total gross margin in the of range Rs.15969.00 to Rs. 26974.00 per annum. On the other hand majority of the medium farmers (53.33%) were found to have high level of total gross margin of more than Rs.26975.00 per annum.

Table 4.4.1 Distribution of respondents according to their total gross margin over variable costs

Category	Range	Number of farmers			
		Marginal (n = 98)	Small (n = 65)	Medium (n = 45)	Total (N = 208)
Low	Upto Rs. 15968.00	26 (26.53)	5 (7.69)	0 (-)	31 (14.90)
Medium	Rs. 15969.00 - 26974.00	72 (73.47)	46 (70.77)	21 (46.67)	139 (66.83)
High	Above Rs. 26975.00	0 (-)	14 (21.54)	24 (53.33)	38 (18.37)
	Mean	12619.89	27183.40	32494.78	21470.00
	S.d.	1833.92	4075.65	6103.01	5502.98
	C.V.	14.53	23.72	27.13	25.63

A sizeable proportion of the marginal farmers (26.53%) were found to have low total gross margin which was below Rs.15968.00 per annum. No marginal farmer was found to have total gross margin above Rs. 26975.00.

As regards small farmers, 21.54 per cent of them were in the high category of the total gross margin of more than Rs.26975.00 per annum. A small proportion of them (7.69%) were in the low category having a total gross margin below Rs.15968.00 per annum.

In respect of medium size farms, 46.67 per cent of the farmers respondents were in the medium category of total gross margin ranging between Rs.15969.00 and Rs.26974.00. No respondent in the medium farm size group were found to have total annual gross margin below Rs.15968.00.

The pooled data revealed that majority of the farmer respondents (66.83%) obtained a total gross margin ranging between Rs.15969.00 and Rs.26974.00 per annum followed by 18.37 per cent with a total gross margin above Rs.26975.00 and 14.90 per cent with a total gross margin bellow Rs.15968.00 per annum. The average total gross margin in the pooled sample of farmers was Rs.21470.00 per annum.

The highest average total gross margin (Rs. 32,494.78) was obtained in the medium size group farms and lowest (Rs.12619.89) in the marginal size group of farms. In the case of small size group of farm the average total gross margin was Rs.27183.40 per annum.

The values of coefficients of variation indicated that farmers were relatively homogeneous amongst themselves with respect to realization of total gross margin from various activities in their farms. However, medium farmers were relatively more heterogeneous (27.13) as compared to marginal (14.53) and small (23.72) farmers with respect to their realization of total gross margin from various farm activities..

The findings indicated that the level of productivity in medium and small size groups of farms was considerably higher than the level of productivity in the marginal size group of farms. Larger size of operational land holding may be a factor for these differences in level of productivity among different size group of farms. However, an examination of the level of productivity per unit of land holding indicated that per hactare total gross margin was highest in marginal farmers followed by small and medium farmers. Higher cropping intensity in marginal and small farms as compared to medium farms and inclusion of livestock and fishery activities in estimation of total gross margin of a farm may be attributed to this decrease in per hectare total gross margin with an increase in land holding size.

4.5 Relationship of level of adoption with selected independent variables

The relationship of level of adoption of selected agricultural technologies with the independent variables was found out separately for marginal, medium and pooled sample of farmers by using zero order correlation coefficients. Significance of their relationships was ascertained by calculating 't' values. Two tailed tests were employed to verify the hypotheses formulated in this regard. The decision criteria was stipulated at 0.01 level of probability for type 1 error in two tailed tests. The findings on the correlational analysis are presented in Table 4.5.1.

Table 4.5.1 reveals that in case of marginal farmers 13 independent variables were significantly correlated with the level of adoption of selected agricultural technology. The variables cropping intensity (X_3), degree of commercialization (X_4), working capital availability (X_6), innovation proneness (X_{12}), economic motivation (X_{13}), scientific orientation (X_{14}), risk orientation (X_{15}), management orientation(X_{18}), attitude towards improved farm practices (X_{19}), knowledge level on agricultural technology (X_{20}) and degree of information exposure (X_{21}) were positively and significantly correlated at 0.01 level, whereas the variables size of operational land holding (X_1) and social participation (X_{11}) were positively and significantly correlated with level of if adoption at 0.05 level. Hence the null hypotheses that there is no relationship between these independent variables and level of adoption by marginal farmers were rejected and alternative hypotheses were tentatively accepted.

In respect of small farmers, 17 independent variables were found to have significant correlation with level of adoption of selected agricultural technologies. The variables size of land holding (X_1), farm mechanization (X_2), cropping intensity (X_3), degree of commercialization (X_4), working capital availability (X_6), social participation (X_{11}), innovation proneness (X_{12}), economic motivation (X_{13}), scientific orientation (X_{14}),

Table 4.5.1 Relationship between level of adoption and selected independent variables

Sl. No.	Selected independent variables	Marginal farmers (n = 98)		Small farmers (n = 65)		Medium farmers (n = 45)		Pooled sample (N = 208)	
		r value	t value	r value	T value	r value	t value	r value	t value
X_1	Size of operational land holding	.432	4.693*	.418	3.652**	.404	2.895**	.516	8.645**
X_2	Farm mechanization	.109	1.074	.395	3.412**	.513	3.918**	.422	6.680**
X_3	Cropping intensity	.445	4.869**	.505	4.643**	.601	4.930**	.396	6.189**
X_4	Degree of commercialization	.420	4.534**	.463	4.145**	.591	4.803**	.521	8.760**
X_5	Extent of family labour utilization	.107	1.054	.309	2.577*	.432	3.140**	.301	4.530**
X_6	Working capital availability	.512	5.840**	.543	5.132**	.619	5.167**	.645	12.113**
X_7	Age	.096	0.945	.193	1.561	.230	1.549	.123	1.778
X_8	Educational level	.125	1.234	.295	2.450*	.342	2.380*	.136	1.970*
X_9	Family type	.021	0.205	.201	1.628	.215	1.443	.106	1.529
X_{10}	Family size	.056	0.549	.124	0.992	.233	1.571	.119	1.720
X_{11}	Social participation	.219	2.199*	.320	2.680**	.491	3.695**	.120	1.734
X_{12}	Innovation proneness	.397	4.238**	.412	3.588**	.539	4.195**	.426	6.757**
X_{13}	Economic motivation	.573	6.850**	.590	5.799**	.603	4.956**	.592	10.542**
X_{14}	Scientific orientation	.493	5.552**	.419	3.662**	.405	2.904**	.420	6.642**
X_{15}	Risk orientation	.471	5.231**	.560	5.364**	.219	1.471	.392	6.445**
X_{16}	Level of aspiration	.146	1.446	.203	1.645	.209	1.401	.138	1.999*
X_{17}	Orientation towards competition	.169	1.680	.387	3.331**	.503	3.816**	.302	4.546**
X_{18}	Management orientation	.522	5.996**	.509	4.693**	.598	4.892**	.401	6.282**
X_{19}	Attitude towards improved farm practices	.514	5.871**	.426	3.737**	.525	4.044**	.563	9.776**
X_{20}	Knowledge level on agricultural technology	.593	7.215**	.532	4.986**	.641	5.475**	.661	12.642**
X_{21}	Degree of information exposure	.393	4.187**	.493	4.497**	.520	3.991**	.561	9.726**

* : Significant at .05 level with two tailed probabilities

** : Significant at .01 level with two tailed probabilities

d.f. : (N-2) for all cases

risk orientation (X_{15}), orientation towards competition (X_{17}), management orientation (X_{18}), attitude towards improved farm practices (X_{19}), knowledge level on agricultural technology (X_{20}) and degree of information exposure (X_{21}) were positively and significantly correlated with the level of adoption at 0.01 level whereas the variables extent of family labour utilization (X_5) and education level (X_8) were positively significant at 0.05 level. Hence, the null hypotheses that there is no relationship of these variables with level of adoption by small farmers were rejected and alternative hypotheses were tentatively accepted.

In respect of medium farmers, 16 independent variables were significantly correlated with the level of adoption of selected agricultural technology. The variables land holding size (X_1), farm mechanization (X_2), cropping intensity (X_3), degree of commercialization (X_4), extent of family labour utilization (X_5), working capital availability (X_6), social participation (X_{11}), innovation proneness (X_{12}), economic motivation (X_{13}), scientific orientation (X_{14}), orientation towards competition (X_{17}), management orientation (X_{18}), attitude towards improved farm practices (X_{19}), knowledge level on agricultural technology (X_{20}) and degree of information exposure (X_{21}) were positively and significantly correlated with the level of adoption at 0.01 level, whereas the variable education level (X_8) was positively significant at 0.05 level. Hence, the null hypotheses that there is no relationship of these variables with level of adoption by medium farmers were rejected and alternative hypotheses were tentatively accepted.

In respect of pooled sample of farmers, 17 independent variables were found to have significant correlation with level of adoption of selected agricultural technology. The variables size of land holding (X_1), farm mechanization (X_2), cropping intensity (X_3), degree of commercialization (X_4), extent of family labour utilization (X_5), working capital availability (X_6), innovation proneness (X_{12}), economic motivation (X_{13}), scientific orientation (X_{14}), risk orientation (X_{15}), orientation towards competition (X_{17}), management orientation (X_{18}), attitude towards improved farm practices (X_{19}), knowledge level on agricultural technology (X_{20}) and degree of information exposure (X_{21}) were positively and significantly correlated with the level of adoption at 0.01 level, whereas the variables education level (X_8) and level of aspiration (X_{16}) were positively and significantly correlated at 0.05 level.

An examination of the magnitudes of correlation coefficients in the pooled sample of farmers revealed that out of 17 independent variables having significant correlation with level of adoption, only seven variables viz., land holding size (X_1), degree of commercialization (X_4), working capital availability (X_6), economic motivation (X_{13}), attitude towards improved farm practices (X_{19}), knowledge level (X_{20}) and degree of information exposure (X_{21}) had correlation coefficients with magnitudes ranging between 0.516 and 0.661. This indicates moderately strong relationship of these variables with level of adoption. The magnitudes of correlation coefficients of all other significantly correlated variables ranged between 0.136 and 0.426 indicating the very weak to weak relationships of these variables with the level of adoption.

4.6 Relationship of level of productivity with selected independent variables

The relationship of level of productivity with the selected independent variables was found out separately for marginal, medium and pooled sample of farmers by using zero order correlation coefficients. Significance of their relationships was ascertained with the help of 't' tests. Two tailed tests were employed to verify the hypotheses formulated in this regard. The findings on the correlational analysis are presented in Table 4.6.1.

In respect of marginal farmers, 13 independent variables were found to have significant correlation with the level of productivity. The variables size of land holding (X_1), cropping intensity (X_3), degree of commercialization (X_4), working capital availability (X_6), innovation proneness (X_{12}), economic motivation (X_{13}), scientific orientation (X_{14}), level of aspiration (X_{16}), orientation towards competition (X_{17}), , attitude towards improved farm practices (X_{19}), knowledge level on agricultural technology (X_{20}) and degree of information exposure (X_{21}) were positively and significantly correlated at 0.01 level, whereas the variables education level (X_8) had a positively significant correlation at 0.05 level. Hence, the null hypotheses that there is no relationship between these variables with level productivity of marginal farmers were rejected and alternative hypotheses were tentatively accepted.

In respect of small farmers, 17 independent variables were significantly correlated with the level of productivity. The variables size of land holding (X_1), cropping

Table 4.6.1 Relationship between level of productivity and selected independent variables

Sl. No.	Selected independent variables	Marginal farmers (n = 98)		Small farmers (n = 65)		Medium farmers (n = 45)		Pooled sample (N = 208)	
		r value	t value	r value	t value	r value	t value	r value	t value
X_1	Size of operational land holding	0.341	3.554**	0.503	4.619**	0.521	4.002**	0.421	6.661**
X_2	Farm mechanization	0.105	1.034	0.201	1.629	0.320	2.214*	0.226	3.329**
X_3	Cropping intensity	0.542	6.319**	0.520	4.831**	0.501	3.795**	0.643	12.049**
X_4	Degree of commercialization	0.340	3.552**	0.405	3.515**	0.460	3.397**	0.395	6.170**
X_5	Extent of family labour utilization	0.129	1.274	0.362	3.082**	0.410	2.948**	0.368	5.680**
X_6	Working capital availability	0.521	5.980**	0.508	4.680**	0.567	4.513**	0.589	10.460**
X_7	Age	0.126	1.244	0.139	1.114	0.152	1.008	0.137	1.954
X_8	Educational level	0.219	2.199*	0.301	2.502*	0.381	2.702**	0.136	1.970*
X_9	Family type	0.120	1.184	0.124	0.991	0.131	0.866	0.118	1.705
X_{10}	Family size	0.128	1.265	0.291	2.414*	0.195	1.303	0.133	1.925
X_{11}	Social participation	0.107	1.054	0.299	2.486*	0.432	3.140**	0.301	4.665**
X_{12}	Innovation proneness	0.492	5.537**	0.418	3.652**	0.405	2.904**	0.302	4.546**
X_{13}	Economic motivation	0.593	7.215**	0.532	4.985**	0.640	5.461**	0.720	14.890**
X_{14}	Scientific orientation	0.470	5.217**	0.491	4.473**	0.493	3.715**	0.334	5.085**
X_{15}	Risk orientation	0.136	1.345	0.210	1.704	0.290	1.987	0.315	4.763**
X_{16}	Level of aspiration	0.561	6.639**	0.492	4.485**	0.591	4.804**	0.692	13.757**
X_{17}	Orientation towards competition	0.410	4.405**	0.481	4.354**	0.452	3.225**	0.660	12.608**
X_{18}	Management orientation	0.171	1.700	0.406	3.515**	0.419	3.026**	0.325	4.932**
X_{19}	Attitude towards improved farm practices	0.502	5.687**	0.509	4.693**	0.510	3.887**	0.505	8.623**
X_{20}	Knowledge level on agricultural technology	0.564	6.691**	0.580	5.651**	0.603	4.956**	0.562	9.751**
X_{21}	Degree of information exposure	0.391	4.162**	0.490	4.461**	0.419	3.026**	0.361	5.556**

* : Significant at .05 level with two tailed probabilities

** : Significant at .01 level with two tailed probabilities

d.f. : (N-2) for all cases

intensity (X_3), degree of commercialization (X_4), extent of family labour utilization (X_5), working capital availability (X_6), innovation proneness (X_{12}), economic motivation (X_{13}), scientific orientation (X_{14}), level of aspiration (X_{16}), orientation towards competition (X_{17}), management orientation (X_{18}), attitude towards improved farm practices (X_{19}), knowledge level on agricultural technology (X_{20}) and degree of information exposure (X_{21}) were positively and significantly correlated with level of productivity at 0.01 level, whereas the variables education level (X_8), family size (X_{10}) and social participation (X_{11}) were positively significant at 0.05 level. Hence, the null hypotheses that there is no relationship between these variables and level productivity of marginal farmers were rejected and alternative hypotheses were tentatively accepted.

In respect of medium farmers, 17 independent variables were found to have significant correlation with the level of productivity. The variables size of land holding (X_1), cropping intensity (X_3), degree of commercialization (X_4), extent of family labour utilization (X_5), working capital availability (X_6), education level (X_8), social participation (X_{11}), innovation proneness (X_{12}), economic motivation (X_{13}), scientific orientation (X_{14}), level of aspiration (X_{16}), orientation towards competition (X_{17}), management orientation (X_{18}), attitude towards improved farm practices (X_{19}), knowledge level on agricultural technology (X_{20}) and degree of information exposure (X_{21}) were positively and significantly correlated at 0.01 level, whereas the variables farm mechanization (X_2) had a significant positive correlation at 0.05 level. Hence, the null hypotheses that there is no relationship between these variables with level productivity of medium farmers were rejected and alternative hypotheses were tentatively accepted.

In respect of pooled sample of farmers, 18 independent variables were significantly correlated with level of productivity. The variables size of land holding (X_1), farm mechanization (X_2), cropping intensity (X_3), degree of commercialization (X_4), extent of family labour utilization (X_5), working capital availability (X_6), social participation (X_{11}), innovation proneness (X_{12}), economic motivation (X_{13}), scientific orientation (X_{14}), level of aspiration (X_{16}), orientation towards competition (X_{17}),management orientation(X_{18}), attitude towards improved farm practices (X_{19}), knowledge level on agricultural technology (X_{20}) and degree of information exposure

(X_{21}) were positively significant at 0.01 level, whereas the variables education level (X_8) had a positive and significant correlation at 0.05 level.

A perusal of the data in the pooled sample of farmer revealed that out of 18 independent variables having significant correlation with level of productivity, only 7 variables, viz., cropping intensity (X_3), working capital availability (X_6), economic motivation (X_{13}), level of aspiration (X_{16}), orientation towards competition (X_{17}), attitude towards improved farm practices (X_{19}) and knowledge level (X_{20}) had correlation coefficients with magnitudes ranging between 0.505 and 0.720. This indicates a moderately strong to strong relationship of these variables with level of productivity. The magnitudes of correlation coefficient of all other significantly correlated variables ranged between 0.136 and 0.395 indicating a very weak to weak relationship of these variables with level of productivity.

4.7 Contributory effects of selected independent variables on level of adoption

The technique of multiple regression analysis was employed to determine the relative influence of selected independent variables in predicting the variation in level of adoption by farmers. The independent variables which were significantly correlated with the level of adoption were selected for multiple regression analysis. Separate multiple regression analyses were done with respect to the marginal, small, medium and pooled sample of farmers.

The independent variables had their own units of measurement which did not permit a comparison of the partial regression values. To facilitate comparison, the partial regression values were converted to standard partial regression values which were free from the units of measurement. The independent variables were then ranked on the basis of standard partial regression values, to find out their relative importance in predicting the level of adoption by farmers. The predictive power of multiple regression was estimated with the help of coefficient of multiple determination (R^2). The results of regression analysis are presented in Table 4.7.1.

A perusal of the table 4.7.1 reveals that in case of marginal farmers , the highest standard partial "b" value was found in knowledge level on agricultural technology (X_{20}) which was ranked first in order of predictive ability. The standard partial

Table 4.7.1 Relative contribution of selected independent variables towards level of adoption

Sl. No.	Selected independent variables	Marginal farmers (n = 98)			Small farmers (n = 65)			Medium farmers (n = 45)			Pooled sample (N = 208)		
		Partial b value	t value for partial b	Standard partial b value	Partial b value	t value for partial b	Standard partial b value	Partial b value	t value for partial b	Standard partial b value	Partial b value	t value for partial b	Standard partial b value
X_1	Size of operational land holding	2.837	1.157	0.041	3.342	1.991*	0.060(VI)	1.071	0.558	0.025	1.448	1.971*	0.089(VII)
X_2	Farm mechanization	-	-	-	0.223	0.978	0.026	0.383	1.139	0.053	0.474	1.610	0.061
X_3	Cropping intensity	0.048	2.910*	0.096(IV)	0.097	2.314*	0.196(III)	0.121	2.460*	0.210(IV)	1.819	1.091	0.041
X_4	Degree of commercialization	0.054	1.861	0.067	0.037	1.521	0.042	0.223	2.154*	0.203(V)	0.075	2.512*	0.092(VI)
X_5	Extent of family labour utilization	-	-	-	0.011	0.685	0.012	0.027	0.887	0.029	0.021	0.772	0.021
X_6	Working capital availability	0.498	2.410*	0.209(II)	1.167	3.912**	0.207(II)	2.276	3.154**	0.225(III)	3.367	3.488**	0.256(II)
X_7	Age	-	-	-	-	-	-	-	-	-	-	-	-
X_8	Educational level	-	-	-	0.073	1.612	0.010	1.152	0.512	0.021	0.106	1.523	0.016
X_9	Family type	-	-	-	-	-	-	-	-	-	-	-	-
X_{10}	Family size	-	-	-	-	-	-	-	-	-	-	-	-
X_{11}	Social participation	0.447	0.879	0.016	0.390	1.826	0.019	0.642	0.976	0.031	-	-	-
X_{12}	Innovation proneness	0.369	1.092	0.034	0.301	1.210	0.032	0.544	1.501	0.068	0.507	1.964*	0.063(VIII)
X_{13}	Economic motivation	0.510	2.186*	0.206	0.576	3.120**	0.214(I)	0.876	3.257**	0.230(II)	0.780	3.342**	0.234(III)
X_{14}	Scientific orientation	0.047	1.930	0.032	0.011	0.540	0.007	0.095	0.689	0.026	0.085	1.820	0.062
X_{15}	Risk orientation	0.040	1.668	0.014	0.148	1.625	0.051	-	-	-	0.103	0.886	0.032
X_{16}	Level of aspiration	-	-	-	-	-	-	-	-	-	0.031	1.712	0.020
X_{17}	Orientation towards competition	-	-	-	0.033	0.558	0.009	0.274	1.233	0.058	0.108	0.876	0.029
X_{18}	Management orientation	0.046	1.260	0.050	0.056	1.761	0.058	0.143	1.867	0.162	0.043	1.195	0.049
X_{19}	Attitude towards improved farm practices	0.562	2.631*	0.120(III)	0.211	1.885	0.039	0.568	2.769**	0.098 (VI)	0.543	2.962**	0.109(IV)
X_{20}	Knowledge level on agricultural technology	0.640	3.510*	0.228(I)	0.262	2.181*	0.126(IV)	0.491	3.340**	0.251(I)	0.601	3.496**	0.301(I)
X_{21}	Degree of information exposure	0.354	1.670	0.080	0.355	2.103*	0.080(V)	0.421	1.556	0.091	0.429	2.745**	0.101(V)
		$R^2 = 0.798$ (with 13 variables)			$R^2 = 0.762$ (with 17 variables)			$R^2 = 0.744$ (with 16 variables)			$R^2 = 0.684$ (with 17 variables)		

* : Significant at .05 level

** : Significant at .01 level

Figures within parentheses indicate ranks on the basis of standard partial b values b value indicated that other things remaining constant, unit change in the level of knowledge of the marginal farmers will bring about a corresponding change in level of adoption of selected agricultural technology to the extent of 0.23 unit. The variables working capital availability (X_6), attitude towards improved farm practices (X_{19}) and cropping intensity (X_3) were ranked second, third and fourth respectively in order of their predictive abilities.

In case of small farmers , the variables economic motivation (X_{13}), working capital availability (X_6) and cropping intensity (X_3) were ranked first, second and third respectively in order of their productive abilities. The variables knowledge level on agricultural technology (X_{20}), degree of information exposure (X_{21}) and size of land holding (X_1) were ranked fourth, fifth and sixth in order of their predictive abilities.

In respect of medium farmers, the variables knowledge level on agricultural technology (X_{20}), economic motivation (X_{13}) and working capital availability (X_6) were ranked first, second and third respectively in order of their productive abilities. The variables cropping intensity (X_3), degree of commercialization (X_4) and attitude towards improved farm practices (X_{19}) were ranked fourth, fifth and sixth in order of their predictive abilities.

In case of pooled sample farmers, 8 independent variables were found to contribute significantly to the level of adoption by farmers. The variable knowledge level on agricultural technology (X_{20}) ranked first, followed by the variables working capital availability (X_6), economic motivation (X_{13}), attitude towards improved farm practices (X_{19}), degree of information exposure (X_{21}), degree of commercialization (X_4), size of land holding (X_1) and innovation proneness (X_{12}) in order of their predictive abilities.

The R^2 values indicated that 21 independent variables selected for the study were highly efficient in predicting the level of adoption of agricultural technology by farmers. In case of marginal farmers 79.80 per cent of the variation in the adoption level could be predicted by 13 variables. In case of small farmers, the 17 variables used in the multiple regression analysis could predict 76.20 per cent of the variation in the level of adoption of agricultural technology by small farmers. In case of medium farmers, 74.40 per cent of the variation in the level of adoption could be predicted by 17 variables. In respect of pooled sample of farmers, the 17 variables could predict 68.40 per cent of the variation in the level of adoption by farmers.

The result of the regression analysis revealed that for different categories of farmers, different independent variables were important in predicting their level of adoption of agricultural technology. There were, however, some common variables also, which are highlighted below.

Economic motivation (X_{13}) contributed positively and significantly to the level of adoption of agricultural technology by marginal, small, medium and pooled sample of farmers. Economic motivation is an indication of the degree of willingness for investment for adopting improved agricultural technology. To increase the level of adoption of improved agricultural technology, farmers are to be economically motivated to maximise their profits from farming. The profits which might accrue to the farmers by the adoption of improved technology has to be highlighted in agricultural extension work.

Knowledge level on agricultural technology (X_{20}) contributed positively and significantly to the level of adoption of agricultural technology by marginal, small, medium and pooled sample of farmers. Several researchers have found knowledge level on agricultural technology to be an important factor influencing the level of adoption of agricultural technology by farmers. Knowledge is essential to obtain full benefits of a technology. To increase the level of adoption of improved technology by farmers, their level of knowledge on those technologies has got to be increased.

Working capital availability (X_6) contributed positively and significantly to the level of adoption of agricultural technology by marginal, small, medium and pooled sample of farmers. Working capital is required by the farmers to meet the expanses on day to day crop and livestock production activities in terms of both cash and kind. It indicates farmers' investment potential and, therefore, is important in the context of the use of new technology, because the new technology is input intensive and these inputs are costlier than the traditional inputs. This is particularly important for marginal and small farmers.

The variable cropping intensity (X_3) contributed positively and significantly to the level of agricultural technology by marginal, small and medium farmers. The variable attitude towards improved from practices (X_{19}) contributed positively and significantly to the prediction of level of adoption of agricultural technology by marginal, medium and pooled sample of farmers. Favourable attitude of farmers increases the possibility that farmers will use the technology more than those who have unfavourable attitude. Hence, to motivate farmers to adopt improved technology, it is essential to create favourable attitude of the farmers towards those improved technology.

The variable size of land holding (X_1) and degree of information exposure (X_{21}) contributed positively and significantly to the prediction of level of adoption of agricultural technology by small farmers and pooled sample of farmers. The variable degree of commercialization (X_4) contributed positively and significantly to the prediction of level of adoption of agricultural technology by medium farmers and pooled sample of farmers. Commercialization indicates movement from subsistence to commercial farming. This can be achieved by use of improved technology in farming. Degree of commercialization is both cause and effect of technology adoption. However, in this study, it was considered as a cause.

Innovation proneness (X_{12}), i.e., interest in the desire to seek changes in farming techniques and to introduce such changes when practical and feasible, contributed positively and significantly to the prediction of level of adoption of agricultural technology in the pooled sample of farmers.

4.8 Contributory effects of selected independent variables on level of productivity

The technique of multiple regression analysis was used to determine the relative influence of selected independent variables in predicting the variation in the level of productivity of farmers. The independent variables which were significantly correlated with the level of productivity were selected for multiple regression analysis. Separate multiple regression analyses were done with respect to the marginal, small, medium and pooled sample of farmers. The independent variables were ranked on the basis of standard partial regression values. The predicted power of multiple regression was estimated with the help of coefficient of multiple determination (R^2). The results of multiple regression analysis are presented in Table 4.8.1.

In case of marginal farmers the highest standard partial 'b' value was found in economic motivation (X_{13}) which was ranked first in order of predictive ability. The

Table 4.8.1 Relative contribution of selected independent variables towards level of productivity

Sl. No.	Selected independent variables	Marginal farmers (n = 98)			Small farmers (n = 65)			Medium farmers (n = 45)			Pooled sample (N = 208)		
		Partial b value	t value for partial b	Standard partial b value	Partial b value	t value for partial b	Standard partial b value	Partial b value	t value for partial b	Standard partial b value	Partial b value	t value for partial b	Standard partial b value
X_1	Size of operational land holding	0.737	4.899**	0.076(V)	1.664	5.957**	0.098(VII)	1.903	5.998**	0.106 (V)	1.072	4.631**	0.148(VIII)
X_2	Farm mechanization	-	-	-	-	-	-	0.036	1.286	0.012	0.046	1.362	0.023
X_3	Cropping intensity	0.013	2.596**	0.197(IV)	0.034	3.981**	0.298 (III)	0.024	3.652**	0.101(VII)	0.036	3.531**	0.178(IV)
X_4	Degree of commercialization	0.087	1.698	0.072	0.015	1.173	0.056	0.038	1.362	0.082	0.049	2.864**	0.136(IX)
X_5	Extent of family labour utilization	-	-	-	0.016	1.192	0.058	0.018	1.261	0.046	0.051	1.368	0.112
X_6	Working capital availability	0.065	1.021	0.198	0.137	1.988**	0.223(IV)	1.026	2.695**	0.242 (IV)	0.097	2.916**	0.167(V)
X_7	Age	-	-	-	-	-	-	-	-	-	-	-	-
X_8	Educational level	0.075	0.987	0.062	0.031	1.023	0.014	0.045	1.236	0.015	0.56	1.324	0.019
X_9	Family type	-	-	-	-	-	-	-	-	-	-	-	-
X_{10}	Family size	-	-	-	0.032	1.391	0.019	-	-	-	-	-	-
X_{11}	Social participation	-	-	-	0.075	1.261	0.012	0.114	1.632	0.016	0.238	1.364	0.036
X_{12}	Innovation proneness	0.236	1.923	0.156	0.198	1.867	0.066	0.207	1.763	0.062	0.105	1.384	0.0029
X_{13}	Economic motivation	0.114	2.671**	0.329 (I)	0.204	3.562**	0.249 (II)	0.501	6.120**	0.314(I)	0.513	6.162*	0.346(I)
X_{14}	Scientific orientation	0.028	1.930	0.139	0.044	1.865	0.095	0.064	1.761	0.095	0.047	1.687	0.078
X_{15}	Risk orientation	-	-	-	-	-	-	-	-	-	0.070	1.583	0.049
X_{16}	Level of aspiration	0.053	2.510*	0.213(III)	0.115	2.761**	0.218 (VI)	0.201	3.361**	0.258 (III)	0.223	4.326**	0.324(II)
X_{17}	Orientation towards competition	0.058	1.267	0.102	0.086	1.357	0.076	0.140	1.899	0.071	0.279	3.462**	0.217(III)
X_{18}	Management orientation	-	-	-	0.018	1.360	0.061	0.021	1.692	0.058	0.026	1.774	0.065
X_{19}	Attitude towards improved farm practices	0.110	1.981	0.168	0.363	3.754**	0.220(V)	0.255	3.662**	0.105 (VI)	0.339	4.126**	0.153(VII)
X_{20}	Knowledge level on agricultural technology	0.120	2.293**	0.308(II)	0.193	2.691**	0.305(I)	0.234	3.156**	0.286 (II)	0.146	2.872**	0.165(VI)
X_{21}	Degree of information exposure	0.059	0.912	0.096	0.110	1.236	0.082	0.095	1.792	0.049	0.155	3.296**	0.082(X)
		$R^2 = 0.752$ (with 13 variables)			$R^2 = 0.736$ (with 17 variables)			$R^2 = 0.703$ (with 16 variables)			$R^2 = 0.598$ (with 18 variables)		

* : Significant at .05 level

** : Significant at .01 level

#Figures within parentheses indicate ranks on the basis of standard partial b values variables knowledge level on agricultural technology (X_{20}), level of aspiration (X_{16}), cropping intensity (X_3)and size of land holding (X_1)were ranked second, third, fourth and fifth respectively in order of predictive abilities. The 13 selected independent variables could predict 75.20 per cent of the variation in the level of productivity.

In case of small farmers, knowledge level on agricultural technology (X_{20}), economic motivation (X_{13}) and cropping intensity (X_3) were ranked first, second and third respectively in order of predictive abilities. The variables working capital availability (X_6), attitude towards improved farm practices (X_{19}), level of aspiration (X_{16}) and size of land holding (X_1)were ranked fourth, fifth, sixth and seventh respectively. The 17 independent variables could predict 73.60 per cent of the variation in the level of productivity.

In respect of medium farmers, economic motivation (X_{13}), knowledge level on agricultural technology (X_{20})and level of aspiration (X_{16}) were ranked first, second and third respectively in order of predictive abilities. The variables working capital availability (X_6), size of land holding (X_1), attitude towards improved farm practices (X_{19}) and degree of commercialization (X_4)were ranked fourth, fifth, sixth and seventh respectively in order of their predictive abilities. The 16 independent variables could predict 70.30 per cent of the variation in the level of productivity.

In the pooled sample of farmers, 10 independent variables contributed significantly to the level of productivity of farmers. The variables economic motivation (X_{13}), level of aspiration (X_{16}) and orientation towards competition (X_{17}) were ranked first, second and third respectively in order of their predictive abilities. The variable cropping intensity (X_3) ranked fourth followed by the variables working capital availability (X_6), knowledge level on agricultural technology (X_{20}), attitude towards improved farm practices (X_{19}), size of land holding (X_1)and degree of information exposure (X_{21}). The 18 independent variables could predict 59.80 per cent of the variation in the level of productivity.

It is evident from the findings presented above that the variables size of land holding (X_1), cropping intensity (X_3), economic motivation (X_{13}), level of aspiration (X_{16}) and knowledge level on agricultural technology (X_{20}) contributed positively and significantly to the prediction of productivity of marginal, small, medium and pooled sample of farmers. The standard partial 'b' values in the pooled sample of farmers indicated that other things remaining constants, unit changes in these five variables will bring about a corresponding change in the level of productivity of farmers to the extent of 1.16 unit.

The variable attitude towards improved practices (X_{19}) contribute positively and significantly to the prediction of level of productivity of small, medium and pooled sample of farmers.

The variable working capital availability (X_6) were found to contributed positively and significantly to the prediction of level of productivity in small, medium and pooled sample of farmers.

4.9 Direct and indirect effects of selected independent variables on level of adoption

The nine independent variables whose partial regression values were *significant in the multiple regression analyses were included* in the path analysis. The objective of doing path analyses was to get a clear picture of the direct and indirect effects of the selected independent variables on the level of adoption of selected agricultural *technologies by farmers. Variables through which substantial indirect effects were* channeled were also found out. The path analysis was done with the pooled sample of farmers and the results are presented in Table 4.9.1. The variables were arranged from high to low total direct effect.

Table 4.9.1 reveals that the variable knowledge level on agricultural technology (X_{20}) had the highest positive and substantial direct effect (0.267) on the level of adoption of agricultural technology by farmers. There were positive and substantial direct effects of economic motivation (0.210), working capital availability (0.206) degree of commercialization (0.170), size of land holding (0.169) and attitude towards improved farm practices (0.104), in order of importance, on the level of adoption of agricultural technology by farmers. The direct effects of degree of information exposure (X_{21}), cropping intensity (X_3) and innovation proneness were positive but relatively less, the figures being 0.090, 0.061 and 0.018 respectively. The total indirect effect in respect of all the selected independent variables were positive and substantial.

Table 4.9.1 Direct and indirect effects of selected independent variables on level of adoption

Selected independent variables	Direct effect	Total indirect effect	Variables through which substantial indirect effects are channeled
X_{20} Knowledge level on agricultural technology	0.267	0.393	0.101 X_3 0.097 X_{19} 0.083 X_{21}
X_{13} Ecouomic motivation	0.210	0.381	0.108 X_{19} 0.098 X_6 0.090 X_1
X_6 Working capital availability	0.206	0.438	0.114 X_{19} 0.109 X_{20} 0.099 X_{13}
X_4 Degree of commercialization	0.170	0.350	0.109 X_6 0.076 X_{13} 0.060 X_{20}
X_1 Size of operational land holding	0.169	0.346	0.176 X_{13} 0.098 X_{20} 0.086 X_3
X_{19} Attitude towards improved farm practices	0.104	0.458	0.119 X_{20} 0.105 X_{21} 0.096 X_1
X_{21} Degree of information exposure	0.090	0.470	0.130 X_{20} 0.098 X_{19} 0.091 X_1
X_3 Cropping intensity	0.061	0.334	0.069 X_{13} 0.066 X_6 0.058 X_{12}
X_{12} Innovation proneness	0.018	0.407	0.101 X_{20} 0.097 X_{21} 0.071 X_4

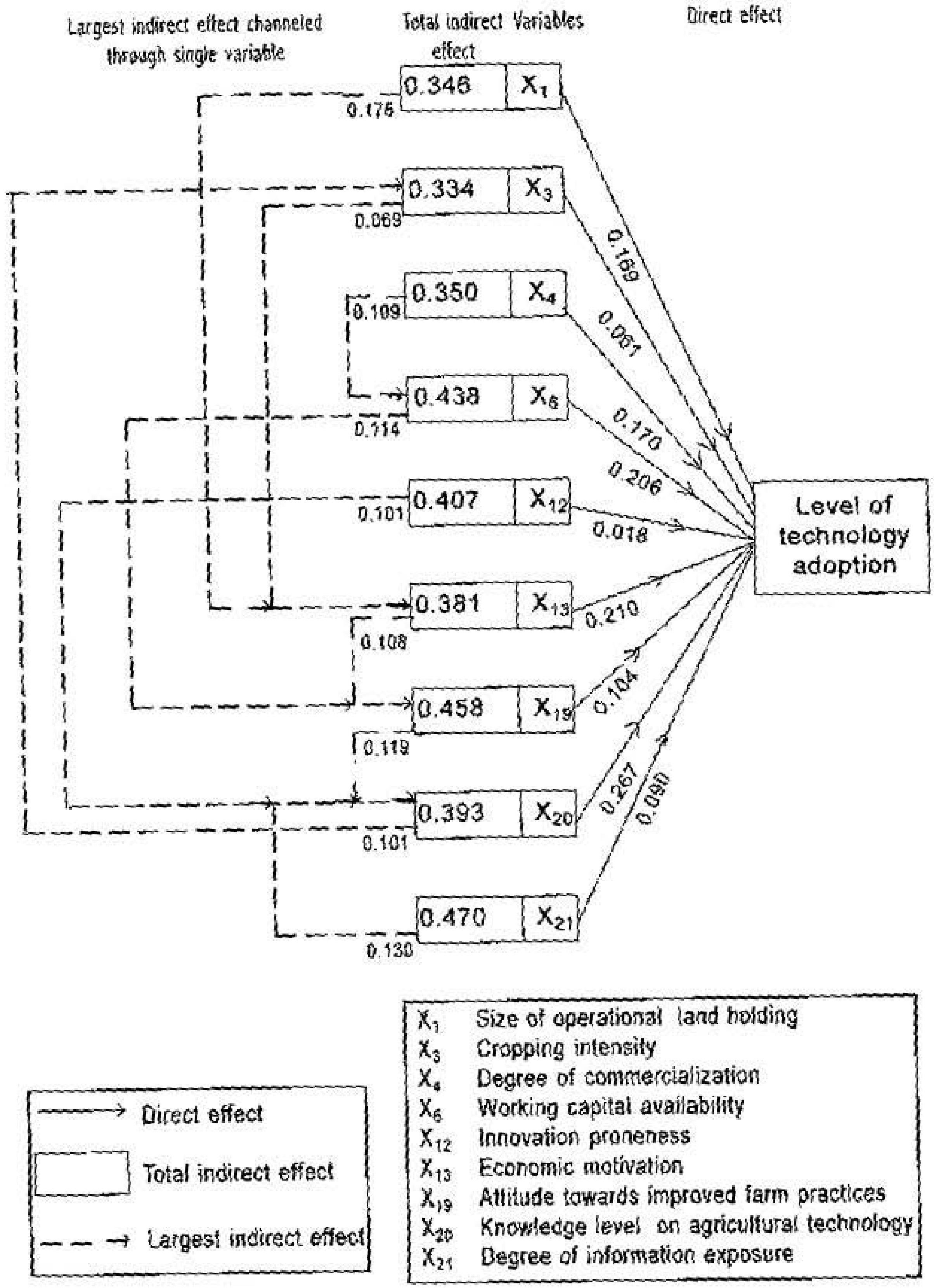

Fig 4.9.1 Path diagram showing direct and indirect effects of selected variables on level of technology adoption

Degree of information exposure (X_{21})had the highest (0.470) and cropping intensity (X_3) had the lowest (0.334) total indirect effect.

The data presented in the Table 4.1.9 also revealed that the variable knowledge level on agricultural technology (X_{20}) was important as substantial indirect effect of as many as six variables were channeled through this variable. The next important variables were economic motivation (X_{13}) and attitude towards improved farm practices (X_{19}) as substantial indirect effects of as many as four variables were channeled through each of these two variables. Next in importance were working capital availability (X_6), size of land holding (X_1) and degree of information exposure (X_{21}) through which substantial indirect effects of three variables were channeled through each of the variables. The substantial indirect effects of two variables were channeled through cropping intensity (X_3). The substantial indirect effects of one variable were channeled through each of these variables degree of commercialization (X_4) and innovation proneness (X_{12}).

The total direct effect, total indirect effect and the largest indirect effect channeled through single variable are diagrammatically presented in Figure 4.9.1.

4.10 Direct and indirect effects of selected independent variables on level of productivity

The technique of path analysis was used to get a clear picture of direct and indirect effects of selected independent variables on level of productivity. The 10 independent variables whose partial regression values were significant in multiple regression analysis were included in the path analysis. The path analysis was done with the pooled sample of farmers. Variables through which substantial indirect effects were channeled were also found out. The variables were then arranged from high to low total direct effect. The result of path analysis are presented in Table 4.10.1.

The Table 4.10.1 reveals that the variable orientation towards competition (X_{17}) had the highest positive and substantial direct effect (0.269) on the level of productivity. There were positive and substantial direct effects of level of aspiration (0.241), cropping intensity (0.219), economic motivation (0.204), attitudes towards improved farm practices (0.179), working capital availability (0.118) and knowledge level

Table 4.10.1 Direct and indirect effects of selected independent variables on level of productivity

Selected independent variables		Direct effect	Total indirect effect	Variables through which substantial indirect effects are channeled
X_{17}	Orientation towards competition	0.269	0.390	0.257 X_1 0.113 X_3 0.093 X_{16}
X_{16}	Level of aspiration	0.241	0.450	0.114 X_6 0.109 X_{20} 0.098 X_1
X_3	Cropping intensity	0.219	0.423	0.112 X_1 0.108 X_{13} 0.106 X_4
X_{13}	Economic motivation	0.204	0.515	0.131 X_3 0.119 X_1 0.110 X_4
X_{19}	Attitude towards improved farm practices	0.179	0.335	0.099 X_{13} 0.079 X_4 0.054 X_1
X_6	Working capital availability	0.118	0.470	0.127 X_3 0.096 X_4 0.082 X_{13}
X_{20}	Knowledge level on agricultural technology	0.106	0.455	0.126 X_{19} 0.099 X_{16} 0.086 X_{17}
X_1	Size of land holding	0.086	0.334	0.092 X_3 0.072 X_{20} 0.042 X_6
X_4	Degree of commercialization	0.069	0.325	0.061 X_{13} 0.049 X_3 0.043 X_{17}
X_{21}	Degree of information exposure	0.049	0.311	0.064 X_{19} 0.052 X_{20} 0.039 X_{16}

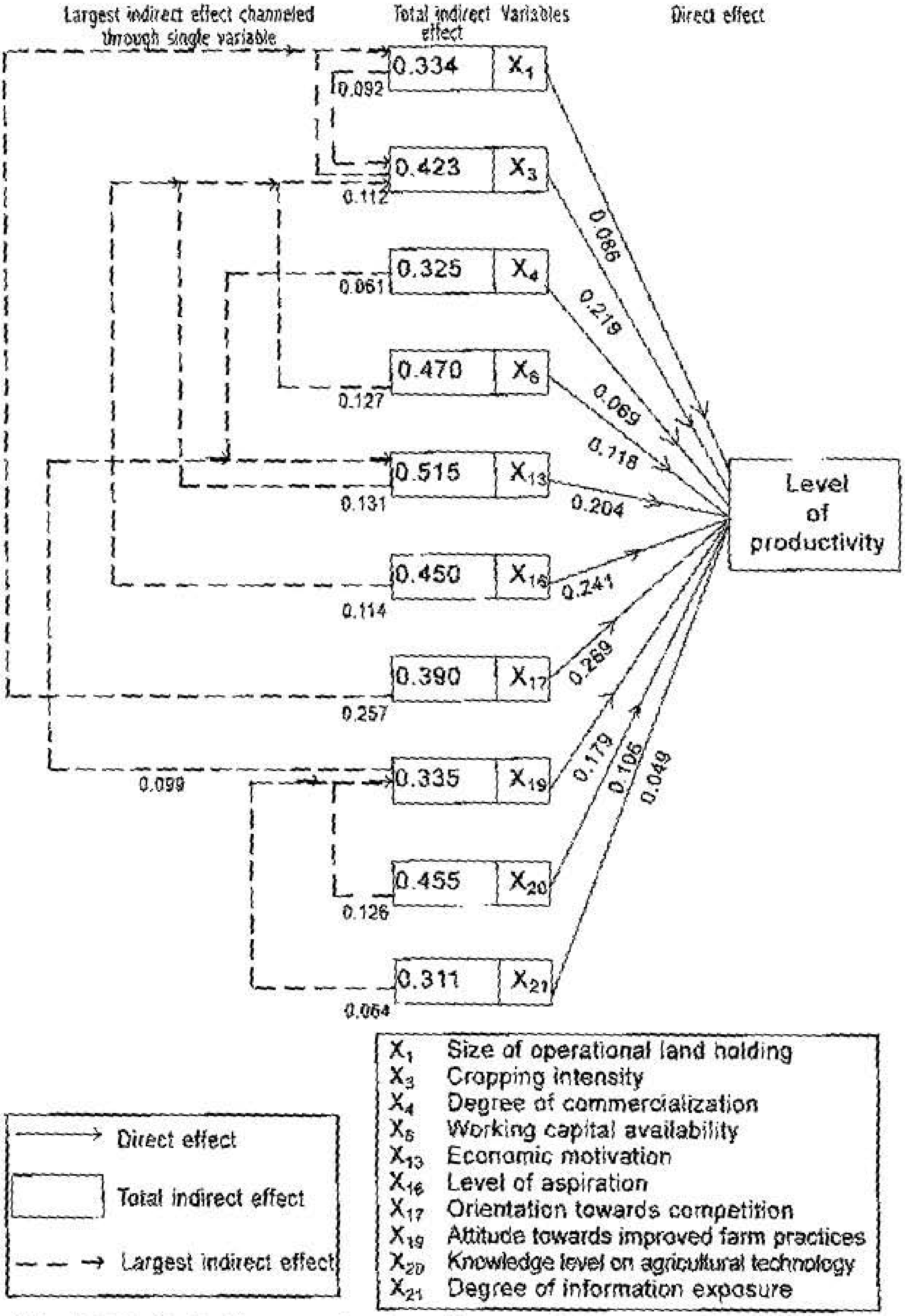

Fig. 4.10.1 Path diagram showing direct and indirect effects of selected variables on level of productivity

(0.106), in order of importance, on the level of productivity. The direct effects of size of land holding (X_1), degree of commercialization (X_4) and information exposure (X_{21}) were positive but relatively less, the figures being 0.086, 0.069 and 0.049 respectively.

The total indirect effects in respect of all the selected independent variables were positive and substantial. The variable economic motivation (X_{13}) had the highest (0.515) and degree of information exposure (X_{21}) had the lowest (0.311) total indirect effects.

Data presented in Table 4.10.1 also revealed that the variables size of land holding (X_1) and cropping intensity (X_3) were important as substantial indirect effects of as many as five variables were channeled through each of these two variables. Next in importance were degree of commercialization (X_4) and economic motivation (X_{13}) as substantial indirect effects of four variables were channeled through each of these two variables. The substantial indirect effects of three variables were channeled through level of aspiration (X_{16}) and knowledge level (X_{20}). The substantial indirect effects of two variables were channeled through working capital availability (X_6), orientation towards competition (X_{17}) and attitude towards improved farm practices (X_{19}). No substantial indirect effect was channeled through degree of information exposure (X_{21}).

The total direct effect, total indirect effect and largest indirect effect channeled through single variable are presented diagrammatically in Fig. 4.10.1.

4.11 Farmers' perceptions of the factors hindering adoption of improved agricultural technology

Table 4.11.1 reveals that a total of nine factors were perceived by more than 20 per cent of both the marginal and small farmers as constraints in adoption of improved agricultural technology by them. In case of medium farmers, a total of ten factors were perceived as constraints in adoption of improved agricultural technology by them.

In respect of marginal and small farmers, 'lack of finance', 'non availability of HYV seeds in time', 'high cost of fertilizers and pesticides' were perceived to be the three most important constraints in adoption of improved technology by them. In respect of medium farmers, 'non-availability of HYV seeds in time', lack of irrigation facilities'

Table 4.11.1 Farmers' perceptions of the factors hindering adoption of improved agricultural technology

Marginal farmers (n = 98)	Rank order	Small farmers (n = 65)	Rank order	Medium farmers (n = 45)	Rank order
• Lack of finance (163)	I	• Lack of finance (122)	I	• Non-availability of HYV seeds in time (81)	I
• Non-availability of HYV seeds in time (113)	II	• Non-availability of HYV seeds in time (82)	II	• Lack of irrigation facilities (49)	II
• High cost of fertilizers and pesticides (103)	III	• High cost of fertilizers and pesticides (70)	III	• Lack of knowledge about plant protection measure (38)	III
• Lack of easily available credit (69)	IV	• Lack of irrigation facilities (39)	IV	• Lack of soil testing facilities (33)	IV
• Lack of irrigation facilities (63)	V	• Lack of easily available credit (38)	V	• High cost of fertilizers and pesticides (28)	V
• Lack of technical guidance from extension personnel (52)	VI	• Lack of technical guidance from extension personnel (34)	VI	• Lack of finance (26)	VI
• Lack of knowledge about plant protection measures (32)	VII	• Lack of knowledge about plant protection measures (26)	VII	• Lack of knowledge about fertilizer management (20)	VII
• Lack of knowledge about fertilizer management (28)	VIII	• Lack of knowledge about fertilizer management (24)	VIII	• Lack of easily available credit (19)	VIII
• Non-availability of agricultural equipment in time (25)	IX	• Non-availability of improved agricultural equipments in time (22)	IX	• Lack of technical guidance from extension personnel (18)	IX
				• Adulteration in inputs (15)	X

Figures within parentheses indicate total rank score of each factor and 'lack of knowledge about plant protection measures' were perceived as the three most important constraints in adoption of improved technology by them.

The findings reveal that lack of finance was ranked as the most important factor by both the marginal and small farmers hindering adoption of improved technology by them. Adoption of modern technology and inputs requires investment. Due to their relatively low economic status both marginal and small farmers face difficulties in purchasing those inputs which are costlier than traditional inputs. So, it was natural for them to mention 'lack of finance' as the most important factor hindering adoption of improved technology by them.

'High cost of fertilizers and pesticides' was another important factor perceived as constraint in adoption of improved technology by all the categories of farmers. It was ranked third by both the small and marginal farmers and fifth by medium farmers.

'Lack of easily available credit' was perceived as a constraint in adoption by all the categories of farmers. It was ranked fourth by marginal farmers, fifth by small farmers and eight by medium farmers. The responses indicated that all the categories of farmers were concerned not only with credit but also with their easy availability.

'Lack of irrigation facilities' as a constraint in adoption was ranked fifth, fourth and second by marginal, small and medium farmers respectively. It indicates that the need for irrigation for adoption of improved technology was felt more by medium farmers as compared to marginal and small farmers.

'Lack of technical guidance from extension personnel' was perceived as a constraint in adoption of improved technology by all the categories of farmers. It was ranked sixth by both the marginal and small farmers and ninth by medium farmers.

'Lack of knowledge about plant protection measures' was a major constraint for medium farmers which was ranked third by them. It was ranked seventh by both the marginal and small farmers.

'Lack of knowledge about fertilizer management' was ranked eighth by both the small and marginal farmers and seventh by medium farmers.

'Non-availability of improved agricultural equipment in time' was perceived as a constraint by both the marginal and small farmers which was ranked ninth by them. However, less than 20 per cent of the medium farmers perceived it as a hindering factor in adoption of improved technology by them.

'Adulteration in inputs' as a constraint in adoption was perceived by medium farmers only, which was ranked tenth by them.

The foregoing findings indicate that to ensure higher adoption of various improved technologies by farmers of rainfed areas, attention has to be paid on adequate and timely supply of critical inputs like HYV seeds, fertilizers, pesticides, farm equipments and credit. Regulatory measures are also to be taken to prevent adulteration of inputs. Efforts are to be made to increase the level of knowledge of the farmers about improved cultivation practices of different crops grown by them. More attention should be paid to enhence farmers' knowledge about fertilizer management and plant protection measures. Modern farm inputs are costly. High cost of fertizers and pesticides was perceived as a constraint in adoption of input technology by the respondent farmers. As it may not be feasible to reduce the price of these inputs, a practical solution of the problem may be to train the farmers on economic and efficient use of those inputs. Emphasis should also be given in augmenting the irrigation potential of the rainfed areas and in scientific water management by the farmers. To increase the level of adoption of various improved technologies by the farmers, the extension workers are required to make more contact with the farmers. This shall not only help the farmers to acquire more knowledge about different improved farm practices but also help to create favourable attitude towards those practices, make them innovative and economically motivated to adopt improved technologies.

Summary and Conclusion

Chapter V

SUMMARY AND CONCLUSION

Although India has achieved outstanding agricultural progress in its more favourable irrigated areas, there has been little effect of green revolution technologies in rainfed areas. Despite strenuous efforts made in the recent past to increase agricultural production in Assam, rainfed farming in the state is still characterised by very low and instable productivity. Increase in agricultural production depends largely on the integration of improved technologies by the farmers into their farming systems. While technology transfer is a highly desirable goal in agriculture, it is often difficult to accomplish it in rainfed farming systems as many factors influence the adoption of technology by farmers in rainfed areas. Keeping these views, the present study was undertaken with the following objectives.

5.1 Objectives of the study

1. To identify different types of specific enterprise based farming systems in the study area across different size group of farms.
2. To assess the level of adoption of selected agricultural technologies and level of productivity in selected farming system across different size group of farms.
3. To identify the variables which significantly contribute towards the level of adoption of selected agricultural technologies and level of productivity in selected farming system across different size greup of farms.
4. To determine the direct and indirect effects of selected variables on level of adoption of selected agricultural technologies and productivity in selected farming system.
5. To find out farmers' perceptions of the factors hindering adoption of improved agricultural technologies in selected farming systems across different size group of farms.

5.2 Research methodology

The study was conducted in the Lower Brahmaputra Valley Zone of Assam. Out of seven districts of the zone, two districts, *viz.*, Barpeta and Kamrup were selected randomly. Two agricultural sub-divisions, one each from the two districts were selected randomly. Four AEO circles, two each from two agricultural sub-divisions, were selected randomly. Four VLEW circles one each from four AEO circles, were selected randomly. Selection of the AEO circles and VLEW circles were based on the prevalence of the rainfed farming situation. Eight villages, two each from four VLEW circles, were selected randomly. A sample of 225 farm families was selected from eight villages with proportional allocation of sampling units in each village. Data were collected by personal interview method with the help of structured research schedule.

The different types of specific enterprise based farming systems prevalent in the study area were identified based on the activities or enterprises taken up by sampled farm families. Out of 225 farm families, 208 (92.45%) were found to practise crop based farming system and rest 17 (7.55%) practised other enterprise based farming systems. Keeping in view the objectives of the study, however, these 17 farm families were left out from the perview of the study and subsequent analysis was done for rest 208 farm families.

All together 2 dependent and 21 independent variables were included in the study. The dependent variables were level of adoption of selected agricultural technology and level of productivity. The level of adoption of three selected agricultural technologies were measured by using a ratio scale developed by Sangle (1984). The level of productivity of each farm family was estimated in terms of total gross margin over variable costs. Out of 21 independent variables, 6 were agro-economic, 14 were socio-personal and psychological and 1 was extension-communication variable. The 6 agro-economic variables were size of operational land holding, farm mechanization, cropping intensity, degree of commercialization, extent of family labour utilization and working capital availability. The 14 socio-personal and psychological variables were age, education level, family type, family size, social participation, innovation proneness, economic motivation, scientific orientation, risk orientation, level of aspiration, orientation towards competition management orientation, attitude towards improved farm practices and knowledge level on agricultural technology. The only extension-communication variable included in the study was degree of information exposure. Farm mechanization and management orientation were measured by using the scales developed by Samanta (1977). Degree of commercialization was measured by using the formula suggested by Singh (1966). Education level and social participation were measured by using the Socio-Economic Status scale developed by Trivedi and Pareek (1964). Innovation proneness was measured by the scale developed by Supe (1969). Level of aspiration was measured by using the scale developed by Muthayya (1977). Orientation towards competition was measured by using the scale developed by Singh (1981). Attitude towards improved farm practices was measured by using the scale developed by Sangle (1984). Knowledge level on agricultural technology was measured by using a knowledge test developed by Das (1991). Degree of information exposure was measured by following procedure suggested by Sangle (1984). The data for the rest of the independent variables were collected with the help of structured schedule. Data on farmers' perceptions of factors hindering technology adoption were collected by using structured schedule.

The statistical techniques and tests used in the study for analysis of data were frequency, percentage, arithmetic mean, standard deviation, coefficient of variation, zero order correlation coefficient, multiple regression analysis, path analysis and 't' test.

5.3 Salient findings

5.3.1 Characteristics of the respondents

The study revealed that 47.12 per cent of the respondents were marginal farmers, followed by 31.25 per cent small farmers and 21.63 per cent medium farmers. While majority (60.20%) of the marginal farmers were in low farm mechanization category, 49.23 per cent of small and majority (68.89%) of medium farmers were in medium farm mechanization category. Majority of the respondents were in medium category of cropping intensity, the figures being 71.43, 69.24, 60.00 for marginal, small and medium farmers respectively. Majority of the respondents had medium degree of commercialization the figures being 67.35, 67.79 and 67.22 per cent for marginal, small and medium farmers respectively. Majority of the respondents were found with medium extent of utilization of family labour, the figures being 70.41, 67.69 and 71.11 per cent for marginal, small and medium farmers respectively. Majority of the respondents had medium level of working capital availability, the figures being 75.51, 70.77 and 57.78 per cent for marginal, small and medium farmers respectively. Majority of the respondents in all the farm-size groups belonged to middle age category. Majority of the marginal (59.18%) and small (52.31%) farmers and 24.44 per cent of the medium farmers were illiterate. Majority of the respondents in all the farm-size groups had single but large size family. While majority (57.15%) of the marginal farmers and 43.08 per cent of small farmers had membership in one organization, 37.78 per cent of medium farmers had membership in more than one organization. Majority of the marginal (55.10%) and small (53.85%) farmers and 40.00 per cent of the medium farmers were with low innovation proneness. Majority of the respondents had medium economic motivation, the figures being 79.59, 64.62 and 57.78 per cent for marginal, small and medium farmer respectively. While half (50.00%) of the marginal farmers and 40.00 per cent of the small farmers had low scientific orientation, 42.22 per cent of medium farmers had high scientific orientation. Majority of the respondents had medium level of risk orientation, the figures being 70.41, 67.69 and 62.22 per cent for marginal, small and medium farmers respectively. While majority of the marginal (61.22%) and small (56.93%) farmers had medium level of aspiration, majority of the medium farmers (51.11%) had high level of aspiration. Majority of the respondents had medium orientation towards competition, the figures being 75.52, 63.08 and 67.67 per cent for marginal, small and medium farmers respectively. Majority of the marginal (64.29%) and small (58.46%) farmers and 40.00 per cent of the medium farmers had medium level of orientation towards management. While 37.76 per cent of the marginal farmers had less favourable attitude towards improved farm practices, 40.00 per cent of the small and 44.44 per cent of the medium farmers had moderately favourable attitude towards improved farm practices. Majority of the respondents had medium level of knowledge on agricultural technology, the figures being 82.66, 67.69 and 66.67 per cent for marginal, small and medium farmers respectively. Majority of the respondents had medium degree of information exposure, the figures being 81.63, 78.85 and 80.00 per cent for marginal, small and medium farmers respectively.

5.3.2 Enterprise mix in selected farming system

There were 18 different types of crop based farming systems practised by the respondents in three size group of farms. The pooled data revealed that the highest percentage of the respondents (19.71%) practised the system crop-dairy-goat-fish-duck followed by the system crop-dairy-fish-duck-pigeon by 16.82 per cent and the system crop-dairy-goat-duck-pigeon by 11.05 per cent of the respondents.

The highest average total gross margin (Rs. 24315.00) was obtained from the system crop-dairy-fish-duck-pigeon. In all the farming systems, crop enterprise had the highest contribution towards the total gross margin ranging between 83.61 and 54.30 per cent.

5.3.3 Level of adoption of selected agricultural technologies

From the analysis of frequencies of adaptors it was found that although the percentage of respondents adopting high yielding variety seeds and chemical fertilizers were relatively high in all the farm size groups, the percentage of respondents adopting plant protection chemicals were low.

More than 60.00 per cent of the respondents in all the farm size groups adopted high yielding variety seeds in *sali* and *ahu* rice and chemical fertilizers in *sali* rice, *ahu* rice and potato. Highest percentage of respondents (39.90%) adopted chemical pesticides in mustard crop.

As regards level of adoption, majority of the respondents had medium level of adoption of high yielding variety seeds, the figures being 69.39, 70.77 and 66.66 per cent for marginal, small and medium farmers respectively. Majority of the respondents had medium level of adoption of chemical fertilizers, the figures being 67.35, 72.31 and 71.11 per cent for marginal, small and medium farmers respectively.

While majority (63.27%) of marginal farmers and 43.08 per cent of the small farmers had low level of adoption of chemical pesticides, 48.89 per cent of the medium farmers had medium level of adoption of chemical pesticides.

The overall adoption scores revealed that while 44.90 per cent of the marginal farmers had low level of adoption of three selected agricultural technologies, 40.00 per cent each of the small and medium farmers had medium level of adoption of three selected agricultural technologies.

The highest overall mean adoption score (42.69) was obtained for medium farmers and lowest (33.73) for marginal farmers.

5.3.4 Level of productivity across different size group of farms

The data on total gross margin over variable costs revealed that while majority of the marginal (73.47%) and small (70.77%) farmers had medium level of total gross margin (between Rs.15969.00 and Rs.26974.00), majority of the medium farmers (53.33%) had high level of total gross margin (above Rs.26975.00) per annum. However, in the pooled sample, majority (66.83%) of the respondents had medium level of total gross margin per annum.

5.3.5 Relationship of level of adoption with selected independent variables

The relationship of level of adoption with 21 independent variables was found out by using zero order correlation coefficients. In case of marginal farmers, 13 independent variables were positively and significantly correlated with level of adoption. In respect of small farmers, 17 independent variables had positive and significant correlation with level of adoption. In case of medium farmers, 16 independent variables had positive and significant correlation with level of adoption. In the pooled sample of farmers, 17 independent variables had positive and significant correlation with level of adoption. Of these, knowledge level on agricultural technology (r = 0.661), working capital availability (r = 0.645), economic motivation (r = 0.592), attitude towards improved farm practices (r = 0.563), degree of information exposure (r = 0.561) and degree of commercialization (r = 0.521) had a moderately strong correlation with level of adoption.

5.3.6 Relationship of level of productivity with selected independent variables

Zero-order correlation coefficients were computed to find out the relationship of level of productivity with 21 independent variables. In case of marginal farmers, 13 independent variables had positive and significant correlation with the level of productivity. In case of small and medium farmers, 17 independent variables had positive and significant correlation with level of productivity. In the pooled sample of farmers, 18 independent variables had positive and significant correlation with level of productivity. Of these, economic motivation (r = 0.692), orientation towards competition (r = 0.660), cropping intensity (r = 0.643), working capital availability (r = 0.589), knowledge level (r= 0.562) and attitude towards improved farm practices (r=0.505) had a moderately strong to strong correlation with level of productivity.

5.3.7 Contributory effects of selected independent variables on level of adoption

The technique of multiple regression analysis was employed to get estimates of the predictive abilities of selected independent variables on the dependent variable, i.e. level of adoption of agricultural technology. The independent variables which were significantly correlated with the level of adoption were selected for multiple regression analysis. The independent variables were ranked on the basis of standard partial regression values.

In case of marginal farmers, out of 13 independent variables, knowledge level on agricultural technology, working capital availability and attitude towards improved farm practices were ranked first, second and third respectively in order of their predictive abilities.

In case of small farmers out of 17 independent variables, economic motivation, working capital availability and cropping intensity were ranked first, second and third respectively in order of their predictive abilities.

In respect of medium farmers, out of 17 independent variables, knowledge level on agricultural technology, economic motivation and working capital availability were ranked first, second and third respectively in order of their predictive abilities.

In the pooled sample, knowledge level on agricultural technology, working capital availability and economic motivation were ranked first, second and third respectively in order of their predictive abilities.

4.3.8 Contributory effects of selected independent variables on level of productivity

The technique of multiple regression analysis was employed to get estimates of the predictive abilities of selected independent variables on the dependent variables, i.e. level of productivity. The independent variables which were significantly correlated with the level of productivity were selected for multiple regression analysis. The independent variables were ranked on the basis of standard partial regression values.

In case of marginal farmers, out of 13 independent variables, economic motivation, knowledge level and level of aspiration were ranked first, second and third respectively in order of their predictive abilities.

In case of small farmers, out of 17 independent variables, knowledge level, economic motivation and cropping intensity were ranked first, second and third respectively in order of their predictive abilities.

In respect of medium farmers, out of 18 independent variables, economic motivation, knowledge level and level of aspiration were ranked first, second and third respectively in order of their predictive abilities.

In the pooled sample, out of 18 independent variables, 10 variables were found to contribute significantly towards the level of productivity. Out of these, economic motivation, level of aspiration and orientation towards competition were ranked first, second and third respectively in order of their predictive abilities.

5.3.9 Direct and indirect effects of selected independent variables on level of adoption

The nine independent variables whose partial regression values were significant in the multiple regression analysis were included in the path analysis. The path analysis was done with the pooled sample of farmers. The variables were arranged from high to low total direct effect.

The findings revealed that the variable knowledge level on agricultural technology had the highest positive and substantial direct effect (0.267) on the level of adoption followed by the variables economic motivation (0.210) and working capital *availability (0.206).*

The variable knowledge level on agricultural technology emerged to be most important as substantial indirect effects of as many as six variables were channeled through this variable.

The variable degree of information exposure had the highest (0.470) total indirect effect on the level of adoption.

5.3.10 Direct and indirect effects of selected independent variables on level of productivity

The ten independent variables whose partial regression values were significant in the multiple regression analysis were included in the path analysis. The path analysis was done with the pooled sample of farmers. The variables were arranged from high to low total direct effect.

The findings revealed that the variable orientation towards competition had the highest positive and substantial direct effect (0.269) on the level of productivity followed by the variables level of aspiration (0.241) and cropping intensity (0.219).

The variables size of land holding and cropping intensity emerged to be important as substantial indirect effects of as many as five variables were channeled through each of these two variables.

The variable economic motivation had the highest (0.515) total indirect effect on level of productivity.

5.3.11 Farmers' perceptions of the factors hindering adoption of improved agricultural technology

In respect of marginal and small farmers, 'lack of finance', 'non-availability of high yielding variety seeds in time' and 'high cost of fertilizers and pesticides' were perceived to be the three most important constraints in adoption of improved technology.

In respect of medium farmers, 'non-availability of high yielding variety seeds in time', 'lack of irrigation facilities' and 'lack of knowledge about plant protection measures' were perceived as the three most important constraints in adoption of improved agricultural technology by them.

5.4 Implications of the findings

1. The findings on level of adoption of agricultural technology revealed that around 80.00 per cent of the respondents had low to medium level of adoption of three

selected agricultural technologies. The overall mean adoption scores indicated that marginal and small farmers used the three agricultural technologies in less than 40.00 per cent of their areas having potential for use of those technologies. In case of marginal farmers it was slightly higher than 40.00 per cent. The overall mean adoption score in the pooled sample indicated that the respondents adopted the three agricultural technologies in only 37.16 per cent of their areas having potential for adoption of these technologies.

An effective strategy for transfer of technology should seek to pin point these gaps in adoption and try to reduce them as far as practicable by the use of appropriate extension methods and aids.

2. The findings of correlational analysis, regression and path analysis indicated that the variables knowledge level on agricultural technology, economic motivation and availability of working capital were three most important variables influencing the level of adoption of improved technology by farmers. A highly significant and positive correlation of these variables with level of adoption indicated that farmers with higher level of knowledge on agricultural technology, higher level of economic motivation and more working capital availability adopted the improved technology to a greater extent. Other important variables influencing level of adoption were degree of commercialization, size of operational land holding, attitude towards improved farm practices, degree of information exposure, cropping intensity and innovation proneness.

   Where these attributes are at a low level in the farmers, suitable extension methods may be adopted to modify adoption behaviour of farmers in the desirable direction.

3. The findings revealed that the variables economic motivation, orientation towards competition, level of aspiration and cropping intensity were four most important variables influencing level of productivity of farmers. A highly significant and positive correlation of these variables with level of productivity indicated that farmers with higher level of economic motivation, higher orientation towards competition, higher level of aspiration and higher cropping intensity realized higher

total gross margin from various farming activities. Other important variables influencing level of productivity of farmers were attitude towards improved farm practices, working capital availability, knowledge level, degree of commercialization and degree of information exposure.

Where these attributes are at a low level in farmers, suitable extension *methods may be adopted to modify farmers' behaviour for increased productivity.*

Productivity may be regarded as a function of some inputs or resources - material as well non-material. It may be helpful for extension workers to view productivity as a manifestation of farmers' behaviour in obtaining return by utilizing the resources which are at their disposal or they can command. This view has been emphasized in the present study.

4. The findings revealed that although crop enterprise had the largest contribution towards the total gross margin of a farming system, the other enterprises, *viz.*, fishery, dairy, piggery, poultry, goatary, duckery and pigeon also had substantial contribution towards the total gross margin. It was also indicated that the average total gross margin increased with an increase in number of enterprises.

Development workers should emphasize these points so that farmers may be helped to enhance their productivity through judicious selection and combination of enterprises in their farming systems.

5. While 'lack of finance', 'non-availability of high yielding variety in time' and 'high cost of fertilizers and pesticides' were the three most important constraints in adoption of improved technology as perceived by the small and marginal farmers, 'non-availability of high yielding variety seeds', 'lack of irrigation facilities' and 'lack of knowledge about plant protection measures' were three most important constraints in adoption of improved technology as perceived by the medium farmers.

For enhancing the level of adoption of resource- poor farmers in rainfed areas, it is essential to look into the availability of production inputs, in adequate quantity, in time and at reasonable prices. The need for expansion of credit facility in the rural areas was urgently felt. This is particularly important for the backward rainfed areas. Moreover, 'lack of easily available credit', 'lack of technical guidance from extension personnel' and 'lack of knowledge about fertilizer management' were perceived as major constraints in adoption of improved technology by farmers. The success of the agricultural extension work in rainfed farming areas shall depend to a large extent on the strength of agricultural extension system and other support systems in solving these problems.

6. The findings revealed that majority of the farmer respondents had low or no formal education. Education helps in developing mental faculty of the individuals. The variability in adoption behaviour of individuals may be, to some extent, due to differences in their level of education. For enhancing the level of technology adoption and level of productivity of farmers in rainfed areas, the need for improving their level of education is very essential.

7. The findings revealed that majority of the farmer respondents had low level of innovation proneness. Innovation proneness may be regarded as a deposition of an individual to accept the innovations. As a result of emphasis on agricultural research, the innovations, especially the high yielding varieties of crops are released periodically at a very faster rate. All the innovations are not alike and therefore quick shift from old to new is expected of the farmers. This is possible only when they are prone to use them when they are recommended. Thus, for enhancing the level of adoption of improved technology, there is need to maker the farmers more innovative by the use of appropriate extension methods and aids.

8. The findings revealed that average cropping intensity of respondents was low, especially in the medium size group of farm, which was lower than the average cropping intensity of marginal and small farms. For improving the level of adoption of agricultural technology and productivity in rainfed farming areas, the need for enhancing the cropping intensity is very essential.

9. The findings revealed that a vast majority of farmer respondents had low and medium degree of information exposure. Dissemination of information on agricultural innovations must precede their adoption by farmers. On the other hand, there is a close relationship between the sources of information used by farmers and their adoption behaviour, as communicators of information not only inform but also

influence farmers' decision regarding the adoption of improved farming practices. Thus, for enhancing the level of adoption of various improved farm practices by the farmers, the need for increasing their degree of information exposure is very crucial.

10. The findings revealed that about one-third of the respondents had less favourable attitude and more than one-third of them had moderately favourable attitude towards improved farm practices. A favourable attitude of farmers towards improved technology increases the possibility that farmers will adopt the technology more than those who have unfavourable attitude. For widespread acceptance of various improved practices, the need for creating a favourable attitude of farmers towards those practices is very essential.

11. The findings revealed that farmers' knowledge about agricultural technology was an important component determining the level of adoption of those technologies by them. Cultivation of high yielding varieties as such may not give high yield, unless farmers acquire adequate knowledge about improved cultivation practices of different crops grown by them. To enhance the level of adoption of improved technology, it is essential to train the farmers thoroughly in improved cultivation practices of crops grown by them. More attention should be paid to enhance farmers' knowledge about principles and practice of plant protection.

12. Farmers' economic motivation was found to be an important component in determining the level of adoption of agricultural technology by them. The extension activities had to be organised in such a way as to increase their level of economic motivation so that it may act as self-sustaining force for increasing the level of adoption of improved technology in their farms.

13. Farmers' orientation towards competition and their level of aspiration were found to be two important factors determining their level of productivity from different farm activities. The extension activities have to be organised in such a way as to increase their level of orientation towards competition and level of aspiration. This shall not only help the farmers to adopt various improved technologies but also help to enhance their level of productivity from different farm activities.

5.5 Suggestions for further research

1. The level of adoption in the present study was studied for three selected agricultural technologies with respect to improved cultivation of seven selected crops in crop based farming system. There is further scope for extensive study on the adoption of different improved farm practices in different types of farming systems prevalent in the rainfed areas.
2. In the present study, the 17 independent variables included in the regression analysis could predict 68.40 per cent of the variation in the adoption behaviour of farmers and 18 independent variables could predict 59.80 per cent of the variation in the level of productivity of farmers. Thus, a considerable portion of the variation in the level of adoption and productivity remained unexplained. There is, hence, scope for further research in this regard by considering more number of relevant variables which may explain better the variation in the adoption behaviour and productivity of farmers in rainfed areas.
3. The contribution of ecological variables towards level of adoption and productivity were not considered in the present study. Hence, there is scope for further research by incorporating different ecological variables relevant to the situation prevailing in the rainfed areas.
4. The research studies of this kind may be undertaken by employing a participatory and inter-disciplinary approach.
5. Investigations may be made to sort out the reasons of not adopting improved technologies equally by the farmers in different types of farming systems in rainfed areas.
6. The present study was conducted without taking help of any farming system model. Research studies of this kind may be undertaken by taking appropriate farming system model into consideration.
7. In estimating the level of productivity in the present study, only partial measures of productivity were taken into account. There is scope for further research to

evaluate productivity of different farming systems by using more appropriate functional measures.

8. The concept of adoption used in the present study comprised of three dimensions. Level of adoption of different improved technologies may be studied with more elaboration by taking more dimensions into consideration.

9. Detailed investigations may be made on the contributions of each enterprise or combination of enterprises towards the level of productivity in different types of farming systems prevalent in the rainfed areas.

10. For arriving at wider generalizations of the findings of the present study, similar research study may be taken up covering a larger area and with a larger sample size.

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Appendices

APPENDIX I

RESEARCH SCHEDULE FOR INVESTIGATION

PART - 1

1. Name of the farmer :

2. Address :

Village :

Block :

VLEW circle :

AEO circle :

Agril. sub-division :

District :

3. Age (years) :

4. Educational level :

Illiterate ☐

Can read only ☐

Can read and write/primary level ☐

Middle school level ☐

High school level ☐

H. S./P. U. level ☐

Graduate/diploma or above ☐

5. Type of family : Single/Joint

6. Family size :

(a) Number of adult male members :

(b) Number of adult female members :

(c) Number of children :

(d) Total number of members in the family :

7. Size of operational land holding (*bighas* or hectares) :

(a) Area of cultivable land owned :

(b) Area of cultivable land leased in for cultivation :

(c) Area of cultivable land leased out for cultivation :

(d) Size of operational land holding = (a+b)-c :

8. Social participation :

Please indicate whether you are a member or office bearer of any organization and if so mention the name of the organization and if so mention the name of the organization.

Nature of participation	**Name of organization**
a. Member of one organization	
b. Member of more than one organization	
c. Office bearer	
d. No membership	

9. Family labour available and utilized (mandays) :

Activities and type of family labour	Kharif season (mid June-mid Oct.)		Rabi season (mid Oct - mid Feb.)		Summer season (mid Feb.- mid June)		Total family labour (mandays)	
	Available	Utilized	Available	Utilized	Available	Utilized	Available	Utilized
A. Crop production activities :								
Adult male :								
Adult female :								
Children :								
B. Livestock/ Fishery activities :								
Adult male :								
Adult female :								
Children :								

10. Farm mechanization :

Please mention which of the following agricultural machines/implements you are using and for how many years.

Machines/Implements	Weightage	No. of years used	Score
1. Tractor	3		
2. Power tiller	2		
3. Disk harrow	2		
4. Cultivator	1		
5. Trailer	1		
6. Mould board plough (Bullock drawn)	1		
7. Seed drill	1		
8. Pump set	3		
9. Wheel hoe	1		
10. Paddy weeder	1		
11. Sprayer	2		
12. Duster	1		

11. Variable Cost/Working Capital Expenditure :

You might use various inputs (such as seed, fertilizer, manure, pesticides, human and bullock labour, feed for livestock and fish farm equipment etc) for production of crops livestock and feeds in your farm. Please mention those inputs which you use during the last agricultural year and also mention the quantity and cost of each input used.

Name of input	Name of crop or livestock	Quantity used (qt/kg/lit/No./MD)			Cost (Rs. per qt/kg/lit/No./MD)	Total expenditure (Rs.)
		Own	Purchased	Hired		

12. Information sources used :

You may be getting information regarding improved farm practices from various sources. Please let me know which of the following sources you have utilized for getting information about improved farm practices and mention the frequency of use of each source.

Sources	Frequency of use		
	Often	Sometimes	Never
A. Personal Cosmopolite			
1. Agril. Extension Officer			
2. Village Level Extension Worker			
3. Block Extension Personnel			
4. Agril Scientists			
5. Input Dealers			
B. Personal Locsalite			
1. Friends/Relatives/Neighbours/Fellow Farmers			
2. Family Members			
C. Mass Media			
1. Radio			
2. Television			
3. News Paper			
4. Farm Publications			
D. Others (Specify)			

13. Crop Enterprises, Production and Sale (during last agricultural year) :

Crops	Cultivated land area (Bigha/ha)	Total production (Qt)		Quantity sold (Qt)		Local price (Rs./qt)	
		Main product	Bye product	Main product	Bye product	Main product	Bye product
A. Kharif crops							
B. Rabi crops							
C. Summer crops							

14. Livestock Enterprises, Production and Sale (during last agricultural year) :

Livestock	Number		Total production (Qt/No./lit)		Quantity sold (Qt/No./lit)		Local price (Rs. per Qt/No./lit)	
	Adult	Young	Main product	Bye product	Main product	Bye product	Main product	Bye product
1. Dairy								
2. Buffalo								
3. Goat								
4. Pig								
5. Duck								
6. Pigeon								
7. Poultry								
8. Others (Specify)								

15. Fishery Enterprise, Production and Sale (during the last agricultural year) :

(a) Total area under fishery (bigha /hectare) :
(b) Total annual production of fish (Qt.) :
(c) Quantity of fish sold (Qt.) :
(d) Local price (Rs./Qt.) :

16.Knowlegde level on agricultural technologies:

Please answer the following questions regarding improved cultivation practices of Rice, Wheat, Pea, Mustard and Potato.

A. Please name atleast two recommended High Yielding Varieties of each of the following crops ?

Crops	Varieties	Remarks
1. *Sali* rice	-------	Correct/Incorrect
2. *Ahu* rice	-------	Correct/Incorrect
3. Wheat	-------	Correct/Incorrect
4. Rape and mustard	-------	Correct/Incorrect
5. Pea	-----	Correct/Incorrect
6. Potato	-------	Correct/Incorrect

B. What are the different methods of chemical seed treatment?

7 (i) ------- Correct/Incorrect
(ii)

C. Please name any recommended chemical that can be used to treat seeds of the following crops?

Crops	Chemical	
8. Rice	-------	Correct/Incorrect
9. wheat	-------	Correct/Incorrect

D. Please tell the method of inoculating the seeds with *Rhizobium* culture ?

10. ------- Correct/Incorrect

E. What are the recommended seed rates per bigha for the following crops ?

Crops	Seed rates (kg/bigha)	
11. Direct seeded *Ahu* :	-------	Correct/Incorrect
12. Transplanted rice :	-------	Correct/Incorrect
13. Wheat	-------	Correct/Incorrect
14. Rape and mustard	-----	Correct/Incorrect

F. What are the recommended doses of the following fertilizers for one bigha of rice crop?

Fertilizers	Doses (kg/bigha) Semi dwarf variety	Tall variety	
15. Urea :	-------	------	Correct/Incorrect
16. Single super phosphate (SSP)	-------	-------	Correct/Incorrect
17. Muriate of potash (MOP)	------	-------	Correct/Incorrect

G. What are the recommended doses of the following fertilizers for one bigha of wheat crop?

	Doses of Fertilizers (kg/bigha)		
Fertilizers	Irrigated	Unirrigated	
18. Urea :	----------	-------------	Correct/Incorrect
19. SSP :	----------	-------------	Correct/Incorrect
20. MOP :	----------	-------------	Correct/Incorrect

H. Please mention in brief the nature of damage caused by the following diseases

Name of disease	Nature of damage	
21. Blast of rice	-------------	Correct/Incorrect
22. Late Blight of Potato	-------------	Correct/Incorrect

I. Which of the following diseases cause damage to the wheat crop?

23. a. Powdery mildew Correct/Incorrect

b. Loose smut

c. Wilt

J. Please tell the exact category of the following chemicals ?

Chemical	Categories			
	Fungicide	Insecticide	Rodenticide	
24. Dimecron	-------------	-------------	-------------	Correct/Incorrect
25. Furadon	-------------	-------------	-------------	Correct/Incorrect
26. Captaf	-------------	-------------	-------------	Correct/Incorrect
27. Ekalux	-------------	-------------	-------------	Correct/Incorrect
28. Zinc phosphide	-------------	-------------	-------------	Correct/Incorrect
29. Endosulfan	-------------	-------------	-------------	Correct/Incorrect

K. Which chemical would you use to control blast disease in rice crop ?

30. -------------------------- Correct/Incorrect

L. Which chemical would you use to control late blight disease in potato crop ?

31. -------------------------- Correct/Incorrect

M. Please mention in brief the nature of damage caused by the following insect-pests in **rice** crop?

Name of Insect	Nature of damage	
32. Stem borer	-------------------------	Correct/Incorrect
33. Hispa	-------------------------	Correct/Incorrect

N. Which chemical would you use to control the following insect-pests in rice crop?

Insect	Chemical	
34. Stem borer	-------------------------	Correct/Incorrect
35. Hispa	-------------------------	Correct/Incorrect

O. Which chemical would you use to control aphids in rape and mustard crops?

36. ------------------------- Correct/Incorrect

P. Please mention in brief the nature of damage caused by pod borers in pea crop ?

36. ------------------------- Correct/Incorrect

P. Please mention in brief the nature of damage caused by pod borers in pea crop?

37. ---------------------- Correct/Incorrect

Q. Which chemical would you use to control pod borers in pea crop?

38. ---------------------- Correct/Incorrect

17.Attitude towards improved farm practices :

Please state the degree of your agreement or disagreement to each of the following statement.

Sl. No.	Statement	Agree	Undecided	disagree
1.	I suppose we have no choice but to use improved methods of cultivation			
2.	We should be willing to spend more money even if using new methods is expensive			
3.	Not using the improved methods of agriculture would now make our situation worst			
4.	The present new methods may not be the best way to improve agricultural situation but it is the only thing we can do			
5.	Increasing the agricultural production is absolutely necessary at any cost			
6.	We are protecting ourselves and our interests by using new methods			
7.	The reason we are using the methods is to increase the yields			

18. Innovation Proneness:

Please indicate which of the following statements is most like your thinking and which is least like your thinking.

Sl. No.	Statements	Most like	Least like
1.	(a) I try to keep myself up-to-date with information on new farm practices, but do not mean that I try out all the new methods on my farm		
	(b) I feel restless till I try out new farm practice I heard about		
	(c) They talk of many new farm practices these days, but who knows if they are better than the old ones		
2.	(a) From time to time I have heard of several new practices and I have tried most of them in the last few years		
	(b) I usually wait to see what results my neighbours obtain before I try out the new farm practices		
	(c) Somehow I believe that the traditional ways of farming are the best		
3.	(a) I am cautious about trying of new practices		
	(b) After all our forefathers were wise in their farming practices and I do not see any reason for changing these old methods		
	(c) Often new practices are not successful, however, if they are promising I would surely like to adopt them		

19. Orientation towards competition:

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

Sl. No.	Statements	Strongly agree	Agree	Disagree	Strongly disagree
I	The key points of success in farming should not be divulged to other farmers				
II	A better yield in comparison to the neighbours bring more prestige				
III	It is of no use to keep information as what other farmers are doing				
IV	Crop competitions should be organized for all important crops				
V	Better farming provides opportunity for recognition by the extension officers				
VI	It is not good for a farmer to become too ambitious in life				

20. Management orientation:

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

Sl. No.	Statements	Strongly agree	Agree	Disagree	Strongly disagree
A	Planning Orientation				
	(i) Each year one should think afresh about the crops to be cultivated in each type of land				
	(ii) It is not necessary to make prior decision about the variety of crop to be cultivated				
	(iii) The amount of seed, fertilizers and plant protection chemicals needed for raising a crop should be assessed before cultivation				
	(iv) It is necessary to think ahead of the cost involved in raising a crop				
	(v) One need not consult an agricultural expert for crop planning				
	(vi) It is possible to increase the yield through farm production plan				
B	*Production Orientation*				
	(i) Timely planting of a crop ensures good yield				
	(ii) One should use as much fertilizer as he likes				
	(iii) Determining fertilizer dose by soil testing saves money				
	(iv) Seed rate should be given as recommended by the specisalists.				
	(v) For timely weed control one should even use suitable herbicides				
	(vi) With low water rates one *should use as much irrigation* as water available				

C	*Marketing Orientation*				
	(i) Market news is not so useful to a farmer				
	(ii) A farmer can get good price by grading his produce				
	(iii) Warehouses can help the farmer to get better price of his produce				
	(iv) one should sell his produce to the nearest market irrespective of price				
	(v) One should purchase his inputs from the shop, where his other relatives purchase				
	(vi) One should grow those crops which have more market demand				

SA denotes to strongly agree
A denotes to agree
DA denotes to disagree
SD denotes to strongly disagree

21. Scientific orientation:

Please state the degree of your agreement or disagreement to each of the following statements

Sl. No.	*Statements*	SA	A	UD	DA	SD
1	New methods of farming give better results to a farmer than the old methods					
2	Even a farmer with lot of experience should use new methods of farming					
3	Though it takes time for a farmer to learn new methods in farming, it is worth the efforts					
4	A good farmer experiments with new ideas in farming					
5	Traditional methods of farming have to be changed in order to raise the level of living of farmers					
6	The way of farming of farmers forefathers is still the best way to farm today					

SA denotes to strongly agree
A denotes to agree
UD denotes to undecided
DA denotes to disagree
SD denotes to strongly disagree

22. Economic motivation:

Please state the degree of your agreement or disagreement to each of the following statements

Sl. No.	Statements	SA	A	UD	DA	SD
1	A farmer should work towards larger yields and economic profits					
2	A most successful farmer is the one who makes the most profit					
3	A farmer should try any new farming ideas which may earn him more money.					
4	A farmer should grow cash crops to increase monetary profits in comparison to growing of food crops for home consumption.					
5	It is difficult for the farmer's children to make good start unless he provides them with economic assistance.					
6	A farmer must earn his living but the most important thing in life cannot be defined in economic terms					

SA denotes to strongly agree
A denotes to agree
UD denotes to undecided
DA denotes to disagree
SD denotes to strongly disagree

23.Risk orientation:

Please state the degree of your agreement or disagreement to each of the following statements

Sl. No.	Statements	SA	A	UD	DA	SD
1	A farmer should rather take more of a chance in making a big profit than to be content with a smaller, but less risky profit.					
2	A farmer who is willing to take greater risks than the average farmers, 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	Trying an entirely new method in farming by a farmer involves risks but it is worth it.					
5	A farmer should grow large number of crops to avoid greater risks involved in growing one or two crops					
6	It is better for a farmer not to try new farming methods unless most others have used them with success.					

SA denotes to strongly agree
A denotes to agree
UD denotes to undecided
DA denotes to disagree
SD denotes to strongly disagree

24. Levels of aspiration:

Please indicate your response to the following questions.

1. What level you expect your sons to reach in their education ?

No education	Primary	Middle	High school	College or above
(0)	(1)	(2)	(3)	(4)

2. What level you expect your daughters to reach in their education ?

No education	Primary	Middle	High school	College or above
(0)	(1)	(2)	(3)	(4)

3.What is your aspiration in respect to increasing your land in next three years ?

None	Less than 25%	25 to 50%	50 to 75%	More than 75%
(0)	(1)	(2)	(3)	(4)

4. What level you expect to increase your crop production in the next three years ?

None	Less than 25%	25 to 50%	50 to 75%	More than 75%
(0)	(1)	(2)	(3)	(4)

5. What is your expectation in respect to purchase of agricultural implements/ machines in the next three years ?

None	Wheel hoe or paddy weeder	M.B. Plough or seed drill	Power tiller or thresher or sprayer	Tractor or pumpset
(0)	(1)	(2)	(3)	(4)

6. What is your aspiration in respect to increase of farm animals in the next three years ?

None	Poultry or duck	Goat or pig	Cows or buffalo	Bullock
(0)	(1)	(2)	(3)	(4)

7. What is your aspiration in respect to increasing your annual income in the next three years ?

None	Less than 25%	25 to 50%	50 to 75%	More than 75%
(0)	(1)	(2)	(3)	(4)

8.What is your aspiration in respect to house alteration or construction **in the next three** years ?

None	Minor repairing in the existing house	Construction of katcha house	Construction of one pucca house	Construction of two or more house
(0)	(1)	(2)	(3)	(4)

9. What is your expectation to have more material possession in the next three years?

None	Chair-table Almirah	Radio Tape Cycle	Television	Silver or Gold ornaments
(0)	(1)	(2)	(3)	(4)

11. What level you expect in your general contentment (satisfaction) to reach in the next three years?

None	Some what better	Better	Mostly better	Certainly better
(0)	(1)	(2)	(3)	(4)

PART II

1. Adoption or non-adoption of improved technology

Following is a list of some improved technologies/practices. Please indicate which of the technologies/practices you are using in your farm during the last three years.

Sl. No.	Technology/practice	Used	Not used
A.	**Crop production**		
	1) Recommended number of ploughing		
	2) HYV/Hybrid seeds		
	3) Compost pit/Farm Yard Manure		
	4) Chemical fertilizers		
	5) Micronutrients		
	6) Line sowing/line transplanting		

	7) Chemical seed treatment		
	8) Rhizobium culture		
	9) Insecticides/fungicides/rodenticides		
	10) Chemical weedicides		
	11) Green manuring		
B.	**Livestock production**		
	1) Improved breeds		
	2) Artificial insemination		
	3) Recommended feed mixture		
	4) Recommended health practices		
C.	**Fish production**		
	1) Recommended species of fish		
	2) Recommended feed for fish		
	3) Lime application in pond		
	4) Fertilizer application in pond		

PART III

1. Factors hindering adoption of improved agricultural technology :

Please mention important factors which, in your opinion, are the main obstacles to adoption of improved agricultural technologies in your farm. Also, rank these factors according to their degree of importance to you (from most to least important).

Factors **Rank**

1.
2.
3.

2. Level of adoption of agricultural technology :

Please state the potential area in which you can cultivate each of the following crops and also state the actual area (out of the potential area for a particular crop) in which you have used the various improved agricultural technologies during the three crop seasons (i.e. Kharif, Rabi and Summer).

Sl. No.	Name of improved technology	Sali rice		Ahu rice		Boro rice		Wheat		Mustard		Potato		Pea	
		P. A.	A. A.	P. A.	A. A.	P. A.	A. A.	P. A.	A. A.	P. A.	A. A.	P. A.	A. A.	P. A.	A. A.

P. A. denotes to potential area for cultivating a particular crop (in bigha or hectatre)

A. A denotes to actual area under a specified agricultural technology (in bigha or hectare)

APPENDIX II

Amount of annual rainfall and number of rainy days in Lower Brahmaputra Valley Zone during last ten years (1990-1999)

Year	Amount of rainfall (mm)	Number of rainy days
1990	3253.20	119
1991	3181.40	131
1992	2855.30	112
1993	3955.20	140
1994	2785.10	128
1995	5222.80	119
1996	3670.90	120
1997	2872.80	96
1998	3201.98	118
1999	4299.10	110

Source : Regional Agricultural Research Station, Gossaigaon