Adoption Behaviour of Rice Growers on Improved Rice Technology Through Krishi Vigyan Kendra (KVK) in Khowai District of Tripura

Thesis

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in partial fulfilment of the requirements
for the award of the degree of

Master of Science (Agriculture)

In

Agricultural Extension

by

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CERTIFICATE – I

Certified that **Ms. Debjani Das** {Admission No. **CAU/CPGS/AGEXT/M-16/02;** Registration No. **CAU/216-A/16(PG)**} has satisfactorily prosecuted her course of research for a period of not less than two semesters and that the thesis entitled **"Adoption behaviour of rice growers on improved rice technology through Krishi Vigyan Kendra (KVK) in Khowai district of Tripura"** submitted by her to the Central Agricultural University, Imphal -795 004 (Manipur) in partial fulfilment of the requirements for the award of the degree of **Master of Science in Agriculture** in the subject of **Agricultural Extension** is the result of original research work conducted by her under my supervision and is sufficiently of high standard to warrant its presentation to the examination.

I also certify that the thesis or part thereof has not been previously submitted by her for a degree of any University.

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CERTIFICATE – II

This is to certify that the thesis entitled **"Adoption Behaviour of Rice Growers on Improved Rice Technology Through Krishi Vigyan Kendra (KVK) in Khowai District of Tripura''** submitted by **Ms. Debjani Das [Regn. No. CAU/216-A/16 (PG)]** submitted to the Central Agricultural University, Imphal -795 004 (Manipur) in partial fulfillment of the requirement for the award of the degree of **Master of Science (Agriculture)** in the subject of **Agricultural Extension** has been approved by the Student's Advisory Committee after oral examination jointly with a Dean's Nominee.

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DECLARATION

I hereby declare that the thesis entitled **"ADOPTION BEHAVIOUR OF RICE GROWERS ON IMPROVED RICE TECHNOLOGY THROUGH KRISHI VIGYAN KENDRA (KVK) IN KHOWAI DISTRICT OF TRIPURA"** is an authentic record of the work done by me and that no part thereof has been presented for the award of any degree, diploma, associateship, fellowship or any similar title.

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Place: Umiam

Dated: **(Debjani Das)**

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LIST OF ABBREVIATIONS

et al.,	and others
Etc.	et cetera
f	Frequency
Fig.	Figure
FLD	Frontline demonstration
GDP	Gross Domestic Product
H_0	Null Hypothesis
Ha	Hectare
ICAR	Indian Council of Agricultural Research
ICT	Information Communication Technology
IEC	Information Education and Communication
IPM	Integrated Pest Management
Kg	Kilogram
KMAS	Kisan Mobile Advisory Service
KVK	Krishi Vigyan Kendra
MT	Metric tonne/Million tonne
NEH	North Eastern Hill
No.	Number
OFT	On-farm testing
P.S.	Proportionate sampling
S.R.S.	Simple random sampling
Sl.	Serial
viz.	Namely

ABSTRACT

The KVK as frontline extension system is mandated to assess and refine (if needed) the newly released technologies, demonstrate the proven ones and train farmers and extension functionaries on the same. It has been reported that, some of the KVKs have been effectively contributing to the technology development and promotion process while many are plagued with several problems. Hence, the present study was undertaken to analyze the adoption behaviour of rice growers on improved rice technology through Krishi Vigyan Kendra(KVK) in Khowai district of Tripura.The objectives of the study were: i)To find out the level of knowledge on improved rice cultivation technologies of farmers. ii)To find out the extent of adoption of improved rice technologies among farmers. iii)To study the problems faced by the farmers in the adoption of improved rice cultivation technologies.It was conducted in four purposively selected villages under KVK, Divyodaya, Chebri Khowai district of Tripura with 120 sample size from the adopted villages selected through simple random sampling with equal allocation. Data collection from the selected respondents was made with the help of structured schedule through personal interview method. Out of 120 respondents, majority were of middle aged (50.83%) with medium education level (45.84%), medium family size (67.50%), and with nuclear family type (61.67%) in case of their personal characteristics. While majority respondents were marginal farmers (68.34%), belonged to medium category of annual income (88.34%), medium farming experience (60.00%) and with medium level of training received (62.50%).The study also revealed that majority of the respondents in KVK adopted villages had medium level of knowledge on improved rice farming practices (54.16%), level of adoption (55.00%), level of productivity (68.34%), annual net income (81.67%), self confidence (58.33%) and materials possession (60.00%). Among the independent variables under study age, education, farming experience, annual income, training received, land holding, were found to be significantly associated with the knowledge and adoption level of improved practices of rice technologies. Inadequate availability of quality seed at proper time, lack of knowledge about scientific cropping pattern, cropping system, method of application, non-availability of improved implements and other critical inputs such as FYM/organic fertilizers, low price of product in local market, lack of storage and marketing facilities, lack of guidelines about seed treatment were the major problems faced by the respondents with respect to adoption of improved rice cultivation practices in the study area. Hence more number of trainings should be organized by KVKs so that it can benefited to more number of rice growers. Different training programmes followed by field demonstration should be organised and imparted so that farmers develop confidence in them to take up improved methods to increase their productivity and improve their socio-economic condition. strong extension network for effective transfer of latest technologies, Improvement of credit and market facilities and crop insurance are required to solve the problems related to rice cultivation.

Keywords: Adoption behaviour, Krishi Vigyan Kendra, Rice cultivation technologies.

Chapter-1

Introduction

Agriculture is the backbone of Indian economy which provides food and nutritional securities as well as employment and livelihoods to rural masses. Agriculture plays a vital role in India's economy. Over 58 per cent of the rural households depend on agriculture as their principal means of livelihood. Agriculture, along with fisheries and forestry, is one of the largest contributors to the Gross Domestic Product (GDP).

As per estimates by the Central Statistics Office (CSO), the share of agriculture and allied sectors (including agriculture, livestock, forestry and fishery) was 15.35 per cent of the Gross Value Added (GVA) during 2015–16 at 2011–12 prices.

India is the largest producer, consumer and exporter of spices and spice products. India's fruit production has grown faster than vegetables! making it the second largest fruit producer in the world. India's horticulture output, comprising fruits, vegetables and spices, has reached to a record high of 283.5 million tonnes (MT) in 2014-15. It ranks third in farm and agriculture outputs. Agricultural export constitutes 10 per cent of the country's exports and is the fourth-largest exported principal commodity. The agro industry in India is divided into several sub segments such as canned, dairy, processed, frozen food to fisheries, meat, poultry, and food grains.

The Department of Agriculture and Cooperation under the Ministry of Agriculture is responsible for the development of the agriculture sector in India. It manages several other bodies, such as the National Dairy Development Board (NDDB), to develop other allied agricultural sectors.

Agriculture plays a vital role in employment generation in Indian economy, with nearly half of its population is dependent on agriculture and allied activities for their livelihood. As per the National Sample Survey Office (NSSO), in 2011-12, the share of agriculture in employment was 48.9 per cent, in 2015-16; agriculture contributed 17.4 per cent to India's Gross Domestic Product (GDP), as compared to 18.3 per cent in 2013-14 (India Economic Survey, 2015-16).

India is among top rice growing countries in the world with an area of 43.8 million ha. followed by China (28.67 million ha). But in terms of productivity, India is behind many countries in the world like- China, USA, Japan and Egypt. Also, depleting natural resources particularly, water is a great challenge in order to overcome

these problems. The System of Rice Intensification (SRI) is an innovation which has been designed to increase the productivity of rice with optimum utilization of water and other inputs. Besides being a major consumer of the rice, India is the largest exporter and producer of Basmati rice in the world. The consumption curve of rice for India is also moving upwards, as there has been about 2-6 times increase in rice consumption by 2006 over 1960. The current population growth rate projects an additional requirement of 2.33 million tonnes of rice per annum in India. Meeting growing demand for rice and such other crops in national and international markets has caused huge stress on natural resources, primarily on land and water. Since these resources have almost been exhausted, the productivity of existing crop land needs to be improved without compromising health of agricultural ecosystem. In this context, development of improved seed technology seems the only emergent measure available for raising the ceiling of yield potential. For example, by adopting new varieties, China produces additional 300 million tonnes of rice due to higher yield by about 20 per cent over the conventional varieties.

Tripura is primarily an agriculture based economy. More than 42 per cent of its population now directly depends on Agriculture & allied activities and its contribution to the Gross State Domestic Product (GSDP) has increased. Small and marginal farmers constitute about 96 per cent of the total farmers in the state against 78 per cent that of country. Agriculture and allied activities have been remained as the backbone of the State's economy and rural economy is largely driven by this sector (GoT, 2015). Tripura a land-locked state of north eastern region of India has a total geographical area of 10491.69 km^2 with altitude of 780 m (north eastern part) to 15 m (western part) amsl. Terrain of the state is parallel hills and ridges alternated with narrow valleys and vegetation in tropical forest type (Dutta et al., 2009). Area under paddy in Tripura to the total cultivable area is 78.1 per cent with major rice seasons being April to June (Kharif-Aush), July to November (Kharif-Aman) and December to March (Boro). State's contribution to national paddy production is 0.66 per cent with an average productivity of 3.71 tonnes per ha and the all India rank in productivity is 7th (GoT, 2015).

The main agricultural crops grown in the State are paddy, maize, wheat, pulses, oilseeds, jute and mesta. The demand for food grains in Tripura was projected at 8.79 lakh tons for the year 2014-15. Rice continues to hold the key to sustained food security in the State. Rice alone contributed 96 per cent to the total food grain production target and required a productivity level of 2863 kg/ha in 2013-14, which was significantly higher than the present average yield of 2800 kg/ha. The production

of food grain reached 7.68 lakh tons during 2014-15 as against 7.27 lakh tons during 2013-14. Traditionally, people in the hills cultivate on high slopes by practicing jhum or shifting cultivation. The State Government has given technical guidance and production inputs under improved method of jhum cultivation programme. The State has become surplus producer of certified HYV (High Yield Variety) paddy and mustard seeds. Seed replacement rate (SRR) of HYV certified paddy has been maintained at the optimum level of 33 per cent for the last few years. In case of mustard, the SRR is 50 per cent. Steps have been taken to achieve self-sufficiency in HYV pulses, groundnut, sesamum seeds also. Major thrust areas of pest Perspective "Road Map". i) Bringing 1 lakh ha paddy area under SRI. ii) 0.50 lakh ha to be brought under Hybrid paddy cultivation. iii) Crop specific training to farmers for adoption of modern agricultural technologies and farmers field school for the whole cropping season. The State was fully dependent for HYV seeds from outside state, but taking special initiatives was taken to make the state self sufficient in respect of HYV seeds. Now, the State is producing surplus quantity of HYV seeds. The surplus production is being marked to the neighbouring seven North Eastern states through National Seed Corporation (NSC). During the period of Perspective Plan, farmers were trained on various agricultural technologies within the state as well as outside. The State Agriculture Department has organized the State Level Krishi Mela, felicitated a number of farmers by celebrating Krishak Sanman Diwas as well as organised the international rice seminar. Many intellectual giants and policy planners, including Prof. M.S. Swaminathan participated in the various seminars in the State.

As regards to the development of new technology and local need based researches, performances have been noticed in the field. New technology like SRI (System of Rice Intensification) has been accepted by the farmers of the Tripura. The production of food grains was increased at least by 30-50 per cent in SRI system than that of conventional methods. The new technologies have also been adopted to boost the production of Jhum cultivation for hill rice. Apart from inputs, agricultural machineries like power tillers distributed at subsidy to the farmers of the State.

The contribution to the GSDP was about 26% in 2014-15 from agriculture and allied activities. Food security as well as providing the gainful employment to the rural labour forces are the priorities of the Government planning and policy making. The State's favourable agro-climatic conditions, fertile soils, sub-tropical climate, large tilla lands and abundance of rainfall of about 2200 mm, well distributed across the season, really offer immense scope for development of horticulture sector comprising of fruits, vegetables, spices, plantation crops, floriculture, medicinal and

aromatic plants etc beside agricultural crops. Agriculture has an important potential demand base for both industry and services sectors, in addition to being the supply base for food and raw materials. The better performance of the agriculture has a direct and multiplier effect across the economy. Around 60 percent of geographical area is under forest and only about 27 percent is available for cultivation.. Fragmentation of land holding is still continuing as a part of social phenomenon. Average size of holding has been declined from 1.25 hectares in 1976-19.

Over the years Indian agriculture has made tremendous progress due to the contributions of agricultural science amongst others through development of improved seeds and planting material, pre and post-harvesting technologies, disease control and plant protection, irrigation and soil conservation techniques and use of farm machinery in agriculture. Thus it can be seen that the country has ushered in a great progress in food grains production in the new millennium. However, the shortage of quality food grains production in farmers' field in proportion to the changing population pattern in the country is a matter of concern at present. Agricultural innovations and diffusion of new technologies are key drivers to attain food security in the country besides providing farmers a competitive edge over traditional farming, thus facilitating better standards of living. To realize their true potential, farmers must have access to the state-of-the-art technologies, necessary inputs and related information in all the segments, be it crop, livestock, forestry or fisheries. In this context, the Government of India through Indian Council of Agricultural Research (ICAR) has established a wide network of Krishi Vigyan Kendra's (KVKs) in all the districts of the country. These KVKs under the aegis of the National Agricultural Research and Education System are the real carriers of frontline technologies and impart knowledge and critical input support to the farmers.

Enhancing the socio-economic status of rural farmers by upgrading their knowledge and skills is the main objective of transfer of technology. Acquisition and application of technology do not stand alone, but are conditioned by political, social, economic, and cultural factors that can impede the diffusion or transfer of technology. One of the major concerns in the transfer process is how to disseminate effectively new technologies considering the questions of where, how, and what technologies are appropriate to a given socio-economic milieu. Agricultural innovations and diffusion of new technologies are important factors for all developing countries including India in their quest for food and nutritional security. Farming in different resource endowments must be sustainable, economical, and intensive in order to provide dependable, long-term support for rural households. To achieve these, farmers must have access to

sustainable technology in crop, livestock, forestry, fisheries and other agri-related sectors. The Indian Council of Agriculture Research (ICAR) has established a network of 665 Krishi Vigyan Kendra's (KVKs) across the country till 2016 with an aim to conduct technology assessment, refinement and demonstration through various activities. In view of the changing scenario of agriculture, the activities of KVKs need to keep pace addressing newer challenge in the areas of climate change, market led extension, mechanization, agri-business and so on. It is to be ascertained if the new technologies are percolating to the ground level. Are farmers inclined to accept new inventions? Are these changes becoming accessible to farmers and helping them in any way and how effective is the role of KVKs in meeting these goals, are some of the pertinent questions.

A large number of institutions in the field of agriculture and allied sector are contributing to research in development of high yielding varieties of crops, technological innovations and other initiatives to boost production and human resource development. The technology available has to be permeated depending upon the necessities of the region- its soil, climate, culture and need and means of the farmers, available human resources, feasibility and viability of different parts of the country. It has been observed that there are variations in knowledge and technological percolation. The National Commission of Farmers (founded in 2004) raised the issue of knowledge deficit, which directly impinges on agriculture productivity. There are significant gaps in backward and forward linkages between the agricultural laboratories and the farmers, insofar as transfer of technology is concerned. The 10^{th} and 11^{th} plans have emphasized the need for effective extension services. The 11^{th} plan approach paper also stated that "in the longer run, growth in agriculture productivity can be sustained only through a continuous technological progress". This continuous technological progress would require high priorities not only for research but also, equally importantly, to ensuring that the results of such research. Hence a scientific transformation of agriculture in the present agricultural scenario is an important requisite of agricultural and rural development. Several organised efforts have been made to disseminate improved agricultural technologies among the farming community. One of the important components of these efforts has been of farmers training to impart knowledge and skills on various technological components in the field of agriculture and its allied sectors.

The situation in agriculture sectors is fast changing. The technology in agriculture is evolving. Is this new knowledge being implemented at grass root level and are farmers accepting the same? How much time it takes to transfer the

technology? It is also to be seen that, if new practices are not being adopted by the farmers then what are the reasons for that? What is the existing level of knowledge among farmers regarding rice cultivation in terms of various activities of KVK? What is the extent of adoption of improved rice technologies among farmers? What are the constraints faced by the farmers in the adoption of improved rice cultivation technologies? To answer all these questions there is a need to evaluate the adoption behaviour of rice growers on improved rice technology through KVK.

1.1 Growth of KVK

The Education Commission (1964-66) recommended that a vigorous effort be made to establish specialized institutions to provide vocational education in agriculture and allied fields at the pre and post-matriculate levels to cater to the training needs of a large number of boys and girls from rural areas. The commission, further, suggested that such institutions be named as 'Agricultural Polytechnics'. The recommendation of the commission was thoroughly discussed during 1966-72 by the Ministry of Education, Ministry of Agriculture, Planning Commission, ICAR and other allied institutions. Finally, the ICAR mooted the idea of establishing KVKs (Farm Science Centres) as innovative institutions for imparting vocational training to the practising farmers, school dropouts and field level extension functionaries. The first KVK, on a pilot basis, was established in 1974 at Puducherry (Pondicherry) under the administrative control of the Tamil Nadu Agricultural University, Coimbatore. As of now, ICAR has established 665 KVKs across the country (ICAR, 2016) and these are hosted by different agencies such as Agricultural/Veterinary Universities, Deemed Universities, ICAR Institutes, State Governments, NGOs, Public Sector Undertakings and other educational institutions.

At present, Krishi Vigyan Kendra (KVK) is the only institution at the district level in India for technological backstopping in agriculture and allied sectors. KVK is designed to have expertise in three areas;

a. Technology assessment, refinement and demonstration to evolve location and site specific need based and viable technologies.
b. Training and capacity development of farmers, rural youth, extension functionaries, and other stakeholders, and
c. Serve as knowledge and resource centre of agricultural technologies.

Technologies developed need proper assessment and refinement for a particular location, before disseminating on a larger scale through demonstrations. Further, the skills related to these technologies are to be transferred to the clientele properly through training programmes. In addition, good quality seeds, planting materials, livestock strains, bio-products etc. have to be produced and supplied to the farmers for the effective adoption. Technologies also reach the masses through various extension activities like Kissan melas, publications, field days, seminars, workshops, and farmers' visit to KVKs etc. KVKs undertake all these activities with the aim and objective of achieving sustainable growth in agriculture and its allied sectors in their respective districts. All KVKs are envisaged to reduce the time lag between generation of technology at the research institution and its application to the location specific farmer fields for increasing production, productivity and net farm income on a sustainable basis.

Reorganized KVK system

Presently there are 86 KVKs functioning in North Eastern Hill (NEH) region of India. Out of the total number of KVKs in the region, 23 KVKs are presently with State Agriculture University, 5 with Central Agricultural University, 32 with State Department of Agriculture, one with State Department of Veterinary & A. H., 20 with ICAR Research Complex, Barapani, 2 with National Research Centre and then 3 with Non-Government Organizations.

Keeping in view the importance of transactional research for effective technology dissemination and considering the changing agricultural scenario, the ICAR in the year 2014 proposed a new Vision, Mission and Mandate of KVK as given below:

Vision: Science and technology-led growth leading to enhanced productivity, profitability and sustainability of agriculture.

Mission: Farmer-centric growth in agriculture and allied sectors through application of appropriate technologies in specific agro-ecosystem perspectives.

Mandate: Technology Assessment and Demonstration for its wider application and to enhance Capacity Development (TADA-CD).

To implement the mandate effectively through creation of awareness about improved agricultural technologies, the following activities are envisaged for KVK-

a. On-farm Testing (OFT) to assess the location specificity of agricultural technologies under various farming systems.

b. Out scaling of farm innovations through Frontline demonstration (FLD) to showcase the specific benefits/worth of technologies on farmers' fields.

c. Capacity development of farmers and extension personnel to update their knowledge and skills in modern agricultural technologies and enterprises.

d. Work as knowledge and resource centre for improving overall agricultural economy in the operational area.

e. Conduct frontline extension programmes and provide farm advisories using Information Communication Technology (ICT) and other media means varied practices.

To operationalise the mandated activities, following broad objectives of KVKs are taken care of-

a. To promptly demonstrate the latest agricultural technologies to the farmers as well as extension workers of State Department of Agriculture/Horticulture /Fishery/Animal Science/NGOs with a view to reducing the time lag between the technology generation and its adoption.

b. To test and verify the technologies in the socio-economic conditions of the farmers keeping in view the production constraints and to modify the technologies to make them appropriate.

c. To impart training to the practising farmers/farm women, rural youth and field level extension functionaries by following the methods of "Teaching by doing" and "Learning by doing".

d. To back-up with training and communication supports to the district level development departments viz. Agriculture/Horticulture/Fisheries/Animal science and NGOs in their extension programmes.

Krishi Vigyan Kendra (KVK) is an institutional extension project of the ICAR at grass root level institutions designed, developed and devoted to impart need-based and skill-oriented short and long-term vocational training courses to the farmers/farm women, rural youths and extension functionaries, vis-a-vis to demonstrate the application of science and technology inputs of agricultural research and education on farmers' field and in the rural area with the help of multi-disciplinary team of scientist with a view to increase food productivity and there by food security. It had provided a

platform at district level to seek integration of efforts in realizing technology application for sustainable agricultural development. Benefits of training to the rice farmers leads to improved profitability and / or more positive attitudes toward profit orientation, improves the job knowledge and skills at all levels of the organization, improves the morale of the workforce, fasters authenticity, openness and trust, provides information for future needs in all areas of rice farming. Rice farmers get various knowledge like more effective decision making and problem solving power which create an appropriate climate for growth, help farmers to adjust to change, through training and development, motivational variables of recognition, achievement, growth, responsibility and advancement are internalized and operational zed, help eliminate fear in attempting new tasks. Therefore, most important and significant benefits of training accrue to not only individual but also to his organization for its overall development.

Krishi Vigyan Kendra's (KVKs) can play an important role in transforming rural India. Interventions of KVK should target the family and not the individual farmer which is a guiding principle of KVKs. KVKs should come out of 'inside the wheel' approach and should also cater to the needs of small and marginal farmers with innovative mind sets. A number of farmers are doing various innovations that should be taken a note of. There is a need for following bottom-up approach also and researches done at field level should also reach to laboratories for validation. As such KVKs approach is to encourage farm innovators and documenting success stories and to follow inclusive approach.

1.2 Statement of problem

Despite the impressive scientific achievement in the field of agriculture, still a yawning gap existed between generated technologies and adopted technologies. It has been varyingly estimated that farmers have adopted very few developed technologies. It has been a matter of great concerns at various levels about the existence of wide gap between potential yield and yield obtained at research station, farm trial, demonstration and farmers' field. Once a technology is generated, the usual practice is to recommend it to the farmers without paying much attention to the farming conditions prevailing, their variability and whether the farmers are resource-rich or resource poor. Consequently the technology adoption may remain partial and wide gap always existed.

There is a need to motivate, train and support the farmers and encourage them to adopt new and improved technologies. In order to bridge the gap, ICAR has established Krishi Vigyan Kendra across the country. Training provides

knowledge and develops skills required for adoption of the latest technology and builds up desirable scientific attitudes. To ascertain the knowledge gained by the trainees as well as to improve the quality and content of the training programs in future. Knowledge plays an important role in decision and adoption process, which is the innovation decision process (Rogers and Shoemakers, 1971). Keeping all this in view, the present study is planned to know the socio-personal characteristics of the participants, to analyze their knowledge gains from the training program.To find out the extent of adoption among farmers and also to study the problems faced by the farmers in the adoption of improved rice cultivation technologies.

Considering this aspect, the present study entitled "Adoption Behaviour of Rice Growers on Improved Rice Technology Through Krishi Vigyan Kendra (KVK) in Khowai District of Tripura."was undertaken with following specific objectives.

1.3 Objectives of the study

- To find out the level of knowledge on improved rice cultivation technologies of farmers.
- To find out the extent of adoption of improved rice technologies among farmers.
- To study the problems faced by the farmers in the adoption of improved rice cultivation technologies.

1.4 Scope of the study

In the present study, an attempt has been made to find out the adoption behaviour of rice growers on improved rice technology through Krishi Vigyan Kendra (KVK) in Khowai district of Tripura. A considerable time has been passed after the implementation of KVK's programmes. The farmers can be benefitted only by the adoption of technologies at each and every stage of production namely; soil preparation, sowing, intercultural operations, plant protection measures, harvesting etc. The findings derived from this study may be of some value in streamlining the rice production programmes which may lead to economic gain to farmers by increasing yield on their farms with the use of recommended practices for these crops. It is also hoped that findings emanated from this study would be of great value and use to planners, policy makers, and scientists of universities and department of agriculture, who are responsible for designing and implementing, extension programmes towards development of agriculture. Likewise, the study might help the field functionaries to prepare and execute extension programmes based on existing knowledge and

adoption level of recommended crop practices. The facts about the relationship of various situational and socio-psychological characteristics of farmers would help to identify the key factors affecting the knowledge and adoption level of farmers regarding crop production. Based on the constraints faced by the farmers, explored during the study, a suitable strategy for effective crop production programmes might also be formulated by the concerned stakeholders.

The findings of the study would be an important document which would be of practical use to the KVKs in planning their future trainings. The knowledge on constraints faced by farmers of improved rice cultivation practices would also help to modify and rebuild the existing training programmes as well design new training programmes.

As the research study was conducted on one of the KVKs of Tripura state, so total no. of KVKs in the state have been mentioned in tabular form:

Sl. No.	Address of Krishi Vigyan Kendras	Host Organisation	Year of Sanction
1.	Krishi Vigyan Kendra, Salema Model Orchard (Farm), Distt. Dhalai.	Direction of Agriculture State Department of Agriculture, Govt. of Tripura, Agartala.	2005 State Govt.
2.	Krishi Vigyan Kendra, Panisagar Progeny Orchard, Distt. North Tripura.	Director, of Agriculture State Department of Agriculture, Govt. of Tripura, Agartala.	2005 State Govt.
3.	Krishi Vigyan Kendra, Birchandra Manu, Manpathar, Distt. South Tripura- 799144.	Director ICAR Complex for NEH Region, Umroi Road, Barapani-799103 (Meghalaya)	1984 ICAR
4.	Krishi Vigyan Kendra, Divyodaya, Chebri, Distt. West Tripura-799207.	The General Secretary, Sri Ramkrishna Seva Kendra, 23, R.N.Mukherjee Road,Kolkata.	1979 NGO
5.	Krishi Vigyan Kendra, Vill. Belbari-TCO., Jirania at Champaknagar Town,West Tripura, Distt. Of Tripura.	Director,ICAR complex for NEH region, Umroi Road, Barapani-799103 (Meghalaya).	25-11-2016 ICAR
6.	Krishi Vigyan Kendra,Rangkang Farm,Amarpur., Gomati Distt, of Tripura.	Director of Agriculture Department of Agriculture, Govt. of Tripura, Agartala, West Tripura.	22-02-2017 State Govt.
7.	Krishi Vigyan Kendra, Chantail Orchard, Kailasahar., Unakoti Distt. Of Tripura.	Director of Agriculture Department of Agriculture, Govt. of Tripura, Agartala, West Tripura.	22-02-2017 State Govt.

1.5 Limitations of the study

Since the present study was a part of the M.Sc. program, the constraints of time, money, difficulties in measurement and other resources were inevitable. These limitations determined the selection of farmers who were in the jurisdiction of Krishi Vigyan Kendra, Khowai district of Tripura, to study the adoption behaviour of rice growers. Hence, the generalization of the results in the wider context should be applied only where similar situations prevail. With the above limitations, the study would bring out findings, which would be of much help in building up the body of knowledge as the topic had been hardly dealt through research.

1.6 Presentation of the study

The study is presented in five different chapters with gradual arrangement as under:

Chapter 1: Introduction, which gives a brief account of the topic. It also specifies the objectives, scope and limitation of the study.

Chapter 2: Review of Literature, which lays emphasis on the findings of previously completed studies related to the current study.

Chapter 3: Materials and Methods, which deals with tools and methodology required to carry out the research work. It gives an account of the research design, area of study, sampling method, variables involved in the study, tools for measuring the variables, data collection, hypothesis of the investigation and analysis including the statistical tools used in the study.

Chapter 4: Results and Discussion, which fulfils the tabulation and graphical presentations of the data from present investigation. The outcomes of data analysis are laid down. It also gives an explanation of the results. The research questions that arise in the study are also answered with explanations derived from the observation and analysis of data.

Chapter 5: Summary and Conclusion, in which the whole study is briefly summed up. Recommendations and suggestions for further study are also pointed out.

References and **appendices** used in the study are presented at the end.

Chapter - 2

Review of Literature

A comprehensive review of literature is an integral part of any investigation, as it not only gives an idea on the work done in the past and assists in delineation of problem area and also provides basis for integration and discussion of findings. Fleishman (1969) said better ways are needed to generate research findings from laboratory studies to operational settings, from one experimental study to another and from one operational setting to another". As on date, literature on empirical evidences on linkages between clients and research, and extension is rather scarce. An attempt has been made here to review the relevant available literature having a direct and indirect bearing on the present investigation. It is to be noted that this study has been a maiden effort in evaluating Divyoday Krishi Vigyan Kendra, Khowai district of Tripura. To enable a lucid reading and comprehension the reviewed literature is classified into different subheads and presented with reference to the objectives of the study as follows:

2.1 To find out the level of knowledge on improved rice cultivation technologies of farmers.

2.2 To find out the extent of adoption of improved rice technologies among farmers.

2.3 To study the problems faced by the farmers in the adoption of improved rice cultivation technologies.

2.1 To find out the level of knowledge on improved rice cultivation technologies of farmers.

Beerannarai (1995) reported that 47.43 per cent of the trained farmers were from medium sized families, while 37.11 per cent of them were from big families and remaining 15.46 per cent of them belong to small families.

Borkar *et al*. (2000) conducted a study on characteristics of farmers influencing their knowledge about use of bio fertilizers observed that, majority of the respondents (58.67%) had knowledge about the use of bio-fertilizers to the moderate level followed by 22.67 per cent of them having high level of knowledge and 18.66 per cent of them having low level of knowledge

More *et al*. (2000) conducted a study on level of knowledge by farmers observed that, majority of the respondents (62.14%) and medium level of knowledge, followed by higher (27.66%) and low (10.00%) level of knowledge about cotton production practices respectively.

Chothe and Borkar (2000) conducted a study on constraints faced by farmers in adoption of bio fertilizers observed that, more than (58.67%) of the respondents had medium level of knowledge about bio control practices, followed by 34.67 per cent and 18.66 per cent of respondents had high and low knowledge respectively.

Kanavi (2000) conducted a study on the knowledge and adoption behaviour of sugarcane growers in Belgaum district of Karnataka. The study revealed none of the respondents participated regularly in training and demonstrations. Nearly one third (31.33%) of respondents participated in Krishimela. Whereas, very less number of respondents participated in extension activities like farm visits (1.33%), group discussion (2.66%) and study tour (4.00%), whereas, 20 per cent participated occasionally in Krishimela followed by training (4.66%), group discussion (4.00%), demonstration and farm visits (2.00%) each and study tour (0. 66%).

Kanavi (2000) conducted a study on the knowledge and adoption behaviour of sugarcane growers in Belgaum district of Karnataka reported that, among the different mass media studied, 82 per cent of the respondents possessed radio and 42.66 per cent television, while 16.66 per cent of them subscribe newspapers and two per cent agricultural magazines. Further, it is reported that in case of television, 13.33 per cent viewed agricultural programmes regularly, which was followed by news (38.66%) and general programmes (15.33%).

Wase (2001) conducted a study on knowledge and adoption of farmers about Jayanti chilli cultivation observed that, majority of chilli growers (52.50 %) were in the age group of 36 to 50 years that is middle age category.

Bhople and Borkar (2002) in their study on bio-fertilizers farmer attitude and adoption observed that, majority of the farmers (84 %) having moderate level of knowledge about different kinds of bio-fertilizers and their associated practices about one tenth of them were adequately equipped with the knowledge about bio fertilizers and appeared in high knowledge category

Nagaraja (2002) conducted study on knowledge of improved cultivation practices of sugarcane and their extent of adoption by farmers in Bhadra command area in Davanagere district, Karnataka and found that, majority of the respondents

belonged to medium land holding (48.75%) followed by semi medium land holding category (30.00%).

Venkataramalu (2003) conducted a study on the knowledge level adoption and marketing behaviour of chilli growers in Guntur district of Andhra Pradesh indicated that, majority of the farmers participated in discussion with village extension workers (70.00%), Krishimela (62.50%) and some exhibitions on agriculture (61.67%).

Raghunandan (2004) in his study on knowledge and adoption level of soil and water conservation practices by farmers in northern Karnataka reported that 45.00 per cent of the respondents (45.33%) belonged to the middle age group, followed by old age (36.25%) and young age group (18.75%), respectively.

Raghavendra (2004) conducted a study on knowledge and adoption level of post harvest technology by red gram cultivators in Gulbarga district and found that, 24.66 per cent of the respondents were participated regularly in agricultural exhibitions, demonstrations (22.67%) conducted in their villages.

Reddy (2005) conducted a study on knowledge, extent of participation and benefits derived by participant farmers of the watershed development programme in Raichur district of Karnataka state reported that, 62.67 per cent of respondents belong to nuclear family whereas 37.33 per cent of them belonged to joint family.

Khin (2005) in his study on knowledge and adoption of improved dairy management practices by women dairy farmers in Dharwad district found that, majority of respondents (74.16%) had low farming experience followed by medium level experience (15.00%) and high level experience (10.83%).

Khin (2005) in his study on knowledge and adoption of improved dairy management practices by women dairy farmers in Dharwad district found that, 45.00 per cent of dairy women had medium annual income i.e. Rs. 30,001 to 50,000 followed by low i.e. up to Rs. 30,000 (29.16%) and high annual income i.e., above Rs.50,000 (23.33%).

Raghavendra (2005) in his study on knowledge and adoption of recommended cultivation practices of cauliflower growers in Belgaum district of Karnataka observed that, 51.60 per cent of respondents were middle aged whereas, 38.30 per cent were young age and 10.00 per cent were old age group. Whereas in education he found that 26.60 per cent of the cauliflower growers studied up to high school, followed by 21.70 per cent studied up to PUC, 20.00 per cent studied up to

middle school and very less percentage i.e., 8.30 per cent and 3.30 per cent of them studied up to primary and post graduate level respectively.

Naik (2005) observed that majority (60.83%) of the respondents had medium level of knowledge, while 25.84 per cent and 13.33 per cent of the respondents had high and low level of knowledge of recommended sugarcane practice in sugarcane.

Ninga Reddy (2005) conducted a study on knowledge, extent of participation and benefits derived by participant farmers of the watershed development programme in Raichur district of Karnataka state reported that, 80.00 per cent of the respondents possessed radio and 54.00 per cent television, while 40.61 per cent of them subscribed newspaper. Further, in case of radio it is reported that 22.0 per cent of them listened to agricultural programme regularly. In case of television 25.34 per cent of respondent farmers viewed the agricultural programme regularly.

Reddy (2006) made a study on knowledge and adoption of integrated pest management practices among vegetable growers of Gadag district in North Karnataka. He observed that majority (72.50%) of the respondents had medium level of innovativeness. But a less percentage of respondents were noticed in high level of innovativeness (15.00%) and low innovativeness (12.50%).

Reddy (2006) in his study on knowledge and adoption of integrated pest management practices among vegetable growers of Gadag district in North Karnataka indicated that majority of the respondents (62.50%) belonged to middle age group. Whereas respondents in young age group (below 35 years of age) and old age group (>45 years age) were noticed with 25.83 per cent and 11.6 per cent respectively. In education, more number of respondents had middle school (29.17%) and primary school (25.83%). While high school and higher secondary school were noticed with 12.50 per cent and 11.63 per cent of respondents respectively and only 3.33 per cent were found to possess graduation but the illiterates was noticed to the extent of 16.67 per cent only.

Thippeswamy (2007) indicated that majority of the respondents (61.88%) belonged to medium level of knowledge groups whereas, 28.75 per cent of the farmers belonged to high level knowledge group and only 9.38 per cent belonged to low level knowledge group about plant protection measures in coconut plantation.

Sharma *et al.* (2008) analyzed impact of KVK training programme on Socio-economic Status and Knowledge of Trainees in Allahabad District majority(74.67 per cent) of the on-campus trainees had high level of knowledge followed by medium

level of knowledge (24 per cent) and low level of knowledge (1.33 per cent), whereas in case of off-campus trainees 75.34 per cent respondents had medium level of knowledge, 15.33 per cent had high level of knowledge followed by 9.33 per cent had low level of knowledge. Hence, it may be concluded that on-campus trainees had high level of knowledge than the off-campus trainees about KVK training programmes.

Sidram (2008) conducted a study on pigeon pea growers in Gulbarga district of Karnataka. He noticed that 13.33 per cent of the respondents had low knowledge on organic farming practices in pigeon pea and majority (63.33%) had medium knowledge level and 23.33 per cent of them were found to have higher knowledge categories of organic farming practices respectively.

Kumar (2009) observed that majority of the respondents (70.66%) had medium level of knowledge about recommended cultivation practices of soybean followed by high (18.00%) and low (11.34%) knowledge level categories respectively.

Chowdhary and Ray (2010) in their study on knowledge level and adoption of the integrated pest management (IPM) techniques revealed that a majority of the respondents (34.16%) belonged to middle age group (35-45 years), closely followed by (33.33%) oung age group (up to 35 years) and 33.00 per cent belonged to old age group (above 45 years).

Jeyawan *et al.* (2010) found that majority of the respondents (69.00%) were having medium level of knowledge followed by low level of knowledge (20.00%) and only 11.00% had high level of knowledge on conservation tillage practices.

Singha *et al.* (2011) studied on behavioural changes of farmers through KVK in the pali district of Rajasthan. They found that majority of respondents (86.50per cent) were acquainted with KVK and the purpose for which they were established. Similarly, majority of them (79.5 per cent) were aware of the operational area for each KVK. As regard to knowledge about TOT (Transfer of Technology) activities, majority of respondents (75.75 per cent) knew about demonstration. its purpose, and types of demonstrations. Farmers fair and vichar-goshthee (Discussion forum) had also attracted the attention of majority (74.75 per cent) of respondents. It is noted that none of the respondents knew about the farm advisory services, which is an important activity of KVK. Likewise farmers had poor knowledge (48.00 per cent) about campaign. More than half (56.00 per cent) of the total respondents did not know about the name of methods commonly used by KVK for the transfer of agricultural technology.

Behera *et al.* (2014) studied on TOT through Krishi Vigyan Kendra for the tribal farmers in Hilly Areas of Koraput district .The main mandate of Krishi Vigyan Kendra is to conduct the variety of trainings for the benefit of farmers, rural youth and extension personnel of the district. Training programme helps the farmers to aware the latest technical knowledge and skill related to agriculture and allied field. KVK training programme starts with identification of training needs in the villages. Then the training programme conducted to improve the knowledge and developed new skills required for adoption of the latest technology and build up scientific attitude among farming community.

Sabi *et al.* (2014) in their study on knowledge and technological gap in Wheat production reported that, 43.33 per cent of the farmers belonged to medium extension category followed by high (35.01%) and low (21.66%) extension contact category.

Uma and Sridhar *(*2014) reported from Andhra Pradesh that 96 per cent of KVK demo farmers are having good knowledge of Dairy Management compared to 86 per cent among other farmers, Gap percentage is 10 per cent between demo and control farmers in knowledge level.

2.2 To find out the extent of adoption of improved rice technologies among farmers.

Dublia and Jaiswal (2000) conducted a study on technological gap of groundnut cultivation among groundnut growers revealed that, the different practices performed by farmers with the extent of adoption of groundnut cultivation were maximum in sowing time, method of sowing, improved varieties, land preparation, seed rate, interculture (weeding and earthing up) other practices like summer ploughing, doses of fertilizers etc. were partially adopted. However, the method of fertilizer application soil treatment and seed treatment showed very low adoption and per cent farmers were not using the groundnut cake.

Patil (2000) conducted a study on adoption of banana production technology under drip irrigation. He observed that, majority of the banana growers (58.33%) were from middle age group followed by young age (24.17%) and old age group (17.50%).

Patil (2000) in his study on adoption of banana production technology under drip irrigation observed that, 36.67 per cent banana growers were educated up

to middle school followed by 25.00 per cent of the banana growers were educated up to high school, while only 05.83 per cent banana growers were illiterate.

Wase (2001) in his study on knowledge and extent of adoption of farmers about Jayanti chilli cultivation observed that, majority of the respondents (56.67%) were medium level of adoption about jayanti chilli cultivation technology. The percentage of the respondents having high level of adoption been 23.33 per cent and 20.00 per cent of respondents were having low level of adoption.

Kadam *et al*. (2001) conducted a study on adoption and knowledge of soil and water conservation practices in watershed development project reported that, majority of the beneficiaries had knowledge about the practices namely dividing the fields with small bunds(82.00%) and small earthen bunds (76.66%). More than two-fifth of the beneficiaries had knowledge about the practices namely stubble and agro waste plucking (46.00%), drains per trenches (43.33%) and intercropping (42.00%).

Kadam *et al*. (2001) their study on Knowledge and adoption of soil and water conservation practices in watershed development project reported that, adoption brought forward that majority (68.00%) of the beneficiaries had adopted only one practice namely dividing fields with small bunds. The practices namely stubble and agro waste plucking (38.66%) and small earthen bunds (23.33%) were also adopted by a considerable number of the beneficiaries.

Veda (2002) in his study on arecanut growers of Shimoga district reported that, majority of the arecanut growers adopted cultural practices (90.66%) while 68.00 per cent of the growers adopted age of the seedlings, 73.00 per cent adopted the advocated spacing and 59.33 per cent of growers fully adopted the recommended practices of harvesting and processing.

Sharma (2002) in his study on Impact of KVK on knowledge, attitude, adoption and diffusion of improved technology in Malava Agro-climatic Zone of Madhya Pradesh revealed that 68.00 per cent of adopted farmers adopted improved technologies on partial scale and 32.00 per cent on full scale. It also indicates that no one represented the no adoption category. In case of non-adopted respondents, 48.00 per cent had partial level of adoption; similar number of farmers had not adopted improved technologies. Only four per cent non-adopted farmers had full adoption of improved technologies.

Raghunandan (2004) conducted a study on knowledge and adoption level of soil and water conservation practices by farmers in northern Karnataka reported that, about 17.50 per cent of respondents had the complete knowledge of

contour cultivation purpose. Majority of respondents possessed the knowledge of reduces soil erosion and conserves soil moisture (62.50%), followed by reduced cost of cultivation (50.00%) and directly improves soil fertility (26.25%).

Moulasab (2004) conducted a study in North Karnataka and reported that, majority of the mango growers (68.33 per cent) were found to be medium adopters followed by low (19.00 per cent) and high (12.67 per cent) adopters.

Raghavendra (2005) conducted study on knowledge and adoption of recommended cultivation practices of cauliflower growers in Belgaum district of Karnataka. He observed that 53.30 per cent of respondents belonged to medium adoption category, while 31.50 per cent and 15.00 per cent of respondents belonged to low and high adoption category of recommended cultivation practices respectively.

Lakshman *et al.* (2006) observed that, low percentage of farmers were ready to take the high risk for adoption of micro irrigation (3.33%), and 80 per cent of farmers were noticed in middle category and remaining 16.66 per cent farmers are not ready to bear the risk.

Maraddi (2006) in his study on analysis of sustainable cultivation practices followed by sugarcane growers in Karnataka reported that majority of the respondents belonged to medium overall adopted category followed by low (26.67%) and 10.00 per cent of respondents belonged to high adopter category.

Kharatmol (2006) conducted a study on vermicompost by Krishi Vigyan Kendra, Bijapur revealed that high majority of trained farmers had fully adopted the practices of vermicompost like material used for pit construction (100.00%), pit position, material used for filling the pit and harvesting of vermicompost (95.00%), leaving worms to pit, adoption of pit size (90.00%) and meagre percentage adopted the practices like pit treatment with chemical (16.67%) and preparation of vermiwash (3.33%).

Venkatesh *et al.* (2008) conducted a study on adoption of integrated pest management among tomato growers in Kolar district of Karnataka. They revealed that 42.00 per cent of farmers were in medium adopter group whereas 34.67 per cent of farmers were in low adopter group and 23.30 per cent of farmers were in high adopter group of integrated pest management practices of tomato crop cultivation.

Singh *et al.* (2010) through their study on adoption behaviour of commercial vegetable growers in Ghaziabad district of Uttar Pradesh reported that

66.00 per cent of respondents had medium adoption behaviour, 19.00 per cent had low adoption behaviour and 15.00 per cent of them had high level of adoption behaviour.

Singh *et al.* (2010) studied on Adoption level and constraints in rice production technology in Jabalpur district Of Madhya Pradesh. Majority of the respondents (44.17 per cent) were found to be medium adopters, followed by low (37.50 per cent) and high (18.33 per cent) adopters. Farmers with more economic resources alone could adopt more production technologies. It may be due to the different constraints faced by the small size holding respondents. A majority of the respondents (65.00 per cent) adopted the recommended varieties in their cultivation. In case of 54.17 per cent of the respondents, seed rate was adopted as per the recommendation. Some of the respondents were not willing to take risk while raising their own nursery and the possibility of loss of seedlings during germination due to heavy rain, pest and disease attack. Only 40.83 per cent of respondents had adopted the recommended nursery practice in their cultivation. Most of the respondents expressed that they could not afford to take risk due to poor germination of own seeds, pest and disease and root snapping problem during pulling of seedling.

Singh and Varshney (2010) studied on Adoption level and constraints in rice production technology in Jabalpur district in Madhya Pradesh that majority of the farmers showed medium level of overall adoption of recommended technology. 'Non availability of high yielding varieties', High cost of labor' 'Lack of conviction in the new technology' and 'Weak extension activities at the village level were the major constraints faced by the farmers.

Singha and Baruah (2011) inferred from their study in Assam that majority of the respondents had medium level of adoption of improved rice cultivation practices. Among the selected independent variables, extension contact, annual income, innovation proneness and positive attitude towards farm diversification of farmers had positively significant relationships with the extent of adoption of improved rice cultivation practices under different farming systems.

Barman *et al.* (2011) studied on Adoption behaviour of vegetable growers towards improved technologies Eighty four percent of the total farmers under study were in medium to high adoption categories in respect to improved tomato technologies. While 69 per cent of farmers were low adopters as far as improved technologies for cauliflower were concerned. In terms of distribution of farmers in different adoption categories, Panager block was slightly advanced than Sihora block. Considering the total responses recorded for tomato and cauliflower technologies, 32

per cent farmers of Panager were high adopters of technologies as compared to 23 per cent (28 per cent for tomato and 18 per cent for cauliflower) high adopting farmers in Sihora.

Khumbhare and Singh (2011) in their study on adoption behaviour and constraints in Wheat and paddy production technologies revealed that 53.75 per cent respondents had adopted the wheat production technology at higher level followed by 31.25 per cent and 15.00 per cent respondents in medium and low level respectively. Also in paddy, 60.00 per cent respondents had adopted the production technology at higher level followed by 21.25 per cent and 18.75 per cent in medium and low level respectively in paddy cultivation.

Meena and Gupta (2013) in their study revealed that none of farmers were following the improved practices of garlic production like soil testing, soil treatment, seed treatment and spacing before training programme whereas, after training programme they were adopting seed treatment (68.30%), seed rate (65.00%), soil testing (51.70%) and soil treatment (36.70%).

Onumadu and Osahon (2014) reported from Nigeria that age, gender, education, farm size, farming experience and membership of Farmers' Association were significant in the adoption of improved rice farming technologies.

Ndagi *et al. (*2014) reported that household size, farming experience, extension contacts, training participation and distance from market were significant determining factors influencing adoption of lowland rice production technologies; farm size and social capital were also significant**.**

Chobitkar *et al.* (2016) studied on Adoption pattern of SRI technology amongst the paddy growers of Balaghat district of Madhya Pradesh. The paddy growers were asked to state their extent of adoption of recommended SRI technology practices of paddy cultivation. Among the seventeen practices the extent of adoption was higher in case of irrigation management. The lower level of adoption was found in case of field preparation. Out of fourteen selected factors, five factors viz. information seeking behaviour, mass media exposure, credit orientation, market orientation and knowledge were relatively more important because these five factors produce near about equal percentage of variation (0.6277).

2.3 To study the problems faced by the farmers in the adoption of improved rice cultivation technologies.

Dublia and Jaiswal (2000) conducted a study on technological gap of groundnut cultivation among groundnut growers revealed that the problems faced by groundnut growers of Surguja district varied practice wise i.e. soil treatment, seed treatment, use of culture, seed rate, fertilizer use, method of fertilizer application and interculturing operations.

Kadam *et al*. (2001) their study reported that lack of information/guidance was reported by almost all the non-adopters in respect of each practice as reason for no adoption. The second important reason for non-adoption of the recommended soil and water conservation practices was non-availability of inputs, material/labour etc. In case of many of the practices, difficulty in crop cultivation, difficulty in maintenance and lack of skill were the important reasons for non-adoption.

Bhople and Borkar (2002) in their study on bio-fertilizers farmer attitude and adoption observed that, constraints encountered by the users of bio-fertilizers were collected and it revealed that 51.33 per cent of the farmers stated that the problem of non availability of bio fertilizers at nearby place for use.

Qamar (2002) said that the extension organisations in developing countries have two major problems when it comes to having face-to-face contacts with the farmers and researchers; first, physical distances and second, lack of transportation facilities.

Singh *et al*. (2004) in their study on constraints and strategies in rural livestock farming in Almora district of Hilly Uttranchal reported that, the major constraints in rural livestock farming were feeds and fodder shortage, poor animal productivity, poor breeding facilities, poor veterinary services, poor livestock extension service and poor credit and marketing facilities.

Kumar (2004) in his study on tomato growers in Belgaum district of Karnataka reported that, majority of the farmers (75.83 per cent) faced the problem of technical knowledge and guidance about improved cultivation practices as well as post-harvest technology whereas 65.00 per cent of the respondents faced the problem of high fluctuation in market price, followed by high transportation cost (62.53%), labour shortage and high wages (55.83%) and lack of irrigation facilities and power shortage (46.66%).

Nagesh (2006) in his study on pomegranate reported the constraints faced by pomegranate growers as lack of storage facility, high incidence of pest and diseases, non availability of skilled labour for pruning, expensiveness of pruning operations, costly chemicals and fertilizers and lack of processing units were the major constraints.

Ofouku *et al*. (2008) revealed that the problems faced by the farmers in getting access to information included inadequate extension contact (33.33%), ineffective communication (29%), distance from other farmers (25%) and illiteracy (13%).

Farooq *et al.* (2010) reported from Peshawar – Pakistan revealed that Government should provide offices and basic resources such as funds; mobility, equipments and staff should be made available for extension agents.

Glendenning *et al.* (2010) in their study emphasized that farmers in India had some challenges facing their production activities and they need information to solve these problems. Some of the problems identified are limited land and water availability, degrading of natural resources like climate change and changes in consumption pattern. The recent global rise in food price and inflation is an opportunity for farmers to earn more, but the information to make this a reality for farmers is lacking. Technology options, management of technology, changing farm systems options (mixed farming system), sourcing reputable input suppliers, collective action with other farmers, consumer and market demand of product, quality specification of products, time to buy and sell products, off-farm income generation options, implications of changing policies, access to credit and loan, sustainable natural resources management and coping with climate change are indicated as major areas of farmers information need.

Saha *et al.* (2011) concluded that the major constraints perceived by respondents were lack of awareness and appropriate skill about latest technology, lack of follow up activity from the extension system, irregularity of field visits by the concern authority. Apart from that, nearly half of the respondents express lack of situational compatibility of the message, lack of proper utility of the message information and complexity of message where hindering themselves in managing the information properly. Majority of the respondents (86.00%) suggested that clear communication of tested and successful technologies through extensionists should be practiced. It was followed by more and timely information about the technologies (79.00%) and frequent visit of scientists and extension person to the field (74.00%).

Shashekala *et al.* (2011) conducted research in Karnataka and came out with the findings that there is non-availability of inputs, lack of credit, lack of assured irrigation, untimely availability of inputs, high cost of inputs, Insufficient funds, lack of knowledge, poor quality seed, lack of technical guidance, non-availability of plant protection equipment, poor marketing facility, poor quality of lands.

Bello and Obinne (2012) in their study in Nigeria concluded that the major constraints in information dissemination were the limited number of trained extension workers.

Patil *et al.* (2014) reported that constraints expressed by the farmers were 'lack of knowledge of available information sources'. Suggestions expressed by farmers to overcome constraints in information management were 'complete information should be given'.

The study conducted by Sharma (2014) in Punjab revealed that high cost of chemicals, non-availability of disease free seeds, non-availability of chemicals, lack of labour, lack of time, lack of technical knowledge, financial problem, poor shelf life etc. were the main constraints encountered by the vegetable growers.

Oinam and Sudhakar (2014) reported that high cost of high yielding varieties seed, complexity of new practices, high cost of inputs, weak extension activities at village level etc. were the main constraints encountered by the rice growers.

Patel *et al.* (2016) reported that lack of support from superiors and colleagues and lack of participation in programme planning were the personal constraints faced by extension personnel.

Suggestive measures to solve the problems

Shashidhara (2006) in a study on management of eco-friendly practices by vegetable growers in North Karnataka observed that more number of respondents expressed the suggestions like, availability of pest resistant varieties (83.12%) an organizing training on eco-friendly practices (73.75%). Around two third of respondents expressed the need for encouraging farmers to grow organic vegetables through subsidies, technical guidance etc. (68.75%), strict quality control measures for pesticides (65.62%) and use of bio pesticides and bio fertilizers (61.85%). Use of bio agents to control pest (56.87%), premium price for organically growing vegetables (53.75%), educating public and farmers about environmental issues (36.25%) and

introducing environmental education at secondary level (20.62%) were the other suggestions expressed to promote eco-friendly practices.

Naik (2008) observed that majority of the maize FFS participants (78.00%) suggested that government should take appropriate measures to control the mining industry. Whereas, 82.00% of groundnut FFS participants suggested that FFS should continue for one session on the field of other participants. Majority of the groundnut participants also suggested that more number of FFS sessions should be conducted with respect to ICM practices which involve skill.

Venkatesh *et al.* (2008) noticed that supply of inputs at cheaper or at subsided price was suggested by 91.33 per cent of the respondents, followed by to make available of IPM inputs in open market (88.00%), conducting demonstrations in IPM on each village (87.33%), film show (64.00%) and training of IPM techniques (58.00%).

Chapter - 3

Materials and Methods

Research methodology is considered to be a ‘blue-print’ of the research architect. The term methodology, in broad sense, refers to the process, principles and procedures by which we approach our problem and seek its answer. In social science, the term “methodology” is applied to know how one carries out the process of research. In this chapter, attempt was made to study the procedure followed in sampling and measurement of the variables selected in the study, collection of data and statistical measures used in analysis of data:

This chapter deals with materials and methods followed in conducting the present investigation, which are given as follows:

3.1 Research design

3.2 Selection of the district

3.3 Brief description of study area

3.4 Selection of Blocks

3.5 Selection of villages

3.6 Selection of respondents

3.7 Variables for the study

3.8 Operationalization and measurements of variables

3.9 General Information

3.10 Constraints faced by the farmers

3.11 Instruments used for data collection

3.12 Hypothesis of the investigation

3.13 Statistical analysis

3.1 Research design

In the present investigation, descriptive research design was employed. This design was appropriate because the phenomenon had already occurred. Descriptive study is a fact-finding investigation with adequate interpretation. It is the simplest type of research. It is more specific than an exploratory study, as it has focus

on particular aspects or dimensions of the problem studied. It is designed to gather descriptive information and provides information for formulating more sophisticated studies. Data are collected by using one or more appropriate methods: observation and interviewing on structured schedule.

3.2 Selection of the district

Tripura was divided into four districts namely West, South, North and Dhalai but with effect from 21st January 2012 four more new districts namely Khowai, Unakoti, Sipahijala and Gomati was divided making a total of eight districts in the state. Khowai is one of the largest districts of Tripura located in the western part of the State. Before 2012 it was under west district. From 2012 onwards it became a separate district .The study was conducted in Khowai district of Tripura during the year 2017-18. Khowai district was purposively selected for the study. The considerations for selection of the district under study were:

1. The Khowai district has the highest production (69,580 MT) under rice cultivation.(Directorate of Economics & Statistics Planning Department, Government of Tripura)
2. That practically no research study was undertaken in the district to see the adoption behavior of rice growers on improved rice technology conducted by Divyodaya KVK Khowai district of Tripura.
3. That the investigator's familiarity with the culture of the district would help in developing rapport with the selected respondents.
4. That the district uniformly represents the agro-climatic conditions and farming situations of the entire hilly areas of the state.

3.3 Brief description of study area

Khowai is one of the largest districts of Tripura located in the western part of the State. The entire West district was bounded by Bangladesh in the north and west by the Khowai district in the east and by Sepahijala district in the south. The district headquarters of Khowai is Town Khowai. The Khowai district has two sub-division and six development blocks with population of 3, 27,564 (2011 census). The district is pre-dominantly inhabited by the both Bengali and Kokborok language speaking tribe. Khowai is situated in a plain along the Khowai River and has a monsoon influenced humid subtropical climate with large amount of rain almost all year.The city experiences long,hot and wet summers, lasting from April to October. Average temperature are around 28 degree Celsius(82 degree Fahrenheit), fluctuating with rainfall.There is a short, mild winter from mid-November to early March,with mostly

dry conditions and average temperature around 18 degree Celsius(64 degree Fahrenheit).

Agriculture is the main occupation of the people of Khowai district and rice, maize, cashew nut, areca nut and turmeric are the principal crops along with Jhuming and piggery farming for livelihood security for the people of the district. Agriculture and allied fields are the major income generating sources for more than 70% of population in the district. According to 2011 census, agriculture provides full time employment to 15.59 per cent of total workers. There are about 1,15,740 cultivators and 37,498 agricultural labourers in the district. Heterogeneity in cultivation practices and diversity of cropping patterns are the important features of agriculture in the district. The district shows different types of soil as the provenance differs widely. Red Gravelly Soil and Red Sandy Loam in the hilly slopes and Clayey Loam in the plains are the common soil types. The soils are acidic in nature and comparatively rich in organic matter and nitrogen but poor in phosphorous.

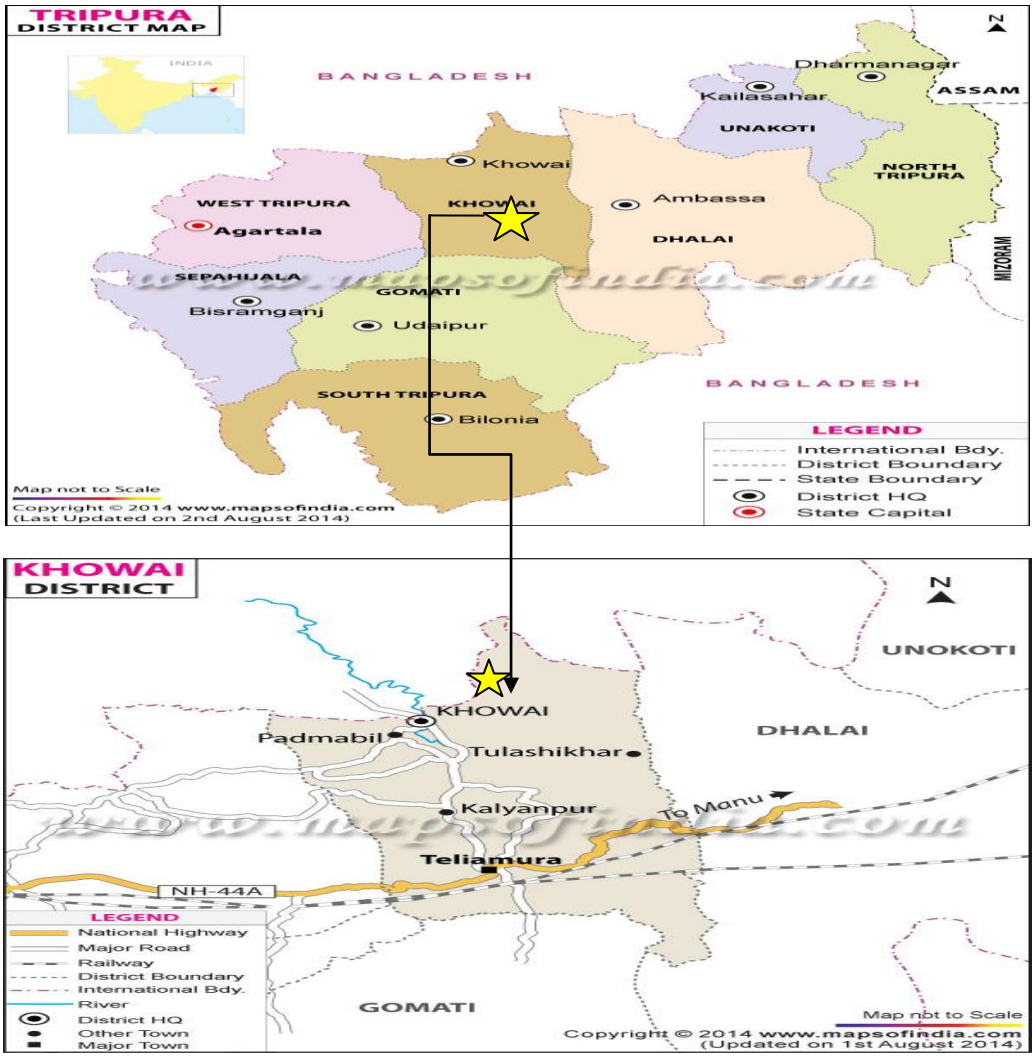

Fig. 1- Map showing the study area

3.3.1 Krishi Vigyan Kendra (KVK), Divyodaya, Chebri, Khowai District

The Kendra started functioning since 1979, under the General Secretary,Sri Ramkrishna Seva Kendra, Non Governmental Organisation. The Kendra is situated at Chebri, Khowai.It is the oldest KVK in entire Tripura.

a) Mandates

The mandate of KVK is-

Technology Assessment and Demonstration for its wider Application and to enhance Capacity Development (TADA-CD). To implement the mandate effectively through creation of awareness about improved agricultural technologies, the following activities be defined for each KVK. (a) On-Farm Trial (OFT) to assess the location specificity of agricultural technologies under various farming systems. (b) Out scaling of farm innovations through Frontline Demonstration (FLD) to showcase the specific benefits/worth of technologies on farmers‘ fields. (c) Capacity development of farmers and extension personnel to update their knowledge and skills in modern agricultural technologies and enterprises. (d) Work as Knowledge and Resource Centre of agricultural technology for improving overall agricultural economy in the district (e) Conduct frontline extension programmes and provide farm advisories by using Information Communication Technology (ICT) and other media mean on varied subjects of interest to farmers. (f) Data documentation, characterization and strategic planning of farming systems.

b) Major extension activities

- Training programmes
- Front Line Demonstration (FLD)
- On Farm Testing (OFT)
- Plant and Animal Health Clinic
- Farm Advisory Services
- Farmers Study Tours/Exposure visit
- Farmer's visit to the Kendra
- Exhibitions, Kisan Melas, Camps, etc.
- Kisan Mobile Advisory Service (KMAS)
- Production and supply of quality planting materials, breeds of animals and other technological inputs

c) Other activities

The Kendra also organizes the following programmes:

- Field days
- Farmers day
- Film shows
- World soil Health Day
- Radio talks
- World food day celebration
- Publication of popular articles
- Farmers Scientist Interaction Programme
- TV programme
- Vaccination & health care camp
- Exposure visit
- Scientist visit to farmers field

3.4 Selection of Blocks

This district comprises of six blocks namely, Khowai, Tulasikhar, Padmabil, Kalyanpur, Teliamura and Mungiakami. Out of six blocks, one block namely, Khowai was purposively selected, because it has maximum number of rice farmers trained under the KVK, Divyadaya, Chebri, Khowai district.

3.5 Selection of Villages

Since, the study attempted to find out the adoption behaviour of rice growers on improved rice technology Through Krishi Vigyan Kendra (KVK) in Khowai District of Tripura. From Khowai block, Purba Ramchandraghat, Paschimganki, East Sonatala and North Chebri villages were selected purposively. A total of four numbers of adopted villages were finally selected under the present study.

3.6 Selection of the respondents

A complete list of trainee farmers who had participated in training programme conducted by Krishi Vigyan Kendra, Divyodaya Khowai district was prepared in consultation with the official records of the staff of the KVK. From each selected village respondents were selected by simple random sampling with equal allocation, thus constituted 120 as the final size of the sample.

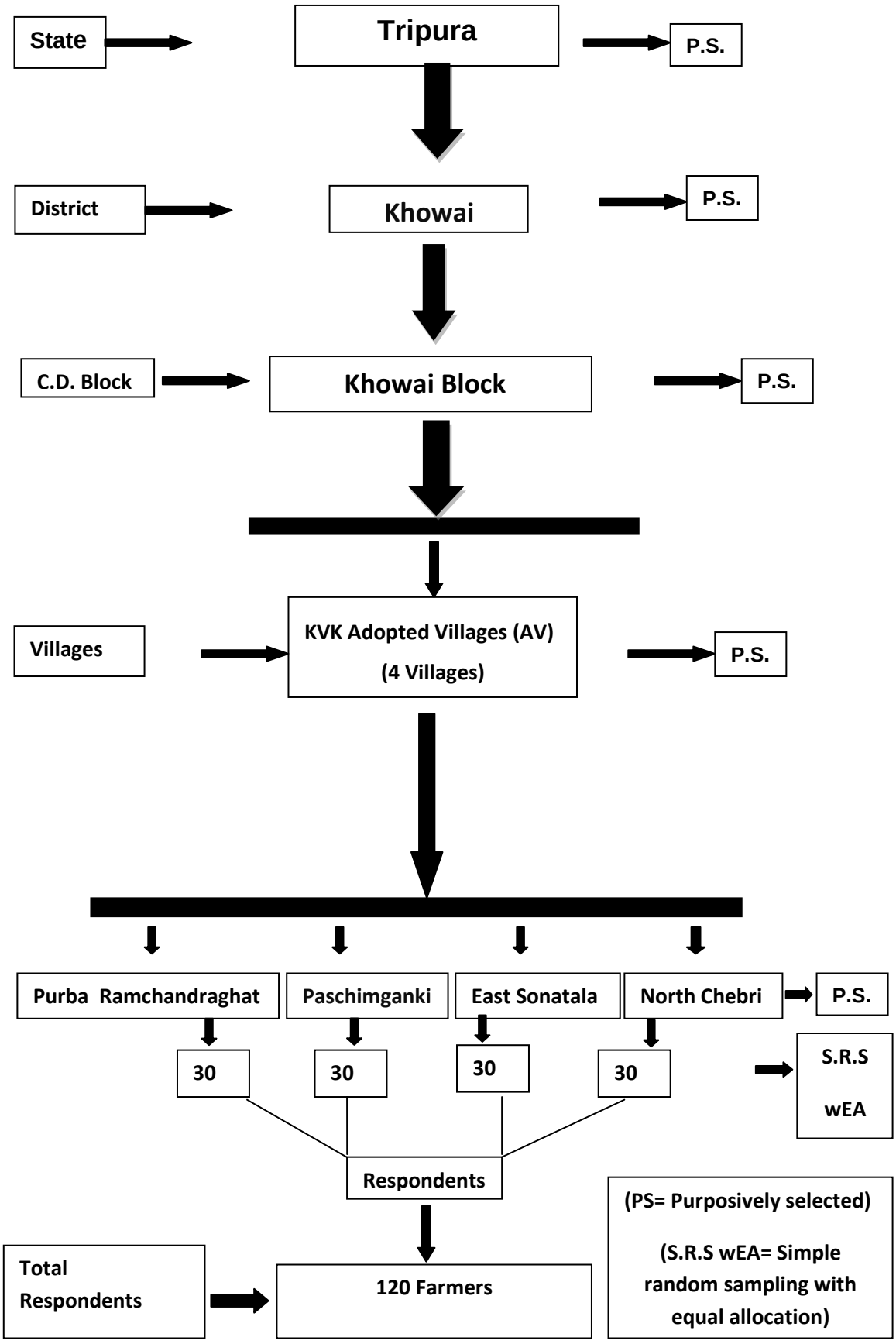

Fig. 2- Sampling plan

3.7 Variables for the study

For the present study, relevant variables were selected after careful and extensive review of the relevant literature and consultation with the experts considering the theoretical background and objectives of the study. The variables and their measurements are presented below:

3.7.1 Dependent variables

In the light of objectives set under the study, the dependent variables considered were;

1. Adoption behaviour of rice growers on Improved Rice technologies: The dimensions are:

- Knowledge and skills on rice technologies
- Adoption level of the improved practices of rice technology

3.7.2 Independent variables

Based on the review of literature and discussion with the members of advisory committee and extension functionaries of Divyodaya Krishi Vigyan Kendra Khowai district of Tripura, the following independent variables were selected for the study.

I. Socio-personal variables

1. Age
2. Education
3. Family Size
4. Family type

II. Economic variables

1. Size of operational land holding
2. Annual income of family
3. Farming experience
4. Training received

3.8 Operationalization and measurement of variables

Dependent variables and their empirical measurements are presented below-

Table 1: Dimensions for degree of dissemination of improved Rice cultivation technologies:

	Dimensions
Degree of dissemination of Improved Rice Cultivation Technologies	• Improve knowledge and skills on rice technologies • Increase adoption level of the improved practices of rice technology

Table 2: Independent variables and their empirical measurement

A.	**Independent Variables**	
II.	**Socio-personal variables**	**Empirical measurement**
1.	Age	Chronological age of the respondents rounded off to the nearest year.
2.	Education	Formal educational qualification at the time of interview.
3.	Family Size	Number of members per family.
4.	Family type	Joint family or nuclear family.
III.	**Economic variables**	**Empirical measurement**
1.	Size of operational land holding	Procedure followed by Debnath (2012) with slight modification.
2.	Annual income of Family	Income in rupees derived from farm and non-farm sources.
3.	Farming Experience	Number of years in farming.
4.	Training received	Number of times a respondent received training related to rice cultivation.

3.8.1 Dependent variables

1. Level of knowledge on improved cultivation practices

Knowledge level of the respondents was measured by developing a knowledge test in rice cultivation. For this purpose, a list of improved practices in rice cultivation was prepared in consultation with different literatures and discussion with experts in the field of agriculture from seed selection to harvesting of rice.

A schedule consisting of questions against each selected practices was administered to the intended respondents by assigning the answer Yes/No with score '1' for 'Yes' and 0 for 'No' response. Three categories of the respondents based on the scores obtained under each major practice namely; "Full Knowledge", "Partial Knowledge" and "No Knowledge" were made for each of the practices in the present study. A farmer is considered having "Full Knowledge" on a practice when he had knowledge on all the recommendations for that practice, deviation from recommendation; was put in the "Partial Knowledge" category for that practice, while a farmer was put in "No knowledge" category when he had no knowledge on any of the recommendation of the practise.

For the purpose of analysis, the mean knowledge scores were calculated separately for each of the practice as well as for all the practices. On the basis of the scores, the respondents were grouped into 3 categories by applying Mean and standard deviation method.

Sl. No.	**Category**	**Score Range**
1.	Low< (Mean - standard deviation).	30-41
2.	Medium (Mean ± standard deviation)	42-50
3.	High > (Mean + standard deviation)	51-60

2. Extent of adoption of improved cultivation practices

The extent of adoption in this study was operationally defined as the level of adoption of practices in rice cultivation by the respondents with a view to improving sustainable agriculture for income and livelihood security. The extent of adoption of the respondents was measured with a set of questions prepared on various aspects of adoption of selected practices in rice cultivation. The procedure adopted for selection of practices for extent of adoption was same as that of the procedure followed

for knowledge level on rice cultivation practices. Three categories of respondents namely; “Full adoption”, “Partial adoption” and “No adoption” were made for each of the practices in the present study using the same criteria as that of knowledge level.

Finally, on the basis of the scores obtained, the respondents were classified into three categories of the level of adoption by applying mean and standard deviation method.

Sl. No.	Category	Score Range
1.	Low< (Mean - standard deviation).	20-30
2.	Medium (Mean ± standard deviation)	31-41
3.	High > (Mean + standard deviation)	42-50

3.8.2 Independent variables

1. Age

Age refers to the chronological age of the respondents expressed in terms of years completed at the time of investigation/interview

The respondents were asked to indicate their age in completed years on the date of data collection. The farmers were grouped into three categories based on the chronological age as followed by Nath (1995).

Sl. No.	Category	Completed years
1.	Low	27-35 years
2.	Medium	36-50 years
3.	High	51-72 years

2. Education

It refers to the formal education acquired by the respondents. Scoring pattern adopted by Trivedi and Pareek (1964) was used with slight modification to measure the education status of the respondents. The scoring pattern to measure this variable is given below.

Sl. No.	Category	score
1.	Illiterate	0
2.	Up to primary school	1
3.	Up to middle school	2
4.	Up to high school	3
5.	Up to higher secondary	4
6.	Up to degree and above	5

Based on the scores obtained, respondent were classified as given below.

Sl. No.	Category	Score range
1.	No education	Up to 1
2.	Low	Up to 3
3.	Medium	Up to 5
4.	High	Up to 6

3. Family size

Family size of the respondent was operationally defined as total number of members in the family of the respondent at the time of data collection. Based on the scores obtained, respondent were classified as given below.

Sl. No.	Category	Score range
1.	Small	Up to 3 members
2.	Medium	4-6 members
3.	Large	7 and above

4. Family Type

Operationally it was defined as the blood relation and on the basis of composition of family; it was categorized into nuclear and joint family. Nuclear family was defined as family consisting of husband, wife and their unmarried children. Joint family was defined as two or more nuclear families living together under one roof and sharing food from common kitchen. Data were collected through direct questioning.

For convenient the interpretation of data, family type of the respondents were classified into two categories according to the scores obtained as given below.

Sl. No.	Category	Score
1.	Joint	2
2.	Nuclear	1

5. Size of operational land holding

It refers to the land area expressed in hectare operated by a respondent for farm and non-farm activities. The size of operational land holding was calculated by using procedure as follows.

Size of operational land holding (ha) = land owned (ha) + land leased in (ha) – land leased out (ha). For frequency and percentage analysis, the respondents were classified into five categories.

Sl. No.	Category	Farm size in Hectare
1	Marginal farmers	<1
2	Small farmers	1-2
3	Semi medium farmers	2-4
4	Medium farmers	4-10
5	Large farmers	>10

6. Annual income of family

Annual income of family refers to the total earnings of the farm family in terms of rupees from all available sources including farm and non-farm activities in a year. To measure the total income of the respondents, they were asked about the farm income and income from other sources separately; the addition of the two gave the total income. It was calculated in terms of rupees taking in to account all possible sources of income.

On the basis of the scores respondents were divided into three categories as per procedure adopted by Dasgupta (1989).

Sl. No.	**Category**	**Income range**
1.	Low	Rs. 25,900- Rs. 33,280
2.	Medium	Rs. 33,281-Rs. 1,65,066
3.	High	Rs. 1,65,067-Rs. 4,00,000

7. Farming experience

It refers to the total number of years of experience in doing agriculture by the respondents at the time of investigation. The respondents were categorized into three categories based on the mean and standard deviation as measure of check.

Sl. No.	**Category**	**Farming experience (in years)**
1.	Low< (Mean - standard deviation).	up to 17 years
2.	Medium (Mean ± standard deviation)	between 18 to 38 years
3.	High > (Mean + standard deviation)	39 years and above

8. Training received

Training received is operationally defined as actual participation of the respondents in different trainings organized by the KVK meant for the farmers of the district to enhance their knowledge and skills in agriculture.

Training received was measured in term of the number of times a respondent has attended training for the last ten years till the date of data collection. Based on the numbers of training attended, the respondents were classified into three categories as given below:

Category	Number of training
Low< (Mean - standard deviation).	Up to 5
Medium (Mean ± standard deviation)	06 - 08
High > (Mean + standard deviation)	More than 8

3.9 General Information

1. Production and Productivity

Agricultural productivity may be defined as the ratio of total agricultural output to total input used in farm production. Productivity has interchangeably been used to explain production. Production refers to the total volume of output, while productivity refers to the output in relation to resources expended. Therefore, agricultural productivity can be defined as a measure of efficiency in agriculture with which land, labour, capital and other resources are employed. Productivity or yield of the respondents in the study area was ascertained on the basis of the direct questioning.

Sl. No.	Category	Productivity (kg/ha)
1.	Low< (Mean - standard deviation).	less than 1742
2.	Medium (Mean ± standard deviation)	1743-1924
3.	High > (Mean + standard deviation)	more than 1925

2. Economic condition

It was measured by considering the total income of the family from all the sources. It refers to the total annual earnings of the respondents in rupees and it was measured with the help of schedule and respondents were

categorized into low, medium and high category using mean and standard deviation value.

Sl. No.	Category	Annual net income
1.	Low< (Mean - standard deviation).	Below Rs. 41,279
2.	Medium (Mean ± standard deviation)	Rs.41,280-76,402
3.	High > (Mean + standard deviation)	Above Rs. 76,403

3. Self confidence

The concept self confidence as commonly used is self-assurance in one's personal judgement, ability, power, etc. One increases self confidence from experiences of having mastered particular activities. It is a positive belief that in the future one can generally accomplish what one wishes to do. Social psychologists have found self confidence to be correlated with other psychological variables within individuals exercise influence over others, and being a responsible person. This variable was quantified by following the procedure of Debdulal Dutta Roy (2009) and the respondent were asked to indicate their present position towards the selected statements on confidence in the response categories. The interview schedule consisted of 8 statements and the items were rated on a five point continuum. The 5 point rating categories are (i) to a greater extent (ii) to a great extent (iii) neither agree nor disagree (iv) to a less extent (v) to a least extent on weight ages of 5, 4, 3, 2 and 1. On the basis of the scores obtained, the respondents were classified into three categories:

Sl. No.	Category	Score range
1.	Low< (Mean - standard deviation).	Up to 18
2.	Medium (Mean ± standard deviation)	19-34
3.	High > (Mean + standard deviation)	Above 35

4. Material possession

It is operationally defined as the total farm goods and non-farm goods possessed by the respondents. Material possession of the respondents in the study area was ascertained on the basis of the direct questioning and each good will be given unit score.

Material possession was categorized into low (2-4), medium (5-6), high (7-8) based on mean and standard deviation method

Sl. No.	Category	Score range
1.	Low< (Mean - standard deviation).	2-4
2.	Medium (Mean ± standard deviation)	5-6
3.	High > (Mean + standard deviation)	7-8

3.10 Constraints faced by the farmers and suggestive measures

During investigation, the respondents were asked to indicate the constraints faced in adoption of the recommended practices of rice cultivation. Further, they were asked to indicate the suggestions as means to solve those problems, which were systematically recorded in the schedule. Respondents expressed many reasons due to which they could not use recommended practices in their farming particularly in rice cultivation. The reasons or causes were termed as constraints in the study.

3.11 Instruments used for data collection

Keeping in view the objectives and variables of the study, a structured interview schedule was prepared by reviewing the previous research studies, consulting and discussing with the experts and professional workers in the field of agricultural extension and KVK scientists which was then pre-tested by using split half method on 20 non-sampled rice farmers in the study area. On the basis of pre-testing, necessary additions and modifications and appropriate changes were carefully made in the scales and indices. Then the schedule was finalized and used for the collection of necessary data and information from their intended respondents. The final format of the schedule is furnished in Appendix I. The data were collected by personal interview method by researcher using structured interview schedule. Various published sources of information were used such as Department of Agriculture, Government of Tripura,

Zonal Project Directorate, Divyodaya Krishi Vigyan Kendra, Directorate of Extension Education and various reports published by the State Agriculture and KVK journals as secondary information like the geographic and demographic particulars, livestock population, rice production and yield, area etc.

3.12 Hypothesis of the investigation

Goode and Hatt (1952) defined hypothesis as a proportion, which can be put to test to determine validity.

According to Kerlinger (1973), a hypothesis is a conjunctional statement of the relation between two or more variables.

Keeping the objectives of the study in view, the relevant hypothesis was framed on different aspects of the study. While formulating the hypothesis, the nature of relationship between the variables was determined on the basis of review of literatures. The hypothesis was framed in the form of null hypothesis, which states that, there is no relation between the variables (Kerlinger 1973). Every research may be said to exist only in order to give research findings a chance of disproving the null hypothesis. The hypothesis of the study is as follows:

$H_0$1: There was no significant relationship between the personal and economic characteristics of the respondents and their knowledge level in rice cultivation practices.

$H_0$2: There was no significant relationship between the personal and economic characteristics of the respondents and their extent of adoption of improved rice cultivation practices.

3.13 Statistical analysis

The collected data were scored, compiled, tabulated and subjected to various statistical tools to draw the logical conclusions. The statistical tools like frequency, percentage, arithmetic mean, standard deviation and cumulative cube root frequency and Chi-square test of independence were applied for analysis of the collected information to draw the meaningful and logical conclusions.

1. Frequency and percentage

Frequency was used to know the distribution pattern of respondents according to variable. The data were presented in sample percentages to understand the nature of distribution of respondents.

2. Arithmetic mean

It is defined as the sum of all values of the observation divided by the total number of observations. Symbolically, it is represented as.

$$\overline{X} = \frac{\sum X}{N}$$

Where,

$\overline{X}$ = Arithmetic mean

∑X= Sum of the items

N= Total number of respondents

3. Standard deviation

Standard deviation is the square root of the arithmetic mean of the square of all deviations, the deviations being measured from the arithmetic mean of the distribution. It is commonly denoted by the symbol σ (sigma). It is less affected by sampling errors and is a more stable measure of dispersion. The standard deviation of the data grouped in the form of frequency distribution is computed by the formula.

$$\sigma = \sqrt{\frac{\sum X^2}{N}}$$

Where,

σ= Standard deviation

$\sum X^2$ = Sum of square of deviation of x series from an assumed mean

N= Total number of observation

4. Chi- square test of independence

Chi- square test used for test of independence enables the researcher to explain whether or not two attributes are associated. The formula used for chi-square is as follows:

$$\chi 2 = \sum_{i=1}^{r} \sum_{j=1}^{c} (oij - eij)2 / eij$$

Where,

$\chi 2$ Values are compared with table values for (r-1) (c-1) degrees of freedom (df)

'r' denoting the number of rows,

'c' denotes number of columns in the contingency tendency

'oij' denotes observed frequencies of the i^{th} class

'eij' denotes expected frequencies of i^{th} class

Chapter - 4

Results and Discussion

The findings of the present investigation are presented in this chapter under the following subheads, in the light of the objectives set forth for the study.

4.1 To find out the level of knowledge on improved rice cultivation technologies of farmers

4.2 To find out the extent of adoption of improved rice technologies among farmers.

4.3 To study the problems faced by the farmers in the adoption of improved rice cultivation technologies.

1. Personal characteristics of the farmers

Age

It is noticed that, 50.83 per cent of farmers belonged to the middle age group ranging from 36-50 years, followed by old age (43.34 %) with age from 51-72 years and young age group (5.84%) with age from 27-35 years. This indicated that middle and old age farmers preferred more than young farmers in rice farming activities. The youth in general were interested in government jobs, business and other occupation compared to farming activities. The findings were in conformity with that of studies conducted by Shashidhara (2006) and Mangala (2008).

Education

With regard to level of education, majority respondents (45.84%) had medium level of formal education attaining either, high school or secondary standard. This was followed by high level (27.50%) with graduate diploma or above and low level (25.00%) in standards of primary or middle school. Only 1.67 per cent respondents were found to have no education from any of the formal educational institution.

This indicated that farmers, by and large, in study area were found having medium to high level of education, possibly due to realization of importance of formal education by the respondents' parents and the increase importance of literacy and facilities available. The other factors attributed to this were availability of good numbers of school in nearby towns with transportation and communication facilities. The findings are supported by that of Gohain (2006).

Family size

Majority of the respondents were from medium family group (67.50%) with 4-6 members followed by large family group (25.00%) with 7 members and above and small family group (7.50%) with up to 3 members only. The findings are in conformity with that of study conducted by Beerannarai (1995).

Family type

It is noticed that, 61.67 per cent of the trained farmers belonged to nuclear family category. Whereas, 38.33 per cent belonged to joint family category. This might be due to changing value of family system and modernization. The results are in line with the findings reported by Deshmukh and Mane (1999) and Sridhara (2002).

Table 3: Distribution of respondents according to their socio-personal characteristics

n=120

Sl. No.	Socio personal variables				
A.	**Age**				
	Category	**Frequency (f)**	**Percentage (%)**	**Mean**	**S.D.**
1.	Young (27-35 years)	7	5.84	51.25	9.09
2.	Middle (36-50 years)	61	50.83		
3.	Old (51-72 years)	52	43.34		
B.	**Education**				
1.	No education (0-1)	2	1.67	3.69	1.45
2.	Low (1-3)	30	25.00		
3.	Medium (3-5)	55	45.84		
4.	High(5-6)	33	27.50		
C.	**Family size**				
1.	Small (Up to 3 members)	9	7.50	2.09	0.50
2.	Medium (4-6 members)	81	67.50		
3.	Large (7 members and above)	30	25.00		
D.	**Family type**				
1.	Joint	46	38.33	1.67	0.48
2.	Nuclear	74	61.67		

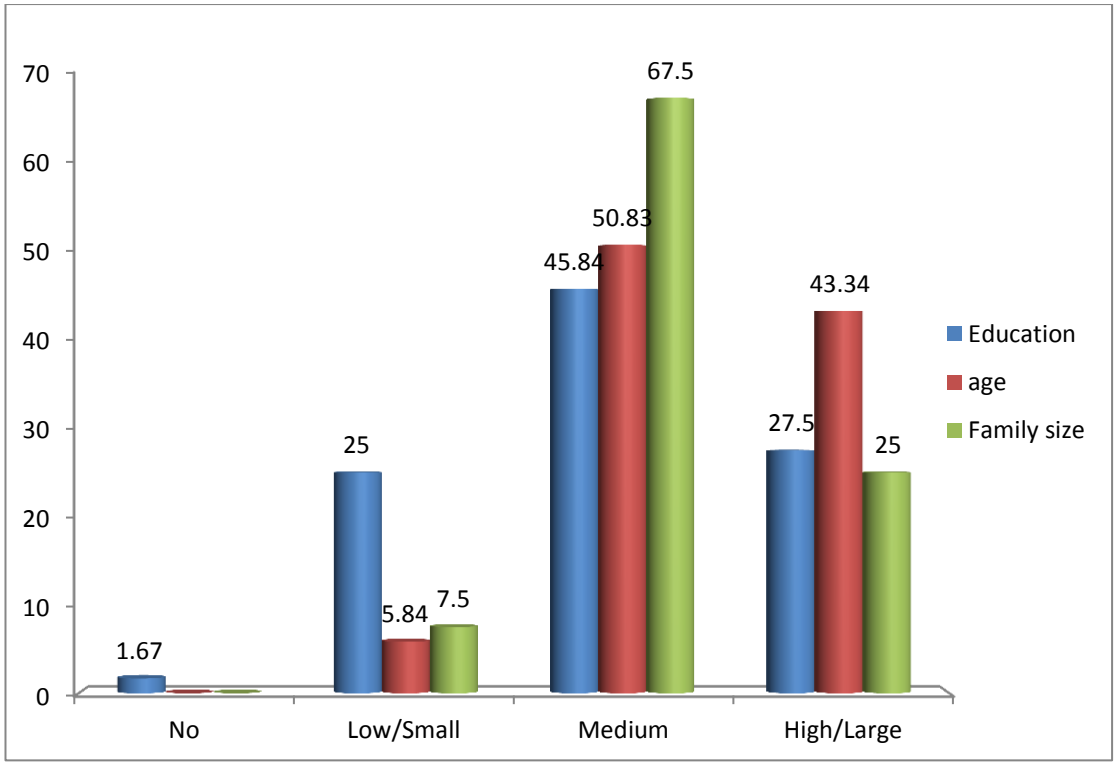

Fig. 3: Diagrammatic presentation of respondents according to their socio-personal characteristics

2. Economic characteristics of the farmers

Size of operational land holding

The data presented in Table 5 show that majority (68.34%) of the respondents were marginal farmers possessing land holding size of up to 1.0 hectare with the prevailing cultural/traditional norms of distribution of the parental land property among the sons followed by small farmers (28.34 %) with land holding between 1.01 to 4.0 hectares. Only 3.34% respondents belonged to the high category of land holding size (above 4.0 ha). The results were in line with the results of Arathybalkrishnan (2001).

Annual income

It can be observed from the table that as many as 88.34 per cent respondents belonged to medium category of annual income from all sources which ranged from Rs. 33,281 to Rs. 1, 65,066. This was followed by high category (3.34%) with income above Rs. 1, 65, 066 and low (8.30%) with income less than Rs. 33, 281 per year. It is learnt that most of the farmers in the study area engaged in different non-farm activities as per their occupation more than agricultural activities for ensuring

regular employment and income. The results were in conformity with the results of the studies conducted by Raghavendra (2005) and Reddy (2006).

Farming experience

It is revealed from the table that, 60.00 per cent of farmers belonged to medium experience category, followed by high experience (27.50%) and low experience category (12.50%). Majority of the trained farmers belonged to marginal land holding category i.e. land holding (up to 1.0 ha) and also majority of the trained farmers were educated up to middle school therefore, majority of the respondents belonged to medium experience category. The findings were in conformity with the findings of Gopalswamy and Anbarashan (2011).

Training received

From the table it can be seen that most of the respondents had medium level of training (62.50%) followed by low (31.60%) and 5.84% respondents were found in the high level category. Most of the respondents had medium level of education and medium level of attitude towards KVK training; this might be the probable reason for medium level of training by majority of the trained farmers.

Table 4: Distribution of respondents according to their economic characteristics

n=120

Sl. No.	Socio-economic variables				
A.	**Size of operational land holding**				
	Category	**Frequency (f)**	**Percentage (%)**	**Mean**	**S.D.**
1.	Marginal (Up to 1.0 ha)	82	68.34	1.56	0.94
2.	Small (1.01-4 ha)	34	28.34		
3.	Big (above 4 ha)	4	3.34		
B.	**Annual Income**				
1.	Low (Rs. 25,900- Rs. 33,280)	10	8.30	97,604	67,294
2.	Medium (Rs. 33,281-Rs. 1,65,066)	106	88.34		
3.	High (Above Rs. 1,65,067)	4	3.34		
C.	**Farming experience**				
1.	Low (up to 17 years)	15	12.50	21.55	9.85
2.	Medium (between 18 to 38 years)	72	60.00		
3.	High (39 years and above)	33	27.50		

D.	Training received				
1.	Low (Up to 5)	38	31.60	10.34	2.35
2.	Medium (6-8)	75	62.50		
	High (More than 8)	7	5.84		

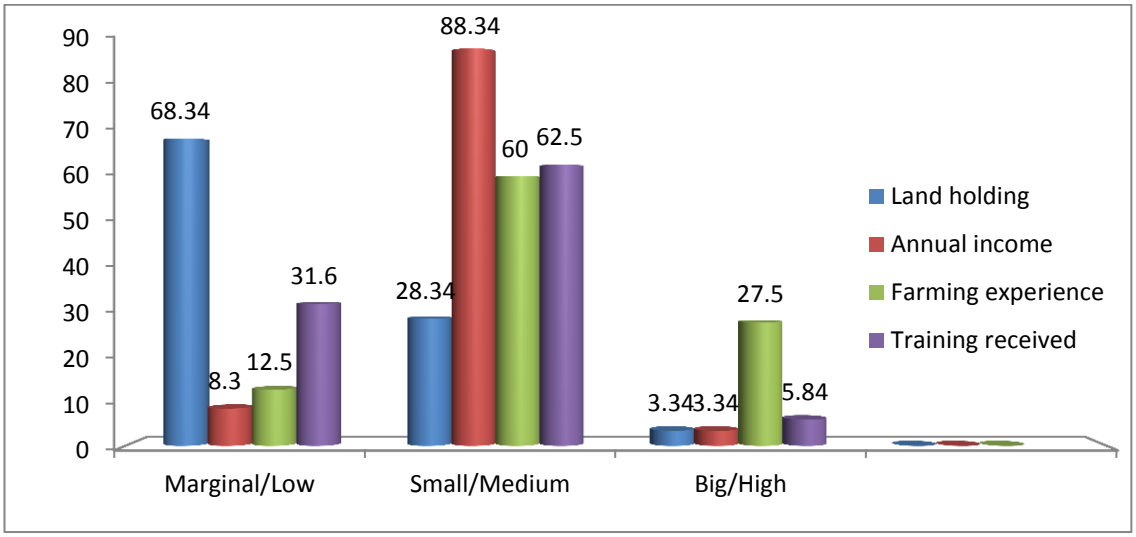

Fig. 4: Diagrammatic presentation of respondents according to their economic characteristics

General Information

Production and productivity

The results presented in the table indicate that majority of the respondents (68.34%) had medium level of productivity followed by low (25.00%) and high (5.00%). Most of the farmers were marginal with medium level of annual income; hence they could not adopt better cultivation practices. This by and large, attributed to the medium level of productivity by majority of the rice growers'.

Table 5: Distribution of respondents according to productivity or yield of rice:

(n=120)

Sl. No.	Category	Frequency (f)	Percentage (%)	Mean	S.D.
1	Low (less than 1742 kg/ha)	30	25.00	1564.39	89.5
2	Medium (1743-1924 kg/ha)	82	68.34		
3	High (more than 1925 kg/ha)	8	6.67		

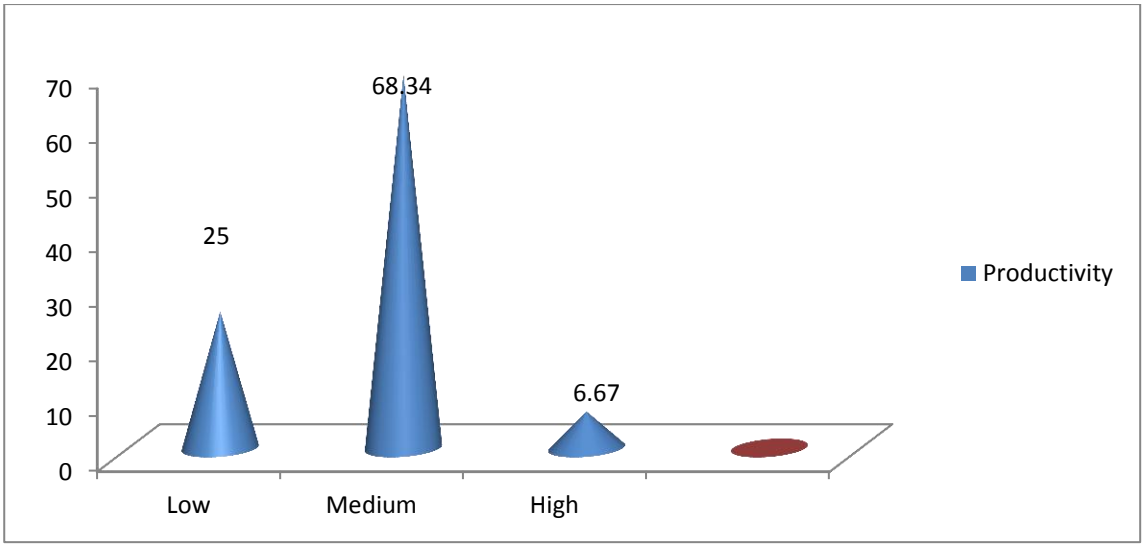

Fig. 5: Diagrammatic presentation of respondents according to their productivity.

Annual net income from rice cultivation (economic condition)

It can be seen from the table that most of the trainees (81.67%) were found under medium category i.e. 41,280 – 76,402 rupees per annum followed by high (10.00%) and low category (8.33%), respectively. Majority of the farmers are marginal with smaller land holding with medium level of productivity, which may be the probable reason for medium level of net annual income by majority of farmers.

Table 6: Distribution of respondents according to annual net income from rice cultivation

(n=120)

Sl. No.	Category	Frequency (f)	Score	Percentage (%)	Mean	S.D.
1	Low (Below Rs. 41,279)	10	1	8.33	47655.32	15644.97
2	Medium (Rs.41 ,280-76,402)	98	2	81.67		
3	High (Above Rs. 76,403)	12	3	10.00		

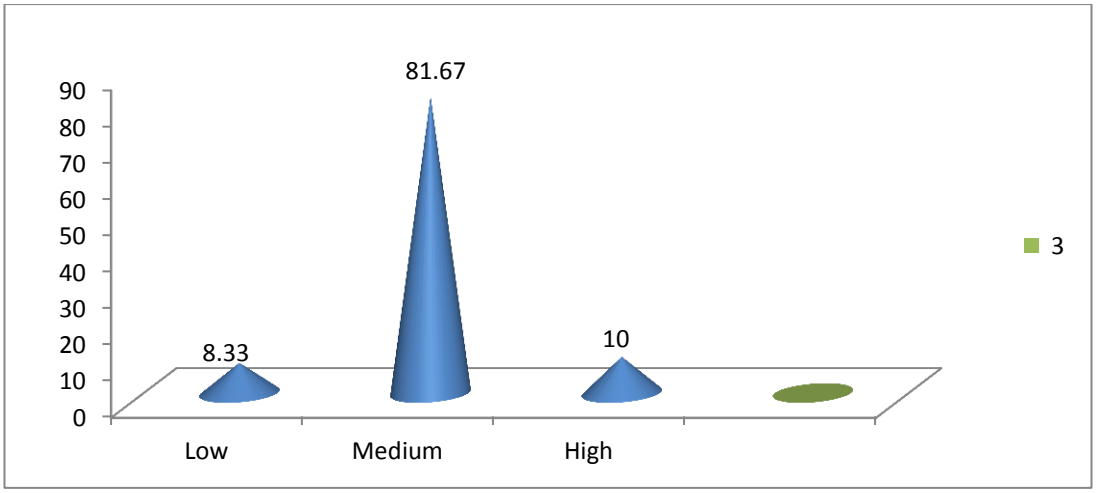

Fig. 6: Diagrammatic presentation of respondents according to their annual net income

Self confidence

The results presented in the table indicate that more then half (58.33%) of the respondents had medium level of self confidence followed by low (33.34%) and high (8.33%). Exposition of different information and adoption of new technology are assumed to develop farmer's self-confidence. Self-confidence of farmer refers to judgment of his capabilities to organize and execute courses of action required to attain designated types of agricultural performance. To make the farmers motivated to improve cultivation practices, attention should be paid to adequate training in considering their basic educational level, psychological, economical and personal attributes. The findings are in conformity with the empirical evidence reported by Ahmed *et al.* (2011).

Table 7: Distribution of respondents according to Self confidence level of respondents

(n=120)

Sl. No.	Category	Frequency(f)	Percentage (%)	Mean	S.D.
1	Low (Up to 18)	40	33.34	30.2	9.7
2	Medium (19-34)	70	58.33		
3	High (Above 35)	10	8.33		

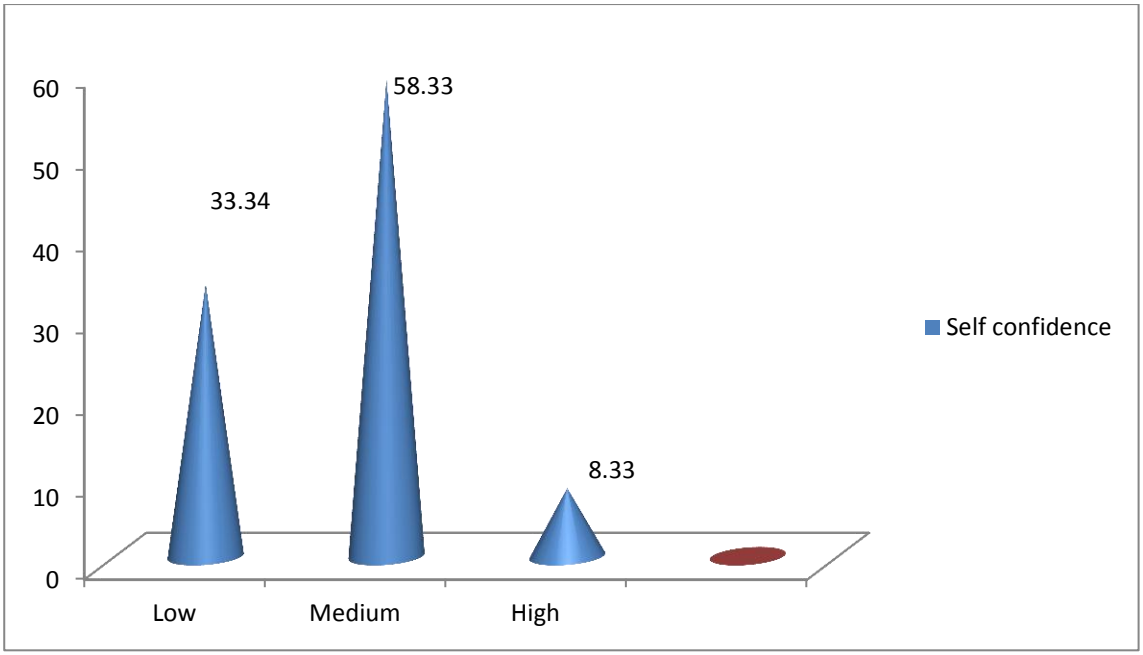

Fig. 7: Diagrammatic presentation of respondents according to their self confidence

Materials possession

Majority of the trainee respondent (60.00%) were found under medium category followed by low (25.00%) and high (6.66%),, respectively. Because of majority of farmers (70.83%) fell under marginal and small land holding they posses less farm material. The findings are in conformity with the findings of Roy *et al.,* 2013.

Table 8: Distribution of respondents according to materials possession of the respondents

(n=120)

Sl. No.	Category	Frequency (f)	Percentage (%)	Mean	S.D.
1	Low (2-4)	30	25.00	9.5	3.7
2	Medium (5-6)	72	60.00		
3	High (7-8)	8	6.66		

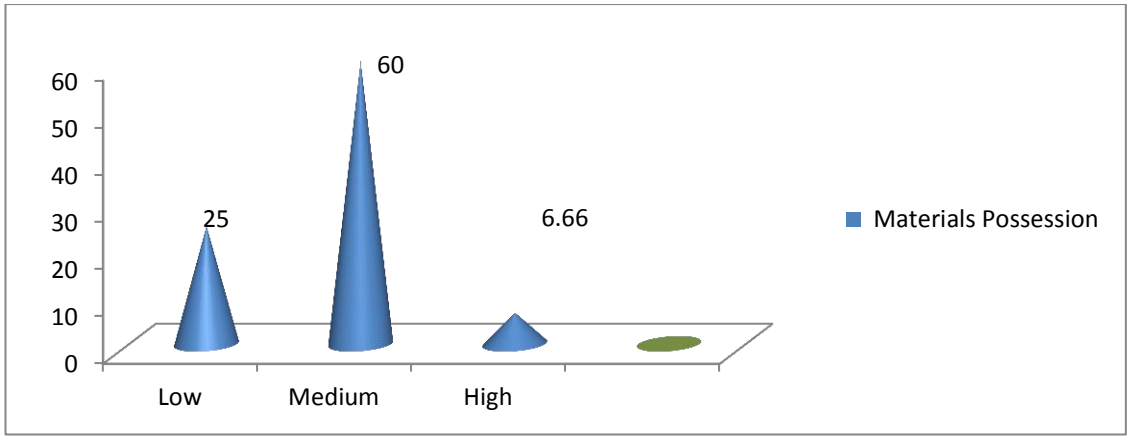

Fig. 8: Diagrammatic presentation of respondents according to their materials possession

4 Objectives

4.1 To find out the level of knowledge on improved rice cultivation technologies of farmers

Knowledge and skills on rice technologies

The findings related to farmers' knowledge level indicate that over half of the respondents (54.16%) had medium level of knowledge towards rice cultivation practices. While 40.00 per cent and 5.83 per cent respondents had low and high level of knowledge in rice cultivation practices (Table 13). The mean value of 45.54 indicates that by and large, farmers in the study area had low to medium level of knowledge on improved technologies in rice cultivation. It is reported that the concept of improve technologies in agriculture despite gaining its popularity among the farmers, its systematic and scientific application were not properly trained under different farming situations. These calls for hand-on training programmes for farmers by the experts in this field to improve their knowledge and skills towards improve rice cultivation practices. The findings of the study were in agreement with the results obtained by Naik (2005), Thippeswamy (2007) and Kumar (2009). Sidram (2008) also reported similar findings with majority respondents belonged to medium level of knowledge in improved cultivation practices of pigeon pea in Gularga district of Karnataka, India.

Table 9: Distribution of respondents according to their level of knowledge towards rice cultivation

(n=120)

Sl. No.	Category	Frequency(f)	Percentage (%)	Mean	S.D.
1	Low (30-41)	48	40.00	45.54	7.11
2	Medium (42-50)	65	54.16		
3	High (51-60)	7	5.83		
	Total	**120**	**100**		

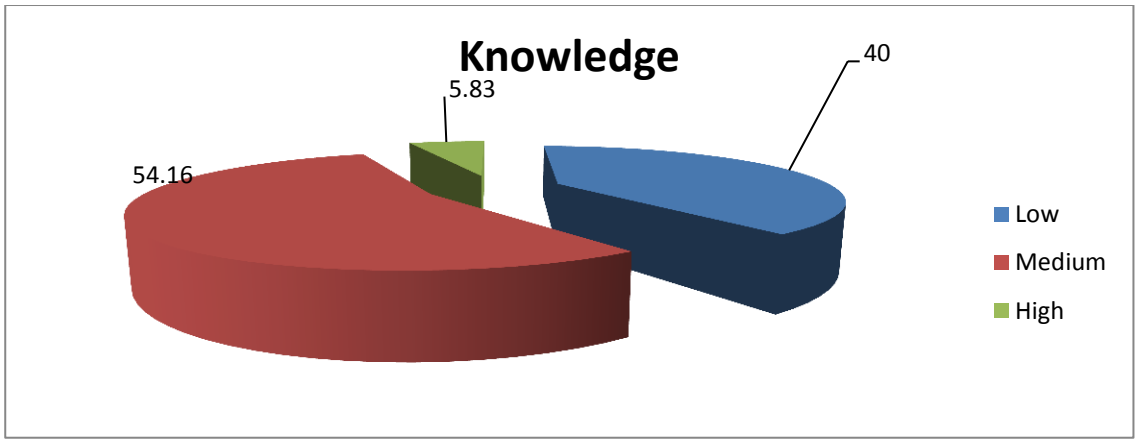

Fig. 9: Diagrammatic presentation of respondents according to their level of knowledge.

Practice- wise Knowledge Level by the rice growers'

Out of the nine selected practices (Table 14) namely, seed selection, seed treatment, land preparation/ soil tillage practices, sowing and transplanting, weed management, soil fertility and nutrient management, water management, plant protection measures and harvesting, majority (54.16%) of the respondents were found having full knowledge of all the water management recommendations/ practices such as rain water conservation, withdrawing water/ draining water after grain filling stage, drainage at maximum tillering stage and irrigation when water from ponds disappears. Whereas, in case of practices like seed treatment, land preparation/soil tillage practices, weed management, plant protection measures and harvesting, all the respondents had reported their partial knowledge level in rice cultivation. The table also

shows that none of the respondents were found in the no knowledge category towards rice cultivation practices. The study further reveals that farmers, by and large, had partial knowledge of all the selected practices in rice cultivation except water management where majority of them were found in full knowledge category of the recommendations. Extension efforts therefore, may be strengthened through different capacity building programmes for the farmers for strengthening the knowledge of the farmers towards improved rice cultivation practices.

Table 10: Practise wise level of knowledge towards rice cultivation: (n=120)

Practices	Full knowledge		Partial knowledge		No knowledge	
	f	%	f	%	f	%
Seed selection	45	37.50	75	62.50	0	0
Seed treatment	3	0.00	117	97.50	0	0
Land preparation/soil tillage practices	5	0.00	115	95.83	0	0
Sowing & transplanting	40	33.34	80	66.67	0	0
Weed management	0	0.00	120	100.00	0	0
Soil fertility & nutrient management	37	30.83	83	69.16	0	0
Water management	65	54.16	55.00	45.83	0	0
Plant protection measures	0	0.00	120	100.00	0	0
Harvesting	0	0.00	120	100.00	0	0

In order to study the nature of relationship between the selected personal and economic characteristics of the respondents and the effectiveness of training programmes on major rice technology in their farming system chi-square test for independence was used to find the correlation coefficients with the help of computer software SPSS. The results are given in table 24.

Level of knowledge

Table 11- Chi-square test of independent variables with level of knowledge

Sl. No.	Independent variable	Dependent variable	Chi-Square value	'p' value
1	Age	Level of knowledge	13.253**	0.025
2	Education		25.057**	0.003
3	Family size		1.858	0.656
4	Family type		4.768	0.353
5	Land holding		1.855	0.679
6	Annual income		8.299	0.098
7	Farming experience		17.566**	0.004
8	Training received		2.455	0.438

*Significant at 0.05 level of probability **Significant at 0.01 level of probability

From the table, it is seen that out of eight independent variables namely; age, education, family size, family type, land holding, annual income, farming experience, training received, except five variables- family size, family type, land holding, annual income and training received, other variables were found with significant correlation with the level of knowledge on rice cultivation practices as evident from their corresponding 'p' values having significant at 0.01 and 0.05 level of probability. This indicates that higher the level of those significant variables of the respondents higher would be their level of knowledge on rice cultivation. Thus the null hypothesis $H_0$1 of no significant relationship between the personal and economic characteristics of the respondents and their knowledge level in rice cultivation practices, therefore, were disproved except in the case of family size, family type, land holding, annual income, training received, and hence rejected them summarily.

Hence, the concerned stakeholders in the district should pay more emphasis to improve the knowledge level through different capacity building programmes supported by the provision for infra- structure facilities and inputs.

4.2 To find out the extent of adoption of improved rice technologies among farmers

Extent of adoption

The result presented in the Table 15 indicate that over half (55.00%) of the respondents had medium level of adoption of improve technologies in rice cultivation followed by low (40.00%) and only 5.00% were found in high adoption category. Further investigation reveals that a formidable proportion of farmers in the study area although with good knowledge on improve and better cultivation practices in rice cultivation, could not adopt them in full due to their poor nature of short term immediate returns in small farming situation coupled with poor economic condition of the farmers. This by and large, attributed to the medium level of adoption by majority of the rice growers'. The findings are in conformity with the findings of Raghavendra (2005), Marradi (2006), and Singh *et al.* (2010).

Table 12: Distribution of categories of respondents according to their extent of adoption in rice cultivation

(n=120)

Sl. No.	Category	Frequency(f)	Percentage (%)	Mean	S.D.
1	Low (20-30)	48	40.00	35.45	7.34
2	Medium (31-41)	66	55.00		
3	High (42-50)	6	5.00		
	Total	**120**	**100**		

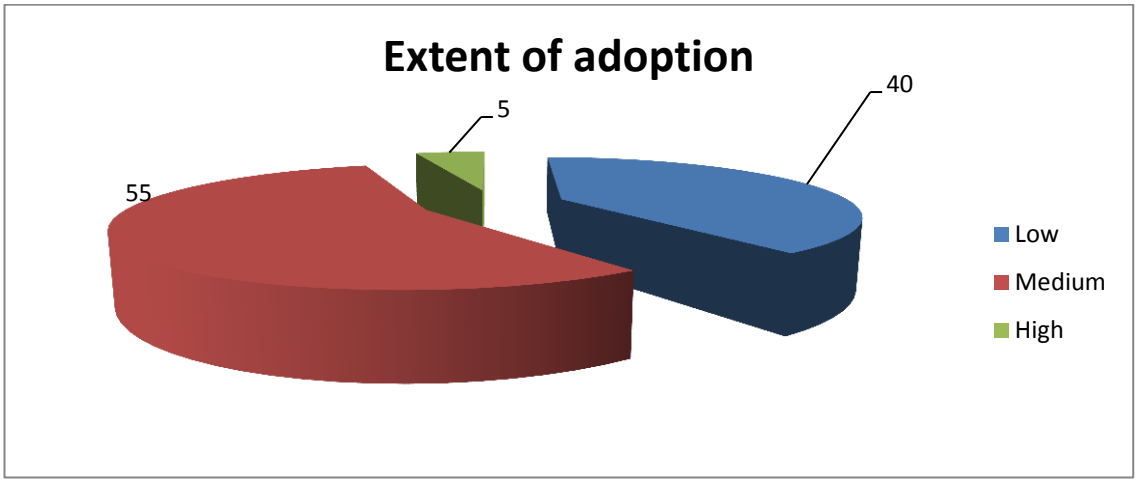

Fig. 10: Diagrammatic presentation of categories of respondents according to their extent of adoption.

Practice- wise extent of adoption by the rice growers

From the table, it can be clearly seen that out of the nine selected practices namely; seed selection, seed treatment, land preparation/ soil tillage practices, sowing and transplanting, weed management, soil fertility and nutrient management, water management, plant protection measures and harvesting, over half (58.34%) of the respondents were found full adoption of all the water management practices/recommendation such as rain water conservation, withdrawing water/draining water after grain filling stage, drainage at maximum tillering stage and irrigation when pond water disappears.

Whereas, in case of practices like land preparation/soil tillage practices, sowing and transplanting, weed management, soil fertility and nutrient management, plant protection measures and harvesting, all the respondents had reported their partial adoption in rice cultivation. The table shows that 2.50% and 0.83% respondents had no adoption of seed treatment and seed selection respectively.

The study reveals that farmers, by and large, had partial adoption of all the selected practices in rice cultivation except water management where majority of them were found in full adoption category of the recommendations. Extension efforts therefore may be strengthened through different capacity building programmes for the farmers for full adoption of improve and better practices in rice cultivation.

Table 13: Major practice wise extent of adoption by the respondents (n=120)

Practices	Full adoption		Partial adoption		No adoption	
	f	%	f	%	f	%
Seed selection	44	36.66	75	62.50	1	0.83
Seed treatment	0	0.00	117	97.50	3	2.50
Land preparation/soil tillage practices	4	3.34	116	96.67	0	0
Sowing & transplanting	9	7.50	111	92.50	0	0
Weed management	0	0.00	120	100.00	0	0
Soil fertility & nutrient management	8	6.67	112	93.34	0	0
Water management	70	58.34	50	41.60	0	0
Plant protection measures	0	0.00	120	100.00	0	0
Harvesting	0	0.00	120	100.00	0	0

Extent of adoption

Table 14- Chi-square test of independent variables with extent of adoption

Sl. No.	Independent variable	Dependent variable	Chi-Square value	'p' value
1	Age	Extent of adoption	10.458*	0.045
2	Education		24.832**	0.001
3	Family size		1.079	0.791
4	Family type		4.644	0.069
5	Land holding		2.434	0.897
6	Annual income		8.600	0.079
7	Farming experience		14.235**	0.009
8	Training received		4.995	0.097

*Significant at 0.05 level of probability **Significant at 0.01 level of probability

From the table, it is seen that out of eight independent variables namely; age, education, family size, family type, land holding, annual income, farming experience, training received, except five variables- family size, family type, land holding, annual income, training received, other variables were found with significant correlation with the extent of adoption as evident from their corresponding 'p' values having significant at 0.01 and 0.05 level of probability. This indicates that higher the level of those significant variables of the respondents higher would be their extent of adoption. Thus the null hypothesis $H_0$2 of no significant relationship between the personal and economic characteristics of the respondents and their extent of adoption of improved rice cultivation practices, was disproved except in the case of family size, family type, land holding, annual income, training received, and hence, rejected them summarily.

Hence, the concerned stakeholders in the district should pay higher emphasis to improve and develop these variables in order to increase the adoption rate of the respondents.

Here, I have shown some farm machineries which they have adopted.

Fig. 11(a): Thresher

Fig. 11(b): Hand Compression Sprayer

Fig. 11(c): Power Tiller

4.3 To study the problems faced by the farmers in the adoption of improved rice cultivation technologies

It refers to the limitation or hindrance perceived by rice farmers in adoption of the recommended practices of rice cultivation. The respondents were asked to indicate constraints in an open ended questionnaire schedule under various subheads in their day to day activities of rice cultivation. Open ended questions were asked to elicit suggestions from the respondents to overcome the said constraints.

Problems faced by the respondents

In the present study constraints refers to the limitation or hindrances perceived by the trained farmers in adoption of improved technology in their farming system. An attempt was made to find out the constraints faced by the respondents. The frequency along with the percentage indicating each of the constraints was taken into account. The highest percentage so obtained among the constraints was considered as the most important constraints accordingly. For the present study those constraints which are expressed by more than 50 per cent of the respondents is considered as the major constraints faced by the trained rice grower.

Table 15: Problems faced by the trained farmers in rice cultivation practices

Sl. No.	Problems	Frequency (f)	Percentage (%)
1.	Inadequate availability of quality seed at proper time	116	96.67
2.	Lack of knowledge about scientific cropping pattern and cropping system and their method of application	109	90.84
3.	Non-availability of improved implements and other critical inputs such as FYM/organic fertilizers etc.	99	82.50
4.	Low price of product in local market	105	87.50
5.	Lack of storage and marketing facilities	95	79.16
6.	Lack of guidelines about seed treatment	90	75.00

7.	Lack of credit facilities	80	66.67
8.	High cost and risk to adopt improved agricultural practices	70	58.34
9.	Irregular supply of electric power	66	55.00
10.	Unawareness of various developmental programs of the government	70	58.34
11.	Training time was not convenient	72	60.00
12.	Lack of self employment opportunities	70	58.34
13.	Lack of proper demonstration	75	62.50
14.	Lack of transportation facilities	69	57.50
15.	Non – availability of subject material at hand.	72	60.00

Among the various problems identified by the respondents, Inadequate availability of quality seed at proper time (96.67%), Lack of knowledge about scientific cropping pattern and cropping system and their method of application (90.84%), Non-availability of improved implements and other critical inputs such as FYM/organic fertilizers etc. (82.50%), Low price of product in local market (87.50%), Lack of storage and marketing facilities (79.16%), Lack of guidelines about seed treatment (75.00%) were considered as the major problems as indicated by its corresponding frequency. The other problems associated were Lack of credit facilities (66.67%), High cost and risk to adopt improved agricultural practices (58.34%), Irregular supply of electric power (55.00%), Unawareness of various developmental programs of the government (58.34%), Training time was not convenient (60.00%), Lack of self employment opportunities (58.34%), Lack of proper demonstration (62.50%), Lack of transportation facilities (57.50%), Non – availability of subject material at hand (60.00%) respectively.

Suggestive measures

In the present study, the various suggestions as expressed by the respondents were collected and arranged according to their frequency and percentage. For the present study those suggestions which are expressed by more than 60 per cent of the respondents is considered as the suggestions to solve the problems.

Table 16: Suggestions as expressed by the respondents to solve the problems

Sl. No.	Suggestions	Frequency (f)	Percentage (%)
1.	Strong extension network for effective transfer of latest technologies	117	97.50
2.	Improvement of credit and market facilities and crop insurance are required	102	85.00
3.	Organising as many as awareness and training programme towards improved practices covering more village in the district	115	95.84
4.	To encourage the integrated pest management approach for effective control of pests and diseases by emphasizing the need based application of pesticides	105	87.50
5.	Development activities are required to be strengthened suitably achieving growth in rice productivity and production	102	85.00
6.	Conduct group discussion/meetings, demonstration, and on-farm testing on different rice cultivation practices.	95	79.17
7.	Establish more storage and marketing facilities	91	75.83
8.	The line sowing in upland rice areas through suitable seeding devices is required to be made popularized for desired plant population	88	73.34

From the table, it can be clearly seen that the main suggestions expressed by the respondents were Strong extension network for effective transfer of latest technologies, Improvement of credit and market facilities and crop insurance are required, Organising as many as awareness and training programme towards improved practices covering more village in the district, To encourage the integrated pest management approach for effective control of pests and diseases by emphasizing the need based application of pesticides. The other suggestion as expressed by the respondents to solve the problems are Development activities are required to be strengthened suitably achieving growth in rice productivity and production, Conduct

group discussion/meetings, demonstration, and on-farm testing on different rice cultivation practices, Establish more storage and marketing facilities and line sowing in upland rice areas through suitable seeding devices is required to be made popularized for desired plant population respectively.

Chapter - 5

Summary and Conclusion

A brief summary of the findings of the research study is presented in this chapter.

5.1 The problem

Agriculture is the mainstay of Indian economy with the country's over 70 per cent of its population lives in rural areas (Census of India 2011, Registrar General and Census Commissioner, Ministry of Home Affairs, Govt. of India). Agriculture provides employment to not only the adult males of households but also to women on the households extensively in production of major grains and millets, in land preparation, seed selection and seedling production, sowing, applying manure, weeding, transplanting, threshing, winnowing and harvesting. Agriculture plays a significant role in overall socio-economic development of the people of the country particularly farming community. Therefore, fostering rapid, sustained and broad-based growth in agriculture remains key priority for the country. So for the development of nation and citizens, there is necessity to bring a development revolution in agriculture and the scientific transformation of agriculture is an important requisite of agricultural and rural development. The new paradigm of agricultural development in India necessitates incorporation of Krishi Vigyan Kendra as a grassroots level institution for driving overall development. ICAR has established over 665 KVKs throughout the country and this concept was laid down by Dr. Mohan Singh Mehta Committee for the farmers training concerned with new agricultural research technology to produce vocational efficiency among farmers and farm women, and to reduce the gap between technical knowledge and farmers' level of knowledge.

Krishi Vigyan Kendra (KVK) is an institutional extension project of the ICAR to demonstrate the application of Science and Technology inputs of agricultural research and education on the farmers' field and in the rural area with the help of a multi-disciplinary team of Scientists with a view to increasing food productivity and there by food security. The major activities of the KVK are to conduct training programme, frontline demonstration and on-farm testing (Venkatasubramanian *et al.,* 2010). Farming is an integral part of the Indian economy and also to rural economy. KVKs are providing training in improved farming practices to make it more profitable at

moderate risk to reduce vulnerability of the farmers and providing sustainable livelihood. Training is provided to increase in knowledge of the farmers about improved farming practices so that the gap between input-output cost ratios becomes wider leading to more income and employment generation. KVKs play a pivotal role in the districts as an agent of agricultural change by coming out from the inside the wheel approach. So there is requirement to formulate a sound strategy for use of KVKs potential in agricultural development and there is need to know the actual farm information needs and socio-economic environment while making a strategy to reduce the gap between agricultural technological knowledge and adoption practices of farmers.

So a study has been planned with the primary objective of assessing "Adoption Behaviour of Rice Growers on Improved Rice Technology Through Krishi Vigyan Kendra (KVK) in Khowai District of Tripura."

5.2 Objectives

1. To find out the level of knowledge on improved rice cultivation technologies of farmers.
2. To find out the extent of adoption of improved rice technologies among farmers.
3. To study the problems faced by the farmers in the adoption of improved rice cultivation technologies.

5.3 Research Methodology

The present study was carried out in Khowai district of Tripura, which comprises of six blocks namely Khowai, Tulasikhar, Padmabil, Kalyanpur, Teliamura and Mungiakami. Out of six blocks, one block namely, Khowai was purposively selected, because it has maximum number of rice farmers trained under the KVK, Divyadaya, Chebri, Khowai district. A total of 120 respondents were selected from each selected villages and the selected block by using proportionate random sampling. Data collection from the selected respondents was made with the help of pre-tested structured schedule through personal interview method during December-January 2017-18.

The independent variables such as Age, Education, Family Size, Family type, were measured with the help of scales developed by Trivedi and pareek (1964), structured schedule. The socio-economic variables size of operational land holding, annual income of family, farming experience and training received were measured with the help of schedules structured for the purpose. The adoption behaviour of farmer

was measured with dimensions namely; Improve knowledge and skills on rice technologies, Increase adoption level of the improve practices of rice technology. It was studied by developing a test schedule containing questions on improved method of rice cultivation for knowledge and adoption, structured schedule to measure production and productivity, improve economic condition, increase social recognition and increase material possession. Scale developed by Roy (2013) was used to measure the self-confidence of rice growers' with slight modification.

Frequency and percentage analysis, mean, standard deviation, cumulative cube root method of categorization and chi-square test for independence were the statistical tools used in the study.

5.4 Salient findings

1. Major Findings

The findings related to farmers' knowledge level indicate that over half of the respondents (54.16%) had medium level of knowledge towards rice cultivation practices. While 40.00 per cent and 5.83 per cent respondents had low and high level of knowledge in rice cultivation practices. These calls for hand-on training program for farmers by the experts in this field to improve their knowledge and skills towards improve rice cultivation practices. The result for extent of adoption indicates that half (55.00%) of the respondents had medium level of adoption on improved technologies in rice cultivation followed by low (40.00%) and only 5.00 per cent were found in high adoption category. The extent of adoption of the majority of the farmers was low to medium level of adoption. In case of productivity the result indicates that majority of the respondents (68.34%) had medium level of productivity followed by low (25.00%) and high (6.67%). The annual net income for most of the trainees (81.67%) was found under medium category i.e. 15001 to 40000 rupees per annum followed by high (10.00%) and low category (8.33%), respectively. Half (58.33%) of the respondents had medium level of self confidence followed by low (33.34%) and high (8.33%). For material possession majority of the trainee respondent (60.00%) were under medium category followed by high (6.66%), and low (25.00%) respectively.

2. Characteristics of the respondents

Out of 120 respondents, majority were of middle age with medium education level, medium family size, medium level of social participation and majority of them with nuclear family type in case of their personal characteristics. While majority

respondents were marginal farmers, belonged to medium category of annual income, medium farming experience and with medium level of training received.

3. Relationship and contributory influence of independent variables with dependent variables

Level of knowledge: Age, education, farming experience, were found with significant correlation with the level of knowledge on rice cultivation practices. Also could be commented that education, age and risk orientation had strong association with level of knowledge and will have more influence on dependent variable.

Extent of adoption: Age, education, farming experience, were found with significant correlation with the extent of adoption. Also could be commented that education and farming experience had strong association with extent of adoption and will have more influence on dependent variable.

4. Problems and their suggestive measures

Among the various problems identified by the respondents, inadequate availability of quality seed at proper time, Lack of knowledge about scientific cropping pattern and cropping system and their method of application, Non-availability of improved implements and other critical inputs such as FYM/organic fertilizers etc. Low price of product in local market, Lack of storage and marketing facilities, Lack of guidelines about seed treatment were considered as the major problems by the respondents.

Strong extension network for effective transfer of latest technologies, Improvement of credit and market facilities and crop insurance are required, Organizing as many as awareness and training programme towards improved practices covering more village in the district. To encourage the integrated pest management approach for effective control of pests and diseases by emphasizing the need based application of pesticides were the suggestion made by the farmers to solve the problems related to rice cultivation.

5.5 Conclusion and implications

Krishi Vigyan Kendra is considered as the knowledge and resource center of the local areas at district level to meet the requirements of the local agro-climatic conditions. These institutions were set up to enhance the level of technical knowledge among farmers. Prof. M.S. Swaminathan aptly coined the word ‘technical ability’ to mean ‘ability of rural people (although illiterate, otherwise) in understanding and using technical knowledge of farm science’. Such technical literacy would be

imparted through work experience and farmers' training through 'learning by doing'. This calls for conscious consideration and take care on the part of extension worker and other concerned departments on training and proper management of technology in agriculture for further progress and development in rural areas.

The major findings of the present study have a measure of implications for extension workers, agricultural scientists, planners, policy makers and administrators. Some of the important implications are given below.

1. It was found that it is increasing the knowledge of trainees about improved rice farming practices and rice growers who are associated with KVK, most of them fully or partially adopted different rice technologies. It can be clearly seen that out of the nine selected practices namely; seed selection, seed treatment, land preparation/ soil tillage practices, sowing and transplanting, weed management, soil fertility and nutrient management, water management, plant protection measures and harvesting, over half (58.34%) of the respondents were found full adoption of all the water management practices/recommendation such as rain water conservation, withdrawing water/draining water after grain filling stage, drainage at maximum tillering stage and irrigation when pond water disappears.

   Whereas, in case of practices like land preparation/soil tillage practices, sowing and transplanting, weed management, soil fertility and nutrient management, plant protection measures and harvesting, all the respondents had reported their partial adoption in rice cultivation. 2.50% and 0.83% respondents had no adoption of seed treatment and seed selection respectively.

   The study reveals that farmers, by and large, had partial adoption of all the selected practices in rice cultivation except water management where majority of them were found in full adoption category of the recommendations. Extension efforts therefore may be strengthened through different capacity building programmes for the farmers for full adoption of improve and better practices in rice cultivation.

   Hence more number of trainings should be organized by KVKs so that it can benefit to more number of rice growers. Different training programmes followed by field demonstration should be organised and imparted so that farmers develop confidence in them to take up improved methods to increase their productivity and improve their socio-economic condition.

2. Allocation of budgets under contingency head should be increased for trainings leading to increase in dimensions and numbers of KVK trainings under different thematic areas of agriculture and allied sectors.

3. Since some of the specific practices under different major practices although very much necessary in rice cultivation were not adopted by any of the farmer under study. Necessary technical guidance through specific training programmes followed by other extension efforts may be taken up by the, KVK, concerned line departments and other organisations on such non-adopted practices.

4. The findings also indicate that the variables such as education, age, farming experience, training received and land holding had significant impact on the effectiveness of training programme as evident by their chi-square value, there is a call for extension agencies and other departments to manipulate these crucial factors through different extension efforts and programmes.

5. The KVK staff should try to improve their job efficiency especially in ensuring that the rural youth within the KVK district could take up self-employment venture for sustainable income generation.

6. Establishment of ICT facilities for effective dissemination of information to different stakeholders including farmers may be encouraged.

7. Publication of regular and reliable farm magazine should be made available for the benefit of the farming community.

8. Non-availability of improved implements, inadequate availability of quality seeds at proper time and other critical inputs in the study area suggested that government should create adequate infrastructure facilities and arrange to supply these inputs to farmers at cheapest rates by offering stores in the villages so that farmers find them accessible at the lean period.

9. The study covered only one district of the state and therefore, its findings could be expanded to other districts of Tripura. Similar studies should be planned for other districts of the state, so that the findings of both could be used effectively for drawing generalisation of training programme on other improved agricultural practices.

5.6 Suggested areas for future research

Based on experiences gained in the present study, some learning points can be drawn as suggestions for future research as indicated below.

1. The present study was limited to one district only in the state and involved less number of respondents. In order to derive wider generalization, could be conducted with large sample size covering more areas in the state with inclusion of more variables and taking the more productive traits.
2. Adoption of improved rice farming practices, improved technologies and attitude of rice farmers towards trainings about improved rice farming practices and improved technologies in other districts of Tripura can be further studied with incorporation of more variables and dimensions.
3. Comparative studies on training conducted by KVK's and agricultural department on rice cultivation practices can be taken up to derive wider generalizations.
4. Studies on impact assessment of various training programmes conducted by the Krishi Vigyan Kendra can be undertaken to see the changes across the social system due to KVK interventions.

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Interview Schedule for Data Collection

Topic: "Adoption Behaviour of Rice Growers on Improved Rice Technology Through Krishi Vigyan Kendra(KVK) in Khowai District of Tripura."

(Rice Growers)

(General information)

1. Name of the Respondent _____

2. Sex _____ (M/F)

3. Village _____

4. Block _____

5. Sub division _____

(Personal and Socio-economic Characteristics)

1. Age: _____ (Years)

2. Level of education Please choose your level of education given below by putting a tick (✓) mark

Sl. No.	Categories	Response
i.	Illiterate	
ii.	Up to primary school	
iii.	Up to middle school	
iv.	Up to high school	
v.	Up to higher secondary	
vi.	Up to degree/ Diploma	
vii.	Post Graduate	

3. Size of the family (no. of members)

Please give your response

i) < 4

ii) 4-6

iii) 7 and above

4. Family type

Please give your response- i) Joint family

ii) Nuclear family

5. Size of operational land holding (in ha):

i) Operational land owned.....

ii) Operational land leased in.....

iii) Operational land leased out.....

Operational land holding = (Operational land owned) + (Operational land leased in) – (Operational land leased out)

6. Annual income of family (in rupees)

i. Farm income _____

ii. Off-farm income _____

iii. Other known sources _____

iv. Total = _____

7. Farming experience

For how many years you have been experiencing farming specially rice cultivation? _____ (years)

8. Training received from KVK

Please State the number of times you have attended training programme organised by KVK

.....

9. Annual savings of family (in rupees):

Total Annual income – Total Annual expenditure =Total Annual savings

Cash in hand:

Do you have bank account? – Yes/No

If yes, please answer

Total= _____

PART-I

10.Knowledge in rice cultivation

Sl. No.	Name of the practices	Yes	No
1.	**SEED SELECTION**		
a.	Is it correct that Seed should be from trustworthy company, recognized dealer/Agency?		
b.	Name of drought tolerance varieties		
c.	Name of varieties tolerance to water logging/Submergence		
d.	Name of Early maturing varieties		
e.	Name of Disease/Pest resistant varieties		
(Name of the company, dealer, varieties)			
2.	**SEED TREATMENT**		
a.	What are the method(s) for seed treatment?		
b.	How can you do Salt treatment?		
c.	How can you do Chemical treatment?		
(Interval/time, percentage, name, dose, time, duration, method)			

3.	**LAND PREPARATION/SOIL TILLAGE PRACTICES**		
a.	How can you do Primary tillage?		
b.	What is Secondary tillage?		
c.	What is Conservation tillage?		
d.	What is Mulch tillage?		
e.	What is Minimum tillage?		
f.	What is Rotary tillage?		
h.	What is Raised bed and furrow?		
i.	What is Summer tillage?		
(Concept, no. of ploughings, time, interval, method)			
4.	**SOWING AND TRANSPALNTING**		
a.	How can you do Broadcasting seeding?		
b.	What is direct drill seeding?		
c.	What is direct sowing in zero tillage?		
d.	How can you do zero till drill seeding of rice in presence of crop?		
e.	How can you do hardening of seedlings?		
(Concept, method, time)			
5.	**WEED MANAGEMENT**		
a.	What is hand pulling?		
b.	What is hoeing?		
c.	What is tillage?		

d.	What is flooding?		
e.	What is burning?		
f.	How can you do smothering with non-living materials (mulching)?		
g.	What is sickling?		
h.	What is crop rotation?		
i.	What is intercropping/relay cropping?		
j.	How can you do weed management with parasites/Bio control agent?		
k.	How can you do weed management with herbicides and common salt?		
l.	What is integrated weed management (Chemical hot water)?		
(Stage, method, name of parasites, herbicides, time, etc.)			
6.	**SOIL FERTILITY AND NUTRIENT MANAGEMENT**		
a.	How can you do fertility management with cow dung and urine?		
b.	What is brown manuring technique?		
c.	What is compost?		
d.	What are bio fertilizers?		
e.	What is concentrate organic manure?		
f.	What is biogas slurry?		
g.	What is vermicompost?		
h.	What is LCC- (Leaf Colour Chart)?		

(Name, concept, method, stage, time dose etc.)			
7.	**WATER MANAGEMENT**		
a.	What is bed and furrow method?		
b.	What is furrow system of irrigation?		
c.	What are intermittent irrigation/ alternate wetting?		
d.	How can you apply water with half furrow depth?		
e.	What is rain water conservation?		
f.	How can you withdraw water/drain water after grain filling stage?		
g.	Is it correct to irrigate at a depth of 5 cm when the pond water disappears?		
h.	How can you do drainage at maximum tillering stage (summer tillage)?		
(Concept, method, time, stage, duration)			
8.	**PLANT PROTECTION MEASURES**		
a.	What are light traps?		
b.	How can you protect plants by removing infected leaves/plants?		
c.	What is sanitation?		
d.	What is in-situ burning of slashed debris in field?		
e.	How can you protect plant by burning of soil mixed debris in heaps?		
f.	How can you do fencing with hedge?		
g.	What are insect repellent plants?		

h.	What are trap crops?		
i.	What are bi control agents?		
j.	What are bio pesticides?		
k.	What are botanical insecticides?		
(Concept, method, stage, time, dose)			
9.	**HARVESTING**		
a.	Is it correct to harvest paddy leaving 50 per cent of standing stubble stalk?		
b.	Is it correct to harvest paddy when moisture content of grains is less than 20 per cent?		
c.	Whether paddy should be dried to safe moisture content within 24 hours after harvesting?		
(Time, Stage, moisture percentage)			

PART-II

11. Extent of Adoption of rice cultivation practices

Sl. No.	**Name of the practices**	**Yes**	**No**
1.	**SEED SELECTION**		
a.	From where do you collect Seed?		
b.	Did you cultivate Drought tolerance varieties?		
c.	Did you cultivate water logging/Submergence varieties?		
d.	Did you cultivate early maturing varieties?		
e.	Did you cultivate disease/pest resistant varieties?		

2.	**SEED TREATMENT**		
a.	Did you practise alternate heating and cooling for several times?		
b.	Did you practise salt treatment?		
c.	Did you practise chemical treatment?		
d.	Did you practise seed treatment with bio fertilizers?		
e.	Did you use bio-pesticides?		
f.	Did you use botanicals?		
3.	**LAND PREPARATION/SOIL TILLAGE PRACTICES**		
a.	Did you practise primary tillage or ploughing?		
b.	Did you practise secondary tillage?		
c.	Did you practise conservation tillage?		
d.	Did you practise mulch tillage?		
e.	Did you practise minimum tillage?		
f.	Did you practise rotary tillage?		
h.	Did you practise raised bed and furrow method?		
i.	Did you practise summer tillage?		
4.	**SOWING AND TRANSPALNTING**		
a.	Did you do broadcasting of seeding?		
b.	Did you follow direct drill seeding method?		
c.	Did you practise direct sowing in zero tillage?		
d.	Did you practise zero till drill seeding of rice in presence of crop?		

e.	Did you do hardening of seedlings?		
5.	**WEED MANAGEMENT**		
a.	Did you do hand pulling?		
b.	Did you do hoeing?		
c.	Did you practise tillage?		
d.	Did you practise flooding?		
e.	Did you do burning?		
f.	Did you do Smothering with non-living materials (mulching)?		
g.	Did you do sickling?		
h.	Did you practise crop rotation?		
i.	Did you practise intercropping/relay cropping?		
j.	Did you use parasites/Bio control agent?		
k.	Did you use herbicides, common salt?		
l.	Did you practise integrated weed management (Chemical hot water)?		
6.	**SOIL FERTILITY AND NUTRIENT MANAGEMENT**		
a.	Did you use cow dung and urine as organic manure?		
b.	Did you practise brown manuring technique?		
c.	Did you use compost?		
d.	Did you use bio fertilizers?		
e.	Did you use concentrate organic manure?		
f.	Did you use biogas slurry?		

g.	Did you use vermicompost?		
h.	Did you use LCC-Based (Leaf Colour Chart) for precision nitrogen management?		
7.	**WATER MANAGEMENT**		
a.	Did you use bed and furrow method?		
b.	Did you practise furrow system of irrigation with rice grown on raised bed?		
c.	Did you practise intermittent irrigation/ alternate wetting?		
d.	Did you apply water with half furrow depth?		
e.	Did you practise rain water conservation?		
f.	Did you withdraw water/drain water after grain filling stage?		
g.	Did you irrigate at a depth of 5 cm when the pond water disappears?		
h.	Did you do drainage at maximum tillering stage (summer tillage)?		
8.	**PLANT PROTECTION MEASURES**		
a.	Did you use light traps?		
b.	Did you remove infected leaves/plants?		
c.	Did you practise sanitation?		
d.	Did you do in-situ burning of slashed debris in field?		
e.	Did you do burning of soil mixed debris in heaps?		
f.	Did you do fencing with hedge?		
g.	Did you plant insect repellent plants around the field?		

h.	Did you grow trap crops?		
i.	Did you use bi control agents?		
j.	Did you use bio pesticides?		
k.	Did you use botanical insecticides?		
9.	**HARVESTING**		
a.	Did you harvest paddy leaving 50 per cent of standing stubble stalk?		
b.	Did you harvest paddy when moisture content of grains is less than 20 per cent?		
c.	Did you practise drying of paddy within 24 hours for safe moisture content?		

Some Personal Information

1. Productivity of rice

Productivity or Yield= (q/ha)

2. Annual Net income (Rs.)

Total area under rice cultivation=

Total production per ha=

Gross income by selling of produce (rice) per annum=

Gross expenditure per annum=

Annual Net income=Gross income – Gross expenditure

3. Self confidence attained (State your present position towards the selected statements of confidence in the given response categories)

Sl. No.	Statements	To a greater extent	Great extent	Neither agree nor disagree	Less extent	Least extent
1.	Everyone knows that I am a successful farmer					
2.	I have no difficulty to use new agricultural procedures					
3.	I am success in dealing with any agricultural problems					
4.	I can understand any sort of agricultural discussion					
5.	I want to find reasons when I get good crops					
6.	Comparing with others, I grow more amount of crops					
7.	Always I try to remove all troubles in agriculture					
8.	I brood as how to get good crops					

4. Material possession

Which assets do you have at present? Please give your response

Sl. No.	Items	No. of items	Sl. No.	Items	No. of items
i.	Bullock cart		xiii.	Radio	
ii.	Hand cart		xiv.	Television	
iii.	Power tiller		xv.	Telephone	
iv.	Jeep		xvi.	Mobile	
v.	Car		xvii.	Newspaper	
vi.	Tractor		xviii.	Refrigerator	
vii.	Truck		xix.	Washing machine	
viii.	Motor cycle		xx.	Pressure cooker	
ix.	Rickshaw		xxi.	Cooking gas connection	
x.	Auto rickshaw		xxii.	Electric fan	
xi.	Cycle		xxiii.	Any other (Specify)	

PART-III

(Problems)

Please identify specific problems faced by you (grower) during rice cultivation. Further, you are requested to rank according to their level of importance by putting tick mark in the given response categories.

Sl. No.	Problems	Not so serious	Serious	Very serious
1.				
2.				
3.				
4.				
5.				

(Suggestions)

Please identify important suggestion regarding rice cultivation. Further, you are requested to rank according to their level of importance by putting a tick mark in the given response categories.

Sl. No.	Suggestion	Not so important	Important	Very important
1.				
2.				
3.				
4.				
5.				
