# IMPACT OF ECO -FRIENDLY FARM TECHNOLOGIES IN RICE PROMOTED THROUGH FARMERS' FIELD SCHOOL (FFS)

by

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(2013-11-193)

THESIS

*Submitted in partial fulfillment of the*

*requirement for the degree of*



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## DECLARATION

I, **G. Naveen Kumar** hereby declare that this thesis entitled **"Impact of eco-friendly farm technologies in rice promoted through Farmers' Filed School (FFS)"** is a bonafide record of research done by me during the course of research and the thesis has not previously formed the basis for the award of any degree, diploma, fellowship or other similar title, of any other University or Society.

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**14-09-2015** **(2013-11-193)**

## CERTIFICATE

Certified that this thesis entitled **"Impact of eco-friendly farm technologies in rice promoted through Farmers' Filed School (FFS)"** is a record of research work done independently by **Mr. G. Naveen Kumar** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to him.

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# *Introduction*

# 1. Introduction

High Yielding Varieties (HYVs) and fertilizer centred technologies at subsidized rates offered by the government for rapid acceptance by farming community led to a nine fold increase in the consumption of fertilizers. Total NPK consumption increased from 11.57 million tonnes in 1989-90 to 28 million tonnes in 2012-13. Per-hectare NPK consumption increased from 63.57 kg/ha to 144.14 kg/ha in the same period (GOI, 2014).

The use of pesticides has also increased considerably over the last fifty years. The consumption of pesticides increased from 100 metric tonnes at the beginning of the first five year plan to 83,000 metric tonnes in 1993-94 (GOI, 2013). But in the recent years, consumption of pesticides has shown a downward trend to around 56,000 metric tonnes in 2013-2014 due to popularization of Integrated Pest Management approach.

With ever growing population, our compulsion was not only be to stabilize agricultural production, but also to keep it increasing in a sustainable manner. Thus there is a greater need for maintaining a viable equilibrium between growth in agricultural output, environment and ecosystem.

Rice is the staple food more than 65 per cent of the people of India. In India rice is cultivated under diverse climatic conditions. It has been assumed that current level of rice production (104.19 Million Tonnes) has to be raised to 110 Million Tonnes by the end of twelfth five year plan to meet the needs of increasing population. This situation necessitates the use of High Yielding Varieties, pesticides, fertilizers, and other cultural and management practices which often aggravate other biotic constraints

Hence to meet the increasing needs of population with limitations on a sustainable basis, the efforts needed are immense and multidimensional. The current thrust is on eco-friendly technologies, whose objective is to exploit only renewable resources to control pollution to tolerable levels and to recycle wastes for future needs.

The important eco-friendly methods worth mentioning are organic farming, natural farming, traditional farming, sustainable farming, and permaculture which may altogether represent eco-friendly farming.

Raj *et al.* (1996) defined "eco-friendly farming as a farming of integration of biological and natural inputs including integrated disease and pest management practices". It not only advocates for stopping or restricting the use of chemical fertilizers, pesticides, weedicides and other chemicals. It also emphasises the need for farming which should create an ecological balance and a micro environment suitable for health and growth of soil micro flora plants, animals and finally the vast population which consume the produce.

Farmers' Field School is a non-formal, learner centred educational process and a promising extension method for popularising eco-friendly farm practices. As most of the practices are skill based, it can be disseminated through Farmers' Field School. KVK is served as an institutional support system helping in large scale dissemination of eco-friendly farming practices among the farmers.

The Farmers' Field School (FFS) is a group-based learning process that has been used by a number of governments, NGOs and international agencies originally to promote Integrated Pest Management (IPM). FFSs bring together concepts and methods from agro-ecology, experimental education and community development, as a group-based learning process. Overall, FFSs orient to reinforce the understanding of farmers about the ecological processes that affect the production of their crops and animals, through conducting field learning exercises such as field observations, simple experiments and group analysis in single

platform. The knowledge gained from these activities enables participants to make their own location specific decisions about crop management practices.

The FFS approach, promotes group learning optimally from field observation and experimentation, based on principles of adult education, and training to farmers. It can be viewed as the single approach of agricultural extension that can meet these goals (Vandenberg, 2004).

The modern agriculture has been successful in meeting the increased food needs of alarmingly growing population, but the problems associated with them are high cost of inorganic or chemical fertilizers, plant protection chemicals, stagnated yield levels and degradation of natural ecosystems. In order to mitigate the health hazards and to bring out natural balance and protection of ecosystem, organic movement has started in several parts of the world, in which no chemical fertilizers and plant protection chemicals are used in the cultivation of field crops, vegetables and fruits.

In Kerala, the area under rice fields has been filled up for non-agricultural activities, the area under cash crops expanded during the last 20 years (16 % under rubber alone), while that area under food crops had drastically reduced to a total of 9 per cent in cultivated area. The monoculture of such economically valuable crops led to soil erosion and depletion of fertility to a greater extent. The advent of chemical intensive farming and its prevalence in Kerala for the past 50 years have resulted in the near stagnant levels of productivity of many of these economically important crops such as coconut, cashew, pepper, coffee, tea, cardamom and arecanut (Sasidharan and Kumar, 2012). The State has taken note of it and given priority to it in the annual plans 2010-11, 2011-12 resulting in the birth of the scheme on "Sustainable Development of Rice Based Farming System" and scheme on "Macro Management in Agriculture – Rice Development Programme" these two schemes targeted to promote rice cultivation through group farming system enabling farmers to adopt improved production technology and scientific package of cultivation suited to each agro-climatic condition and

promoting eco-friendly method of pest management like use of bio-pesticides, releasing of predators and parasites and fungal/bacterial pathogens to control pests.

There are various factors influencing stakeholders of rice farming in adopting eco-friendly cultivation practices. The role played by these factors is very significant in view of the eco-system upkeep.

With the above considerations the present study entitled "Impact of eco-friendly technologies in rice cultivation promoted through Farmers' Field Schools (FFS)" was conceived and conceived with the following **objectives**:

- To assess the impact of eco-friendly farm technologies in rice disseminated through FFS approach
- To identify the factors influencing farmers adoption behaviour of eco-friendly farm technologies in rice
- To elucidate the constraints encountered by farmers on adoption and prescribe suggestions

**Scope and importance of the study**

In the present study, the main focus was given to probe the extent of impact created by knowledge and adoption of eco-friendly practices disseminated through FFS. Further, an attempt was made to seek suggestive measures to minimize the ill-effects of agrochemicals as perceived by the paddy growers.

Thus, the findings of the study on the existing knowledge on environmental hazards and adoption of eco-friendly practices would help the concerned development departments and agencies to design appropriate educational programmes to educate the farmers in adoption of eco-friendly practices. The suggestive measures as perceived by the paddy growers would also help to initiate appropriate measures by the agencies concerned. Above all, the findings of the

study would help farmers to know the environmental hazards caused by the indiscriminate use of agrochemicals and to promote eco-friendly technologies as an alternative measures to mitigate the situation.

The instrument developed for measuring the impact of eco-friendly practices could be used among the farmers for quantifying the phenomenon, with reference to paddy in particular and other crops in general.

The findings on the relationship of various socio-economic and psychological characteristics with the extent of knowledge, adoption and impact created on farmers would be helpful to design a sound environmental education programme to benefit the farmers.

**Limitation of the study**

1. Due to the limitation of the resources, the present investigation has restricted the selection of locale, sample size and the variables. Hence, the findings have to be viewed in the specific context of the conditions prevailing in the study area and cannot be generalized for a wider geographical area.

2. Since the study was conducted by using 'ex-post-facto' design, the finding of the study are based on the ability of the respondents to recall and on the verbal opinions expressed by them, hence it is not free from their individual biases and prejudices. However, all possible care was taken to achieve maximum accuracy during the covers of investigation. The findings of the study can not be generalized to other FFS areas as there are regional variations. However, it is believed that the findings and conclusion drawn in the present study would focus for more rigorous field observations

3. The major limitation of this investigation was that findings were based on the expressed responses of the farmers. While interviewing the farmers for getting the information about annual income and cost of cultivation in rice, most of them were reluctant to disclose the information in true sense. Despite,

the researcher had taken much pain in convincing the farmers for getting the genuine information.

**Organisation of the thesis**

The thesis is presented in six chapters. The first chapter is an introductory section, highlighting the objectives, scope, importance and limitations of the study. The second chapter provides the review of literature in line with the objectives of the study. The third chapter is the methodology that was followed in carrying out the research. The fourth chapter deals with the results and discussion of the study. The fifth chapter includes summary, implications and conclusions of the study. References, appendices and abstract are furnished at the end.

# Review of Literature

# 2. Review of literature

A study of research findings both early and recent attempts help to gain an objective understanding about the study under consideration. The past experiences always sharpen the efforts of the researcher and often help to reduce loss of the invaluable resources like time and money. An up-to-date presentation of the relevant aspects of the problem under study not only provides theoretical base of the empirical investigation, but also facilitates to arrive at a set of workable propositions.

Though there was paucity of literature on eco-friendly technologies in rice cultivation, every effort was put forth to review the literature available having direct or indirect bearing on the study. The relevant literature reviewed for this study is presented in this chapter under the following headings.

2.1 Profile characteristics of the respondents
2.2 Knowledge level of farmers on eco-friendly technologies
2.3 Adoption behaviour of farmers on eco-friendly technologies
2.4 Impact of eco-friendly farm technologies
2.5 Relationship between selected profile characteristics and knowledge of farmers
2.6 Relationship between selected profile characteristics and adoption of farmers
2.7. Constraints encountered in adoption of eco-friendly technologies

## 2.1 Profile characteristics of the respondents

### 2.1.1 Age

Laxminarayana and Shankarnarayana (2011) observed that more than one-third of the farmers (36.70%) were young, while about one third of the farmers

were old (33.33%) and middle aged (30 %), respectively.

Venkataswarrao *et al.* (2012) found that more than half (53 %) of the FFS participant farmers belonged to middle age, while more than two-fifth (45 %) of the FFS non- participant farmers belonged to old age.

Desmukh *et al.* (2013) observed that half of the respondents (50 %) were young followed by middle (32 %) and old (18 %) respectively.

Sunitha *et al.* (2013) observed that nearly half of participants (48.30%) and non-participants (46.66%) found in the 36-50 years age group followed by less than 36 and more than 50 years age groups in both type of farmers.

### 2.1.2 Education

Thorat (2005) observed that about two-fifth (39.09 %) of the poultry entrepreneurs were with college level of education followed by one-third (34.55%) and 19.09 per cent of them having education up to higher secondary and secondary level, respectively. Only 7.27 per cent of the respondents were illiterate.

Rabari (2006) disclosed that 38 per cent of the tomato growers had education status up to secondary level followed by 24 per cent, 18 per cent and 15.33 per cent who had higher secondary, college level and primary level of education, respectively. It can be concluded that more than 80 per cent of the respondents had education up to secondary level and above.

Desmukh *et al.* (2013) reported that nearly half of the respondents (46 %) had secondary level education followed by 23 per cent having higher secondary education, 13 per cent with college level, 11 per cent with primary level education, the remaining 7 per cent were illiterates.

Sunitha *et al.* (2013) observed that more than two-fifth (43.30 %) and (45 %) had high school level of education among participants and non-participants

respectively. However one-fourth (26.50 %) of the participant and non-participant farmers had PUC and above level of education.

### 2.1.3 Farming experience

Venkateswararo *et al.* (2012) reported that, more than two-third of the FFS respondents had medium farming experience (43 %) while nearly half of the non FFS respondents (47 %) had high level of farming experience.

Desmukh *et al.* (2013) observed that majority of the FFS respondents had medium farming experience (74 %).

### 2.1.4 Size of land holding

Reddy (2005) reported that, nearly two-third of farmers (64 %) belonged to semi medium land holding category, followed by 22 per cent in medium category, whereas 10.67 per cent of them had small land holding and a meagre 3.33 per cent of them belonged to big land holding category.

Laxminarayana and Shankarnarayana (2011) found that nearly two-fifth (36.70 %) of the respondents possessed large sized land holdings followed by 33.33 per cent and 30 per cent of the farmers having medium and small land holdings, respectively.

Venkataswarrao *et al.* (2012) found that more than one-third (35 %) of the FFS respondents had medium farm holding. In case of the non FFS respondents about half (48 %) of them were small farmers.

Desmukh *et al.* (2013) found that nearly one-third of the respondents were in medium category (29 %) followed by 27 per cent in semi medium category, 22 per cent in small farmers category and a meagre of 11 per cent each of the farmers were large and marginal farmers.

### 2.1.5 Extension participation

Patel (2005) revealed that more than half (53.85 %) of the farmers had medium contact with extension personnel, whereas 26.46 per cent and 17.69 per cent of them had low and high level of contact with extension personnel respectively.

Thorat (2005) observed that majority (69.10%) of the respondents had medium extension contact, followed by equal percentage (15.45%) of entrepreneurs with low and high extension contact.

Vasava (2005) marked that a great majority of the respondents (83.30%) had medium extension contact followed by 10 per cent and 6.67 per cent had low and high extension contact respectively.

Venkataswarrao *et al.* (2012) found that more than half of FFS farmer's (52 %) had high extension contact .The probable reason for the above trend might be due to the fact that majority of respondents were educated and frequently contacted different extension functionaries working in public, private and voluntary organizations to share information and to get the advice on technical matters. Majority (60 %) of non FFS farmers had medium level of extension agency contact.

Desmukh *et al.* (2013) found that majority of the respondents (74 %) had medium extension contact.

### 2.1.6 Mass media utilization

Venkataramalu (2003) indicated that about one-fifth (22.50%) and three-fourth (74.17%) of the respondents possessed radio and television respectively. Among them 10 and 4.17 per cent were regular listeners of news and entertainment farm radio, 55.83 and 26 per cent of them were regular viewers of news and advertisement from television. Further, it was reported that, 41.67 and

28.33 per cent of the respondents regularly read newspaper and success stories of farm magazines, respectively.

Kumar (2004) revealed that about three-fifth of the respondents (59.17%) were occasionally listening agricultural programmes in radio, whereas 30 per cent of them viewed agricultural programmes in television occasionally and 70.83 and 85 per cent of the respondents never used to read the newspapers and farm magazines, respectively.

Reddy (2005) reported that, majority (80 %) of the respondents possessed radio and more than half of them possessed (54%) television, while 40.61 per cent of them subscribed newspaper. Further, in case of radio it is reported that, 22 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.

Venkataswarrao *et al.* (2012) found that three-fifth (60 %) of FFS respondents as well as half of the non FFS respondents (50 %) had medium mass media exposure.

Desmukh *et al.* (2013) in reported that majority of the respondents had medium level of mass media exposure.

### 2.1.7 Trainings attended

Kumar (2005) reiterated that training played a crucial role in gain in knowledge, change in attitude and acquisition of skills as mean knowledge score, mean attitude score and skill score of the selected trainee were found to increase after exposing to scientific beekeeping training. It had also increased the socio economic condition of the trainees.

Dubey and Srivastava (2007) found that the training programme on wheat production technologies had a positive effect on farmers. It was found that trainees had high level of knowledge (100 %) where as in case of non-trainees, 52

per cent with high level, 44 per cent had medium level and only 4 per cent with low level of knowledge. There was a significant difference between trainees and non-trainees regarding the knowledge about package of practices of wheat crop.

Venkataswarrao *et al.* (2012) found that half of the FFS respondents (50 %) had medium participation in training. The reason could be their high extension contact with extension functionaries and institutions like KVK with active participation to learn new technologies.

### 2.1.8 Innovativeness

Siddharth (2005) reported that three-fourth (75 %) of the poultry farmers had high level of innovation proneness.

Patel (2005) revealed that 61.25 percent, 52.50 per cent and 63.75 per cent marginal, small and medium banana growers, respectively had medium innovativeness whereas 23.75 percent, 43.75 per cent and 23.75 per cent of marginal, small and medium banana growers, respectively had low innovativeness.

### 2.1.9 Scientific orientation

Kumar (2003) revealed that majority of Bt. cotton growers (68.12%) had medium level of scientific orientation followed by 16.88 per cent and 15 per cent of them with high and low level of scientific orientation, respectively.

Parashar (2004) observed that a great majority of the respondents (78 %) were found with medium scientific orientation followed by one-fifth of the respondents (20 %) having low scientific orientation.

Patel (2005) observed that 42.31 per cent of the respondents were found with medium level of scientific orientation followed by 30.77 per cent with high and 26.92 per cent with low level of scientific orientation, respectively.

Rabari (2006) reported that more than three-fourth of the tomato growers (76.66%) had medium level of scientific orientation, while 16.67 per cent and 6.67 per cent of them had high and low level of scientific orientation, respectively.

Venkataswarrao *et al.* (2012) found that more exposure to mass media, more number of trainings received and the information sources utilized coupled with educational background helped majority of FFS respondents (45 % medium and 40 % high) to have good scientific orientation.

Chouhan *et al.* (2013) revealed that two-third of the respondents (67.50%) had medium level of scientific orientation, followed by 17.50 per cent with high and 15 per cent with low levels of scientific orientation.

**2.1.10 Risk orientation**

Kumar (2003) revealed that majority of the Bt. cotton growers (75.63%) had medium risk orientation followed by 31.67 per cent and 28.33 per cent with low and high level of risk orientation, respectively.

Thorat (2005) indicated that two-third of the respondents (67.67%) had medium level of risk orientation followed by 22.73 per cent and 10 per cent of them with high and low level of risk orientation, respectively.

Rabari (2006) indicated that nearly two-third (66.67%) of the tomato growers had medium level of risk orientation, while 20 per cent and 13.33 per cent of them had low level and high level of risk orientation, respectively.

Venkataswarrao *et al.* (2012) found that nearly half of the FFS respondents (47 %) had high risk orientation, while three-fifth of the non FFS respondents (60 %) had medium risk orientation.

**2.1.11Annual income**

Deepak (2006) revealed that 36 and 40 per cent of the beneficiaries and non-beneficiaries belonged to semi- medium income group respectively. Nearly one-

third (32 %) of the beneficiaries and 29.33 per cent of the non-beneficiaries belonged to low income group. An equal per cent (20 %) each of beneficiaries and non-beneficiaries belonged to medium income group. Very less per cent of the beneficiaries and non-beneficiaries belonged to high income group.

Nirmala (2003) revealed that, the household income generated from the watershed area Rs.30655.56 was found to be relatively higher than that, of non-watershed area Rs. 23171.47, accounted for an increase in (32.29 %).

Reddy (2005) reported that, three-fifth of the respondents(60 %) belonged to income group of Rs. 11,001 Rs. 22,000 per annum, followed by Rs. 22,001 to 33,000 (20%) and Rs. 11,000 to Rs. 33,000 (10%).

Chandra (2005) revealed that, 18 per cent of the respondent families had annual income above Rs.33,000, 48 per cent of respondent families had annual income between Rs. 11,001 to Rs 22,000.

**2.1.12 Information sharing behaviour**

Sonawane *et al.* (2001) revealed that among the personal localite sources, friends (90.62%) were the major source of information for the farmers, followed by neighbours (76.56%), relatives (60.15%) and progressive farmers (60.15%). Whereas, among the personal cosmopolite sources, Agricultural Assistant (96.87%) was the main source of information followed by University Scientists (53.90%), Agricultural Officer (25.78%) and Subject Matter Specialists (21.87%).

Toppo (2005) revealed that majority (77.50%) of the farm women belonged to medium use category with regard to information source utilization on dairy occupation, whereas 17.50 per cent and 5.00 per cent of them belonged to low and high use categories, respectively.

Rabari (2006) observed that tomato growers have accorded top ranks in terms of credibility to the progressive farmers followed by village level workers,

fertilizer agency, co-operative society and newspapers for getting information for adoption of new recommended technologies.

Verma *et al.* (2012) concluded that 30 per cent farmers were always share livestock related information with family members followed by 21.70 per cent with neighbours, equal numbers (9.2%) with friends and fellow farmers and 2.5 per cent with Gram Pradhan.

Dhayal *et al.* (2013) found that majority of the Ber growers (76 %) were having medium level of information seeking behaviour followed by 13 per cent having low and only 11 per cent were having high level of information seeking behaviour. About 85.11 per cent peripheral Ber growers had high information seeking behaviour, whereas only 67.92 per cent distant Ber growers had high information seeking behaviour.

### 2.1.13 Attributes of technology

Vasantha and Buchareddy (2006) concluded that majority of the cotton farmers in that area perceived the initial cost of IPM technologies as high. According to them IPM technologies gave meager and irregular net profit, but may be beneficial in the long run. Moreover, farmers stated that IPM technologies were not feasible with the situation of the district, culturally not acceptable, not necessary, not socially recognized, have more complexity, reversible, and consume more labour.

Ramesh and Govind (2011) in their findings on overall attributes of sugarcane technologies like relative advantage, complexity, compatibility, trialability and feasibility, revealed that two-fifth of the respondents (40 %) of quasi-government extension services expressed the attributes as less favourable for adoption of sugarcane technologies, followed by 38.33 per cent and 21.67 per cent as favourable and more favourable respectively for adoption of technologies, whereas majority of the farmers (70 %) of private extension services expressed the attributes as more favourable for adoption of sugarcane technologies.

Peshin (2013) observed that farmers exhibited very different adoption behaviours. Generally, farmers adopted practices that having less complexity, higher economic advantage, and observability. IPM practices with adoptability indices higher than 0.60 have been widely adopted. The predicted adoptability and effective actual adoption of IPM practices were well correlated with a correlation coefficient of 0.88. Technological attributes complexity and relative economic advantage induced a variation of 99 per cent in the adoptability.

### 2.1.14 Group characteristics

Festinger *et al.* (1965) defined cohesiveness as "the total forces acting on people to remain in a group".

Tuckman (1965) identified different stages in the group development process. These stages include forming, storming, norming, and performing. According to Tuckman, groups identify the boundaries of both interpersonal and task behaviors at the forming stage, whereas storming is characterized by conflict and polarization around interpersonal issues with emotional response in the task sphere. These behaviors are symbolic of the resistance to group influence and task requirements. During norming, cohesiveness develops, as new standards evolve, and new roles are adopted, at the performing stage, the interpersonal structure becomes the tool of task activities. At the performing level, roles become flexible and functional and the group energy is channeled to the task. Structural issues are resolved at the final stage and the structure then becomes supportive of task performance. Through these stages, the group becomes a functional instrument for dealing with the task, and the group overcomes interpersonal problems.

Carron *et al.* (1985) defined cohesion as a "dynamic process which is reflected in the tendency for a group to stick together and remain united in the pursuit of its goals and objectives".

Mullen and Copper (1994) stated that a stronger cohesiveness-performance effect in groups required a greater degree of interaction, and consequently,

coordination among group members would be improved and the smooth operation of the group as a system would be enhanced.

According to Fernandez, (1995), farmer group is a dynamic institution that grows on the resources and management skills of its members and their increasing confidence to get participate in the public and private spheres.

Sreedaya (2001) revealed that majority of the respondents of Kerala Horticultural Development Programme (KHDP), SHGs were in the high category for the variables such as group cohesion, group interaction, group leadership, interdependence of members, team spirit and group co-operation while for the variables need satisfaction, accountability and equity, majority of the respondents were in the medium category. Majority of respondents (77 %) in the high category was observed for the variable group cohesion.

Wittenbaum *et al.* (2004) claimed that the flow of information within a group either contributes to or inhibits group decision-making and problem-solving effectiveness. Therefore, group members should be informed in order to contribute to decision-making as well as problem solving processes. The functional perspective of groups concerned with the purpose for which groups are formed.

Lina *et al.* (2008) reported that effectiveness of group dynamics of women-led agro-processing SHGs of Kerala has been determined by factors like group cohesion, group leadership, team spirit, group decision making and regularity in maintenance of records. The average score on group cohesion for all the performing categories was about 10, the highest being 10.2 for of copra processing units. The nonperforming group had the lowest score (7), indicating weak linkages within the group.

Ofuoku *et al.* (2008) opined that farmers subscribe to farmers' groups for access to credit facilities. In such groups, members harness their financial

resources for the benefit of members. These groups also create access to agricultural information.

Ofuoku and Agbamu (2012) concluded that the various groups were cohesive and the level of adoption of climate change adaptation strategies was high. Group cohesion influenced the high level of adoption of climate change adaptation methods. It was recommended that farmers should be encouraged to continue to subscribe to farmers' group and should be given credit through the groups by the government and more technologies on climate change adaptation should be transferred to farmers.

Ofuoku and Chukwuji (2012) opined that farmers groups may be regarded as socio-economic groups because they are formed to accomplish some common social and economic goals in relation to their farming activities. Farmers subscribe to such groups because they can use the membership to accomplish their social and economic goals.

Abeyrathne and Jayawardena (2014) observed that there was a positive impact of group interactions on entrepreneurial behaviour of the farmers in farmer groups. Group interactions of farmers were significantly correlated with their entrepreneurial behavioural pattern.

### 2. 2 Knowledge of farmers on eco-friendly technologies

Ranganath (2001) found that more than half of the respondents (60 %) had medium level of knowledge about bio-fertilizers, whereas 25 and 15 per cent of them had low and high level of knowledge, respectively.

Shashidhara (2006) revealed that more than half of the respondents (51.87%) had medium level of knowledge about the eco-friendly management practices, whereas 21.88 and 26.25 per cent of them had high and low level of knowledge about eco-friendly management practices, respectively.

Venkatashivareddy (2006) reported that majority of the vegetable growers possessed medium level of knowledge about IPM practices in tomato (66.70%) and cabbage (61.60%).

Yaminiverma and Rajendran (2007) reported that nearly half (45 %) of farmers gained correct knowledge towards IPM, resistant varieties (40 %), INM (35 %), chemical pesticides (55 %) and biological control (50 %) compared to non-FFS farmers towards IPM (40 %) resistant varieties (35 %), INM (30 %), chemical pesticides (40 %) and biological control (30 %).

Yashwanth (2008) reported that more than one-third (42 %) of the maize FFS participants were in 'medium knowledge level category', whereas 40 per cent of the respondents were in the 'high knowledge level category. While, 18 per cent with 'low knowledge level category'.

Raghuvanshi *et al.* (2012) revealed that that beneficiaries-farmers fetched higher total mean score of knowledge (2.08) than non-beneficiaries mean score (1.19). In other word, it can be said that (8.90%) beneficiaries had higher knowledge regarding wheat production technology over non beneficiaries-farmers and it was due to Farmers Field School (FFS).

**2.3 Adoption behaviour of farmers regarding eco-friendly technologies**

Shashidhara (2006) revealed that more than two-third (68.75%) of the respondents belonged to medium adoption category. Whereas, 16.88 and 14.37 per cent of them belonged to high and low adoption categories of eco-friendly technologies, respectively.

Yashwanth (2008) reported that nearly half of groundnut FFS participants (48 %) were noticed in 'medium adoption category' but one-tenth (12 %) were found in 'high adoption' and one-third (40 %) of participants were in 'low adoption' category.

Singh and Varshney (2010) found that more than one-third of the respondents (44 %) studied were found to be medium level adopters. Adoption of correct dosage of fertilizers and manures by 75 per cent of the farmers followed by recommended variety (65 %), seed treatment with fungicides (61 %), plant protection (53 %) and weedicide application (52 %). The least adoption was found for recommended nursery practices (8 %) and plant population (4 %).

Raghuvanshi *et al.* (2012) concluded that beneficiary farmers fetched higher total mean score of adoption (2.05) than non-beneficiaries mean score (1.84). In other words, it can be said that (11.41 %) beneficiaries- had higher adoption of wheat production technology over non-beneficiaries-farmers and it was due to Farmers Field School (FFS).

**2.4 Impact of Farmer Filed Schools (FFS) and eco-friendly technologies on farmers**

Islam *et al.* (2002) conducted a comparative study between DAE Trainer Farmers Field School (DT-FFS) and Farmer-Trainer Farmers Field School (FT-FFS) in Bangladesh. The results showed that the highest proportions of farmers (65-95 %) had medium IPM skill levels. About 26 per cent of DT-FFS farmers had high skill levels as compared to 1.82 per cent of FT-FFS farmers.

Mancini *et al.* (2006) found that farmers trained on IPM, the year after the FFS was conducted, attained a drastic reduction in pesticide use (78 %) and in the total number of pesticide applications (from 7.9 to 1.7) without compromising crop yields. The study also showed that IPM farmers changed their practices as a result of improved ecological knowledge and a change in their decision-making process.

Mancini *et al.* (2008) reported that majority of FFS farmers (73 %) drastically reduced the use of highly toxic pesticides as a result of increased knowledge on biological control principles.

George and Hegde (2009) reported that as a result of FFS programme the frequency of insecticide spray came down to 2.5 times from 8.5 times per crop in farmers practice. Frequency of fungicides came down to 3 as compared to 4.50 in farmer practice.

David and Asamoah (2011) reported that the members enhanced social skills as a result of FFS in three areas, such as public speaking (51 %), arriving at consensus as a group (37 %) and being able to work in groups more effectively (36 %).

Dhawan *et al.* (2014) observed that impact of adoption of IPM strategies in cotton resulted in less number of sprays in IPM (4.65) plots than non-IPM (6.27) plots. Cost of cultivation was also less in IPM villages (23,567 Rs./ha) than non-IPM (26,148 Rs./ha) villages. Net profit was also higher in IPM (55,088 Rs./ha) villages than non-IPM villages (39,660 Rs./ha). Additional profit to the farmer was Rs. 15,428 per ha over the non-IPM practices.

Manoj and Vijayaragavan (2014) revealed that knowledge level of farmers of FFS was higher than the non FFS with regard to all the ICM practices such as integrated nutrient management, seed management, water management and integrated pest management. The results of the t-test showed that the difference between the knowledge level of the FFS farmers and non FFS farmers was statistically significant.

Siddiqui and Mengal (2015) observed that IPM-FFS training programme increased farmers' knowledge regarding cotton insect pest identification and their confidence level to control insect pest but farmers remained unsure over cotton diseases control. The benefits of training are evident five years after termination of the programme; however, the diffusion of IPM knowledge to non-FFS participants appears to have been limited.

## 2.5 Relationship between selected profile characteristics and knowledge of farmers

Meenal and Rajan (2007) found that both knowledge and adoption were significantly influenced by most of the socioeconomic characters except age, education and family size. Linear regression analysis showed the influence of socioeconomic characters on cocoon production. An important finding emerged from the study was that, the training undergone by the sericulturists had a positively significant influence on cocoon production.

Rao *et al.* (2007) observed that land holding, extension participation and innovation proneness had positive and significant relationship with the knowledge of vegetable growers on IPM practices.

Gupta *et al.* (2011) concluded that the socio-economic variables such as age, education, family size and main occupation had significant association with knowledge level and rate of adoption of technologies. However, variable family type did not have much impact on attaining knowledge and adoption of technologies.

Lakshminarayan *et al.* (2013) revealed that age had a negative and significant relationship with the knowledge level, while education had a positive and significant relationship with the knowledge level of the trainees regarding silkworm rearing practices.

Deshmukh *et al.* (2014) reported that the independent variables namely, farming experience, education, risk preference and economic motivation, were positively and significantly related with the level of knowledge of improved cultivation practices of *Kharif* jowar. Whereas land holding, annual income, family type, social participation, source of information and market orientation were having non-significantly relationship with knowledge of the farmers.

## 2.6 Relationship between selected profile characteristics and adoption of eco-friendly technologies.

Prasad and Venkataravana (2006) observed that land holding, annual income, sources of information, economic motivation, scientific orientation, extension participation and attitude had positive and significant relationship with extent of adoption of IPM practices

Yadav *et al.* (2007) revealed that correlation coefficients of nine variables related to IPM adoption, viz: land holding, socio-economic status, land under cotton crop, information seeking behaviour, extension participation, risk orientation, economic motivation, management orientation and innovativeness were positive and significant at 0.01 level of probability. Multiple regression analysis revealed that management orientation was significantly related with adoption. All the selected 10 independent variables contributed only 43 per cent of the variation in the adoption of IPM.

Rao *et al.* (2011) revealed that that age, education, participation in community-based organizations, ability to recognize the insect pests, and farm size influenced the decision to adopt IPM significantly.

Patel and Supe (2011) observed that education, land holding, area under sugarcane, annual income, socio-economic status and sources of information were positively and significantly correlated with adoption level.

Mia *et al.* (2013) found that use of IPM practices by the vegetable growers had significant positive correlation with their level of education, family size, farm size, annual income, organization participation, extension contact and innovativeness of the vegetable growers had significant relationship with their use of IPM practices.

## 2.7. Constraints encountered in the adoption of eco-friendly technologies

Singh and Singh (2007) reported that the major constraints in the adoption of IPM in sugarcane cultivation were lack of knowledge of determining ETL of insect pests, lack of knowledge about identifying the harmful and beneficial insects, lack of knowledge about recommended dose of pesticides, insecticides and fertilizers, lack of timely and appropriate transfer of technology by extension organizations, lack of dedicated and regular extension personnel, lack of supply of farm literature on sugarcane cultivation, high cost of pesticides/bio-pesticides and bio-agents, lack of finance for purchase of pesticides, and implements, non-availability of resistant varieties and adulteration and substandard quality of pesticides and insecticides.

Sivanarayana *et al.* (2008) observed that the major constraints that farmers faced in adoption were the lack of co-operation among the farmers to adopt IPM on a community basis, non-availability of treated seed in the market, non-availability of NPV, Bt and *Trichogramma* cards, risk involved in the practices, non-availability of effective pesticides, difficulty in the preparation of 5 per cent Neem Seed Kernel Extract (NSKE), difficulty of inter cultivation with intercropping and lack of interest towards IPM.

Singh *et al.* (2013) found that maximum adoption gap was found to be existing in crop rotation, seed rate, proper spacing, removal of previous crop residues, use of mixed cropping, light and pheromone traps, hand picking of insects and their destruction, pest monitoring, use of rope in standing crop, use of bio-agents, bio-fertilizers, bio-pesticides, resistant varieties, application methodS and name of pesticides. The results imply that paddy growers with more knowledge have more adoption level of cultural, mechanical, biological and chemical methods of IPM practices.

Gopal *et al.* (2014) observed that lack of knowledge was perceived as the major constraint in the adoption of IPM technologies in rice followed by lack of skill. *Trichogramma* cards, pheromone traps, light traps, clipping of leaf tips,

dipping of nursery bundles in insecticidal solution were the major technologies being not adopted or discontinued by the rice farmers because of lack of proper knowledge in those technologies.

# Methodology

# 3. Methodology

Research methodology is a detailed plan of investigation and the blue print of procedure for carrying out the research. The methodology used for the study is discussed under the following headings.

3.1 Research design

3.2 Locale of the study

3.3 Selection of respondents

3.4. Selection of eco-friendly technologies

3.5. Selection of variables for the study

3.6 Operationalization and measurement of dependent variables

3.7 Operationalization and measurement of independent variables

3.8 Tools used for data collection

3.9 Statistical methods employed for analysis of data

## 3.1 Research design

Ex-post facto research design was adopted for the present study, since the phenomena under study had already occurred. According to Singh (2013), "ex-post-facto research is the empirical investigation in which the investigator draws the inference regarding the relationship between variables on the basis of such independent variables, whose manifestations have already occurred". In this type of research the investigator has no direct control over the independent variables, because they occur much prior to producing their effects.

### 3.2 Locale of the study

The present study was conducted in Palakkad district of Kerala State

### 3.2.1 Description of the study area

Palakkad District is located between north latitude 10"20' and 1 l"14' and east longitude 76'02' and 76'34'. The district is bounded by Malappuram and Nilgiri districts on the North, Coimbatore district on the east, Thrissur district on the South and Malappuram and Thrissur districts on the west.

The district ranks fourth in the State regard to area with an area of 4480 sq. km with 3, 43, 372 ha of agricultural land of which 2 ,17, 229 ha is the cultivable land . The district receives an average annual rainfall of 2,585 mm per year. There are three types of soil (1) Laterite soil seen in Ottappalam, Alathur, Chittur and Palakkad taluks (2) Virgin forest soil of Mannarkkad Taluk and (3) Black soil in Chittur and Attappady Valley which is used for the cultivation of cotton.

It is identified with the three principal seasons in Kerala, namely Autumn (Virippu), Winter (Mundakan) and Summer (Puncha) .The gross area in Palakkad comes to 106548 ha, of which 5 1.3 per cent is contributed by Virippu and 48.7 per cent by Mundakan. Puncha cultivation is very meagre. The net cultivated area of the district is 2, 18, 000 hectares, i.e. 49 per cent of the total geographical area. The total paddy cropped area comes to 1, 20,809 ha. Palakkad is the only district in the State where cotton and groundnut are cultivated. Paddy, cereals and millets are cultivated in 1, 41,630 ha and it is the major agriculture activities of the district. The area under rice cultivation in the district is 36 per cent of the total area in the State.

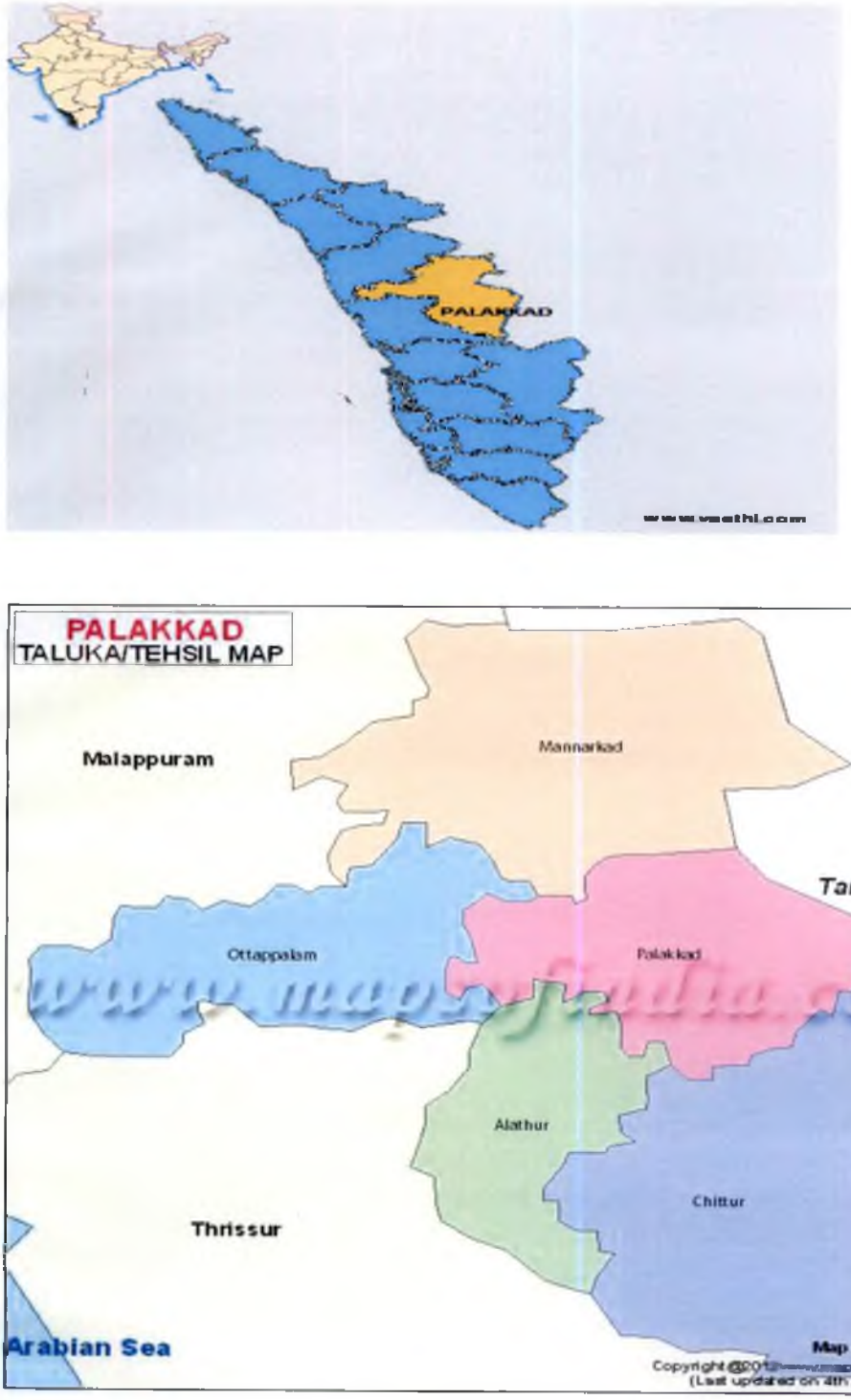


Fig 1: Map showing the study area of Palakkad district in Kerala

### 3.3. Selection of respondents

A list of farmers who had attended trainings on eco-friendly farm technologies in rice conducted by Farmers' Field School were obtained from the Programme Coordinator of KVK Palakkad. Five Farmers' Field School were selected based on the expert opinion. From the selected FFS, 20 farmers each were selected and thus total sample size was made to 100.

**Table -1 Distribution of respondents among different FFS**

| Sl. No. | Name of the FFS/Village | Number |
|---|---|---|
| 1. | Koonathara | 20 |
| 2. | Kinnaserry | 20 |
| 3. | Perumatty | 20 |
| 4. | Olassery | 20 |
| 5. | Manisserry | 20 |
| | **Total** | **100** |

### 3.4. Selection of eco-friendly technologies

A list of the eco-friendly farm technologies in rice promoted through Farmers' Field School was obtained from the Programme Coordinator of KVK Pattambi and presented below

- Use of **pheromone traps** for the control of Yellow stem borer
- Use of **light traps** for the control of Leaf folder
- Application of ***Pseudomonas fluorescens*** for the control of Bacterial Leaf Blight
- Application of ***Trichoderma viridae*** for the control of paddy blast
- Application of ***Beauveria bassiana*** for the control of leaf roller

- Use of ***Trichogarmma*** **cards** for the control of stem borer in paddy
- Use of **PGPR**
- Use of **neem pesticides and bio pesticides**

### 3.4. Selection of variables for the study

Based on the objectives, review of literature, discussion with experts and observations by the researcher, the following variables were selected for the study,

#### 3.4.1. Dependent variables

- Knowledge on eco-friendly farm technologies
- Adoption of eco-friendly farm technologies
- Impact of eco-friendly farm technologies

#### 3.4.2. Independent variables

- Age
- Education
- Land holding
- Farming experience
- Annual income
- Use of internally available resources
- Innovativeness
- Risk orientation
- Scientific orientation
- Extension participation
- Trainings attended
- Mass media utilization
- Information sharing behaviour
- Attributes of technology
- Institutional support

- Group formation
- Group interaction
- Group cohesiveness

**Table 2: Variables and their empirical measurement**

**Dependent variables**

| Variables | Empirical measurements |
|---|---|
| Knowledge on eco-friendly farm technologies | Teacher made test developed for the study, through jury opinion |
| Adoption of eco-friendly farm technologies | Developed for the study |
| Impact of eco-friendly farm technologies | Developed for the study through judges opinion |

**Independent variables**

| Variables | Empirical measurements |
|---|---|
| Age | Procedure followed by Punyavathi (2011) |
| Education | Procedure followed by Punyavathi (2011) |
| Land holding | Land holding classification used Government of Kerala (GOK, 2011) |
| Farming experience | Procedure followed by Yashwanth (2008) |
| Annual income | Developed for the study |
| Use of internally available resources | Developed for the study |
| Innovativeness | Scale developed by Mouliks (1965) used by Shashidhara (2006) |
| Risk orientation | Scale developed by Supe (1969) used by Shashidhara (2006) |
| Scientific orientation | Scale developed by Supe (1969) used by Shashidhara (2006) |

| | |
|---|---|
| Extension participation | Scale used by Parvathy (2004) |
| Attended trainings | Developed for the study |
| Mass media utilization | Procedure followed by Parvathy (2004) |
| Information sharing behaviou | Developed for the study |
| Institutional support | Developed for the study |
| Attributes of technology | Procedure followed by Parvathy (2004) |
| Group formation | Scale developed by Kavya (2008) |
| Group interaction | Scale followed by Jayalekshmi (2001) |
| Group cohesiveness | Scale followed by Jayalekshmi (2001) |

## 3.5 Operationalization and measurement of dependent variables

### 3.5.1. Knowledge

Knowledge is defined as the things known to an individual and represented cognitive domain. Knowledge in this study was operationalized as the quantum of scientific information known to the respondents about the eco-friendly technologies that were disseminated through FFS.

Knowledge level of respondents on eco-friendly farm technologies in rice was measured through teacher made test prepared based on the content of eco-friendly farm technologies in rice disseminated though FFS. The content and the items of knowledge on eco-friendly farm technologies in rice were prepared after the detailed discussion held with experts involved in the dissemination process to ensure the content validity. Accordingly 35 questions items representing the eco-friendly farm technology in rice were screened out and constitute the body of content. The selected knowledge items were tested in non-sample area with another FFS for testing its reliability and validity and out of 35 knowledge test items used for item analysis 21 items having difficulty index in the range of 20 to 80 and discrimination index above 0.10 were retained in the study as such and the remaining 14 items were suitably modified based on the item analysis and included in the study. The questions were asked to the farmers by the researcher

and the answers expressed by the farmers were noted accordingly. The answer to the question was quantified by giving one score to the correct knowledge and zero score to the incorrect knowledge. As a result, the maximum score that one could get was 35 and minimum was 0.

Based on the total score the respondents were categorized viz; low, medium and high knowledge by using mean and standard deviation as a measure of check and a Mean Score Index (MSI) was calculated with respect to the extent of knowledge level on different eco-friendly technologies.

| Category | Score |
|---|---|
| Low (less than) | (Mean – SD) |
| Medium (in between) | (Mean ± SD) |
| High (more than) | (Mean + SD) |

$$\text{Mean Score Index (MSI)} = \frac{\text{Actual score obtained}}{\text{Maximumscore possible}} \times 100$$

### 3.5.2. Adoption

Rogers's defined adoption as a decision to use and implement a new idea. All the eco-friendly technologies disseminated through FFS were taken into consideration. A total of eight eco-friendly technologies were identified. The responses elicited from the respondents were quantified as adoption and non-adoption of the recommended practices. A score of one for adoption, and zero for non-adoption was given. The maximum score that respondents could obtain was 8 and minimum was zero. Depending upon total score obtained by each of the respondent, they were grouped into three categories 'low', 'medium' and 'high' adopter category by using Mean and standard deviation (SD) as a measure of check and expressed as a below, and the frequency for adoption of each technology calculated and expressed in percentage.

| Category | Score |
|---|---|
| Low (less than) | (Mean – SD) |
| Medium (in between) | (Mean ± SD) |
| High (more than) | (Mean + SD) |

### 3.5.3. Impact of eco-friendly technologies disseminated through FFS

Based on exhaustive review of literature, as well as consultation with subject matter specialists of various departments, impact indicators on eco-friendly technologies representing four dimensions 'Economic impact, Environmental impact, Technological impact and Social impact' were sorted out with 64 items.

#### 3.5.3.1 Relevancy testing and selection of items

It is quite possible that all the items/indicators collected initially may not be relevant or equally important in measuring the impact, and hence, these indicators were subjected to scrutiny by a panel of judges. Subsequent screening to determine the relevancy of each of these items, it was sent to 150 judges through different methods. Further, they were also requested to add or modify any indicators needed for the study. Based on the responses obtained from 35 judges on each of the item, the relevancy score for each item was worked out by giving score of 3, 2, and 1 for most relevant, less relevant and not relevant response, respectively. Based on total scores obtained, relevancy indices were calculated for all the 64 items (Appendix-II) individually by using the following formula

$$\text{Relevancy index} = \frac{\text{Actual score obtained}}{\text{Maximum score possible}} \times 100$$

Based on the relevancy indices worked out, the indicators having relevancy index of more than 75 per cent were considered for selection. Accordingly, out of 64 indicators, 26 indicators were selected representing four components viz., economic impact, environmental impact, technological impact and social impact were sorted out.

### 3.5.3.2. Measurement of impact

The indicators on the impact of eco-friendly practices in rice farming on the four dimensions viz., economic impact, environmental impact, technological impact and social impact were presented to the farmers and their perceived impact of the technologies after undergoing the sessions of FFS was recorded by verifying available indicators like secondary data. The responses for each item was rated on three point continuum ranging from greater extent, certain extent and lesser extent of impact created with the scores of 3, 2 and 1. The data obtained were expressed in frequency and percentage based on the scores obtained for each and every indicator and perceived mean score was calculated.

## 3.6. Operationalization and measurement of Independent Variables

### 3.6.1. Age

It is conceptualized as the chronological age of the respondents in completed years at the time of investigation and the percentage analysis was done to interpret the results by adopting the scale followed by Punyavathi (2011) was used for the present study.

| Category | Range |
|---|---|
| Young | <35 years |
| Middle age | 36-55 years and |
| Aged | > 55 years |

### 3.6.2. Education

Education is operationally defined as the extent of formal schoolings successfully completed by the respondents at the time of investigation their ability to read and write and literacy. The educational status of the respondents were classified as follows: Illiterates (people who didn't know read and write), Literate (people who can read and write), Primary level (up to $5^{th}$ standard), High school (up to $10^{th}$ standard), Collegiate (pre degree/degree/diploma). Frequency and

percentage analysis was done to interpret the results by adopting the scoring system followed by Punyavathi (2011) with slight modification.

| Category | Score |
|---|---|
| Illiterate | 1 |
| Literate | 2 |
| Primary level | 3 |
| High school | 4 |
| Collegiate | 5 |

### 3.6.3. Land holding

The size of the farm was operationalized as the land possessed by the beneficiaries' and the procedure followed by Government of Kerala (GOK, 2011) was used for the study. Frequencies and percentages were used to analyses the data.

| Category | Size |
|---|---|
| Marginal land holdings | <1 ha |
| Small land holdings | 1-1.99 ha |
| Semi Medium holdings | 2-3.99 ha |
| Medium land holdings | 4-9.99 ha |
| Large holdings | >10 ha |

### 3.6.4. Farming experience

It refers to number of years completed for cultivation of paddy at the time of research and the procedure followed by Yashwanth (2008) was used for the study and the farming experience was categorized into low, medium and high as indicated below.

| Category | Score |
|---|---|
| Low (less than) | (Mean – SD) |
| Medium (in between) | (Mean ± SD) |
| High (more than) | (Mean + SD) |

### 3.6.5. Annual income

Annual income was operationalized as total income earned by the respondents from both agriculture and non-agriculture activities in the previous years as expressed by the respondents in rupees. The frequencies and percentages were calculated under each category of annual income group. Then, the respondents were categorized based on mean and standard deviation as the measure of check.

| Category | Score |
|---|---|
| Low (less than) | (Mean – SD) |
| Medium (in between) | (Mean ± SD) |
| High (more than) | (Mean + SD) |

### 3.6.6. Use of internally available resources

Internal resources are part of the naturally occurring local environment and their efficient use can promote an ecologically sound method of farming. We can consider these resources as the "natural capital" base for farming. A list of eight items representing locally available resources was presented to the respondents and responses were elicited against each activity with reference to their extent of usage. A score of 1, 2 and 3 were given for never, occasional and regular usage, respectively. The individual score for each of the respondent obtained by summating the responses on all items, which measures the degree of usage of internally available resources of the respondent. Based on the total scores obtained, the respondents were classified into three categories, keeping the mean and standard deviation as check.

### 3.6.7. Innovativeness

This refers to the behaviour pattern of an individual, who has interest and desire to seek changes in farming techniques and ready to introduce such changes into his operations when considered as practical and feasible. For quantifying the innovativeness character of the respondents, "Self rating innovativeness scale"

developed by Moulik's (1965) and used by Shashidhara (2006) was adopted with slight modification for the study. The original scale consists of three sets of statements. Each set of statements contains three sub statements with weights 3, 2, and 1 indicating high, medium and low degree of innovativeness. After obtaining the respondents' response , as in original scale, responses for each of the three sets of statements were measured giving scores ranging from 3 to 1 for "most like" to "least like" respectively. The scoring was done by summing up the scores of the weights of the "most like" statements and the weights of the "least like" statements. As there were three sub sets of statements for innovativeness scale, the sum of scores for the three sub sets was considered as respondents self-rating score for innovativeness. Thus, the score ranges from 18 to 54. Then, the respondents were categorized based on mean and standard deviation as the measure of check. Higher score of the respondents reveals more innovativeness of the respondent.

| Category | Score |
|---|---|
| Low (less than) | (Mean – SD) |
| Medium (in between) | (Mean ± SD) |
| High (more than) | (Mean + SD) |

### 3.6.8. Risk orientation

It refers to the degree to which a farmer is oriented towards risk and uncertainty and has courage to face the problems in farming. Risk orientation was measured with the help of risk orientation scale developed by Supe (1969) and used by Shashidhara (2006) was used for our study with slight modification. The items were rated on a four point continuum ranging "strongly agree, agree, disagree and strongly disagree" with weightages of 4, 3, 2 and 1 for positive statements and 1, 2, 3, and 4 for negative items, respectively. The mean risk orientation score of the respondents was considered for categorizing the respondents into low, medium and high-risk orientation. The possible score ranged from 5 to 20. Higher score reveals better orientation towards risk farming.

| Category | Score |
|---|---|
| Low (less than) | (Mean – SD) |
| Medium (in between) | (Mean ± SD) |
| High (more than) | (Mean + SD) |

### 3.6.9. Scientific orientation

It is referred to the degree to which an individual is inclined to use scientific method in farming and decision-making. Scientific orientation was measured with the help of scale developed by Supe (1969) and used by Shashidhara (2006) was used with slight modification. Of the six statements, the second statement alone is negative. The responses for each statement were rated on four point continuum ranging from "strongly agree, agree, disagree and strongly disagree". With the scores of 4, 3, 2 and 1 for positive statements and 1, 2, 3, and 4 for negative statements, respectively. The possible score ranged from 6 to 24. Higher score reveals better orientation towards scientific farming.

| Category | Score |
|---|---|
| Low (less than) | (Mean – SD) |
| Medium (in between | (Mean ± SD) |
| High (more than) | (Mean + SD) |

### 3.6.10. Extension participation

Extension participation is defined as the degree to which a respondent participated in various non-formal educational activities including individual contact, group contact and mass contact methods with a view to obtain new information, knowledge and skills, that are useful in his profession. A list of extension activities presented to the respondents and responses were elicited against each activity with reference to their frequency of participation. The variable was quantified on the basis of procedure followed by Parvathy (2004), a score of 1, 2 and 3 were given for never, occasional and regular participation,

respectively. Based on the total scores obtained, the respondents were classified into three categories, keeping the mean and standard deviation as check.

| Category | Score |
|---|---|
| Low (less than) | (Mean – SD) |
| Medium (in between | (Mean ± SD) |
| High (more than) | (Mean + SD) |

### 3.6.11. Mass media utilization

It referred to the frequency in using mass media such as radio, television, newspapers and farm magazines by the respondents. Then the respondents were asked to indicate their degree of participation in terms of listening habit, viewing habit and reading habit. The data obtained presented in frequency and percentage. The variable was also quantified on the basis of the procedure followed by Parvathy (2004). Based on the total scores obtained, the respondents were classified into three categories, keeping the mean and standard deviation as check.

| Habit | Score |
|---|---|
| Regular | 3 |
| Occasional | 2 |
| Never | 1 |

| Category | Score |
|---|---|
| Low (less than) | (Mean – SD) |
| Medium (in between | (Mean ± SD) |
| High (more than) | (Mean + SD) |

### 3.6.12. Trainings attended

Training is defined as the organized procedure by which people learn knowledge and skills for definite purpose. Lists of the trainings organized by different institutions were given and the respondents asked to indicate their degree of participation in terms of regular, occasional and never with a scoring of 3, 2

and 1 respectively. The data obtained presented in frequency and percentage. Based on the total scores obtained, the respondents were classified into three categories, keeping the mean and standard deviation as check.

| Category | Score |
|---|---|
| Low (less than) | (Mean – SD) |
| Medium (in between | (Mean ± SD) |
| High (more than) | (Mean + SD) |

### 3.6.13. Information sharing

Information sharing is a central process through which team members collectively utilize their available informational resources. Selected 6 types of information sharing activities were presented to the respondents and responses were elicited against each activity with reference to their frequency of participation. A score of 1, 2 and 3 were given for never, occasional and regular sharing, respectively. Based on the total scores obtained, the respondents were classified into three categories, keeping the mean and standard deviation as check.

| Category | Score |
|---|---|
| Low (less than) | (Mean – SD) |
| Medium (in between | (Mean ± SD) |
| High (more than) | (Mean + SD) |

### 3.6.14. Institutional support

Institutional support refers to the part of providing economic, technical and social support to farmers. It consisting of authorities and institutions whose decisions and active support in form of financial and non-financial help that brings a lot of changes in the agriculture.

The institutions could be government owned, statutory, semi-autonomous or autonomous. It is the government or government supported institutions authorized to take up certain activities - financing, marketing, project preparation, training to promote growth and development of farmers. A possible list of institutions were

presented to the respondents and responses were elicited against each activity with reference to their extent of support that they got from that agency on a three point continuum scale with scoring pattern of 3, 2 and 1 for good , Moderate and Little support respectively. Based on the total scores obtained, the institutional support was categorised into three categories, keeping the mean and standard deviation as check.

| Category | Score |
|---|---|
| Little (less than) | (Mean – SD) |
| Moderate (in between) | (Mean ± SD) |
| Good (more than) | (Mean + SD) |

### 3.6.15. Cost of cultivation

Cost of rice cultivation in the present study was attempted by computing per acre cost. Total operational cost was worked out by total sum of expenditures of land preparation, seeds, and transplanting, plant protection measures and labour components the variable was quantified on the basis of procedure followed by department of economics and statistics (2011) with slight modifications. Calculated by using the formula

Total operational cost = inputs + labour components

Where, inputs = expenditure towards land preparation + seeds + manures + plant protection measures.

Labour components = sowing + hand weeding + intercultural operations + chemical spraying + harvesting.

### 3.6.16. Attributes of technology

Innovation attributes are most often measured as the perceptions by potential adopters of the characteristics associated with a particular innovation. Rogers & Shoemaker (1971) synthesized studies of innovation attributes as a set of codified factors that affect the rate at which innovations are adopted. Other

variables affect rate of adoption too, but the attributes of relative advantage, complexity, compatibility, observability, and trialability have been shown to explain significant variance in adoption decisions. Selected eight eco-friendly technologies promoted by KVK were presented to the respondents and their responses were noted against each attribute. The attributes were ranked based on their frequency and percentage.

### 3.6.17. Group formation

It is concerned with identifying issues and analysing individuals and group strengths and weakness, clarifying personal motives, align department goals with personal and organisational goals and develop systems for reaching goals. For the present study the scale developed by Kavya (2008) was used with appropriate modifications to suit for FFS members

The respondents were asked to indicate whether they perceived the identified items as the items which they performed. The response was scored on a four point continuum with points 4, 3, 2 and 1 respectively. The total score for each item was obtained by summing up all the individuals scores on the items. Based on the total scores obtained, group formation process categorised into three categories, keeping the mean and standard deviation as check. The scoring procedure is as shown as below

| **Category** | **Score** |
|---|---|
| Strongly agree | 4 |
| Agree | 3 |
| Disagree | 2 |
| Strongly disagree | 1 |

The mean rank score was worked out for all the five FFS and Kruskal Wallis H test performed to compare mean ranks among different FFS.

### 3.6.18. Group interaction

It is defined as the tendency of a member to get associated with each other member of his/her group and freely mix with them without observing any formality and inhibition.

This dimension was measured using an arbitrary index based on Bales Interaction Process Analysis scoring sheet used by Jayalekshmi (2001) was used for the study . The index consists of 10 items of which eight are positive and two were negative. The responses categories for each item were given in a four point continuum ranging from strongly agree to strongly disagree. Based on the total scores obtained, group interaction were categorised into three categories, keeping the mean and standard deviation as check.

| **Response** | **Score for positive statements** | **Score for negative statements** |
|---|---|---|
| Strongly agree | 4 | 1 |
| Agree | 3 | 2 |
| Disagree | 2 | 3 |
| Strongly disagree | 1 | 4 |

The mean rank score was worked out for all the five FFS and Kruskal Wallis H test performed to compare mean ranks among different FFS.

### 3.6.19. Group cohesiveness

It is defined as the closeness exhibited by the members in the group and it result by action of forces which act on members to remain in the group.

Group cohesiveness is measured by the index used by Jayalekshmi (2001) with slight modification. The index consists of six statements of which two are negative and six are positive. The respondents were asked to give their response on a five point continuum as follows

| Response | Score for positive statements | Score for negative statements |
|---|---|---|
| Always | 5 | 1 |
| Most of the time | 4 | 2 |
| Some times | 3 | 3 |
| Rarely | 2 | 4 |
| Never | 1 | 5 |

The mean rank score was worked out for all the five FFS and Kruskal Wallis H test performed to compare mean ranks among different FFS.

### 3.6.20 Group Dynamics Index (GDI)

Group dynamics is concerned with the interaction forces among group members in a social situation. It is the internal nature of the group-how they are formed, what are their structures and processes, how do they function and affect individual members, other groups and the organization.

Here the group dynamics was calculated as the total score obtained by summing up three dimensions of group characteristics viz., group formation, group interaction and group cohesiveness divided by maximum possible score. Kruskal Wallis H test was used to the GDI among different FFS.

$$GDI = \frac{\sum(Group\ formation + Group\ Interaction + Group\ cohesiveness)}{Maximum\ score\ possible}$$

### 3.7. Data collection tools used

Data were collected in a series of stages and the details are given below.

### 3.7.1 Pre-testing of interview schedule

An interview schedule was developed in consultation with advisory members, resource personnel of KVK, Pattambi and perusing the relevant

literature, to collect the data from the FFS respondents. The instrument was pre-tested with a sample of 30 farmers in non-sampled area. Pre-testing of instrument was done to know whether the contents and forms of the questions/items worked satisfactory i.e., valid, reliable and easily understandable by the respondents. deletions and additions were made based on pre-testing experience. The final interview schedule used for the study is given in the Appendix-I.

### 3.7.2 Administration of the interview schedule

The participants of the FFS were interviewed individually using the finalized interview schedule by the researcher at their residences and fields to collect required data.

### 3.8. Statistical methods employed for analysis of data

The data collected from the respondents were scored, tabulated and analysed by using suitable statistical methods, such as frequency, percentage, Spearman rank correlation analysis and Kruskal Wallis H test with the help of SPSS package version 16.0 .

# Results & Discussion

# 4. Results and Discussion

Keeping the objectives of the study in view the results and discussion of the investigation are presented under the following main headings.

4.1 Profile characteristics of respondents

4.2 Knowledge level of the FFS participants about eco-friendly farm technologies in rice cultivation

4.3 Adoption level of the eco-friendly farm technologies in rice cultivation by the FFS participants

4.4 Impact of eco-friendly farm technologies in rice cultivation as perceived by FFS participants

4.5 Relationship between profile characteristics of rice farmers in FFS with knowledge of eco-friendly farm technologies

4.6 Relationship between profile characteristics of rice farmers in FFS with adoption of eco-friendly farm technologies

4.7 Constraints encountered in the adoption of eco-friendly farm technologies

4.8 Suggestions to enhance adoption of eco-friendly farm technologies

**4.1 Profile characteristics of respondents**

The results pertaining to personal, socio-economic, psychological and communication characteristics of participants in FFS are depicted in Table 3

### 4.1.1 Age

The results presented in Table 3 indicated that 53 per cent of the respondents were middle aged, followed by 43 per cent were old aged and a very low percentage (4 %) of them were young aged, which implied that youngsters are not interested towards agriculture.

The findings were in line with the findings of Venkataswarrao *et al.* (2012)

### 4.1.2 Education

With regard to level of education, it was revealed that, all the respondents were literates and 37 per cent of the respondents were educated up to primary school level, followed by high school level (35 %), whereas the remaining 28 per cent of the respondents were graduates.

It is noticed that all the respondents have education above primary school level. The possible reason might be that as Kerala is the state which is having highest literacy rate and education up to primary level is free and compulsory to all. Formal education of the respondents might have helped to a greater extent in understanding and absorption of modern complex ill-effects of use of agrochemicals and paved the way for shifting to eco-friendly farming.

The findings were in accordance with the findings of Sunitha *et al.* (2013)

### 4.1.3 Land holding

From Table 3 it can be observed that nearly 45 per cent of the respondents possessed small land holdings. While 19 per cent and 15 per cent respondents had medium and marginal land holdings, respectively, 14 per cent possessed semi medium holdings and only 7 per cent possessed large holdings. The findings were in contradictory with the present situation of Kerala, where the average size of land holding was about 0.28 ha. The probable reason for this might be that purposive selection of the farmers representing FFS.

### 4.1.4 Farming experience

It could be noted from the results that three-fourth of the respondents (75 %) belonged to medium farming experience category, followed by almost equal percentage of the farmers under low (12 %) and high (13 %) experience category, respectively.

The farming experience generally makes the farmer to take necessary risks and adopt timely coping mechanisms to get over the adverse situation. It also makes the farmers confident in taking farming decisions. The probable reason could be the high percentage of respondents in the middle aged category.

The findings are in line with the findings of Desmukh *et al.* (2013)

### 4.1.5 Annual income

Income level of FFS participants, as observed from Table 3 depicts that 80 per cent of FFS participants belonged to 'medium level' of income group, followed by high income level (15 %) and only a few respondents (5 %) belonged to low income group.

The possible reason that could be attributed for their better socio-economic condition might be since majority of the respondents had good scientific orientation and medium land holding would have derived a reasonable income from farming

The findings are in line with the results of Christian (2001)

### 4.1.6 Use of internally available resources

The results shown in the Table 3 depicts that 62 per cent of the respondents had moderately used the internally available resources, followed by 33 per cent were used somewhat and a little percentage of the farmers were highly used.

The probable reason might be that as majority of the respondents had attended the sessions of FFS, which might have influenced the farmers for adopting eco-friendly farm technologies. It may be noted that since most of them had livestock as their secondary enterprise which had enabled them to use more FYM than inorganic manures. Moreover farmers had developed a positive attitude towards eco -friendly farming by minimizing external inorganic inputs.

### 4.1.7 Innovativeness

It was observed from the Table 3, that 60 per cent of the respondents belonged to medium innovativeness category and 20 % each belonged to high and low categories.

The reason for medium innovativeness might be due to the fact that, the respondents had a good training exposure by attending regular trainings on various aspects of agriculture and allied fields organized by different agencies viz; KVK, Krishibhavan and ATMA. The major principle of 'learning by doing' practiced by farmers in FFS might have triggered their innovativeness.

The results are in line with the findings of Patel (2005)

### 4.1.8 Risk orientation

The data presented in the Table 3 revealed that 68 per cent of FFS participants belonged to medium level of risk orientation, followed by low (21 %) and high level of risk orientation (11 %), respectively.

The risk bearing capacity of an individual depends upon the personal, psychological and socio-economical characteristics. The individuals with medium level of education, farming experience, land holding and income might have exhibited medium to high risk orientation.

The results are in line with the findings of Rabari (2005)

**Table 3 Profile characteristics of respondents in FFS (N=100)**

| Sl. No | Category | Percentage |
|---|---|---|
| **Age** | | |
| | Young (18-35 Years) | 4.00 |
| | Middle age (36-55 Years) | 53.00 |
| | Aged (Above 55 Years) | 43.00 |
| **Education** | | |
| | Primary level | 37.00 |
| | High school | 35.00 |
| | Collegiate | 28.00 |
| **Land holding** | | |
| | Marginal land holdings (Lesser than 1.00 ha) | 15.00 |
| | Small land holdings (1.00-1.99 ha) | 45.00 |
| | Semi Medium holdings (2.00-3.99 ha) | 14.00 |
| | Medium land holdings (4.00 -9.99 ha) | 19.00 |
| | Large holdings (Greater than 10.00 ha) | 7.00 |
| **Farming experience** | | |
| | Low ( Lesser than 18.00 years) | 13.00 |
| | Medium (18.00-41.00 years) | 75.00 |
| | High (Greater than 41.00 years) | 12.00 |
| | **Mean = 29.50 S.D= 11.70** | |
| **Annual income** | | |
| | Low income (Lesser than Rs. 68,000) | 5.00 |
| | Medium (Rs. 68,000- Rs.3, 30,000) | 80.00 |
| | High income (Greater than Rs. 3,30,000) | 15.00 |
| | **Mean = 1,98,780 S.D= 1,31,389** | |
| **Use of internally available resources** | | |
| | Little used (Lesser than 16.00) | 34.00 |
| | Moderately used (16.00-19.00) | 62.00 |
| | Highly used (Greater than 19.00) | 4.00 |

| | | |
|---|---|---|
| | **Mean = 17.09 S.D= 1.63** | |
| **Innovativeness** | | |
| | Low (Lesser than 41.00) | 20.00 |
| | Medium (42.00-48.00) | 60.00 |
| | High (Greater than 48.00) | 20.00 |
| | **Mean = 44.05 S.D= 3.37** | |
| **Risk orientation** | | |
| | Low (Lesser than 13.00) | 21.00 |
| | Medium (14.00-17) | 68.00 |
| | High (Greater than 17.00) | 11.00 |
| | **Mean =15.13 S.D= 1.81** | |
| **Scientific orientation** | | |
| | Low (Lesser than 16.00) | 21.00 |
| | Medium (17.00-19.00) | 62.00 |
| | High (Greater than 19.00) | 17.00 |
| | **Mean =17.89 S.D= 1.62** | |
| **Extension participation** | | |
| | Low ( Lesser than 16.00) | 12.00 |
| | Medium (17.00-21.00) | 68.00 |
| | High(Greater than 21.00) | 20.00 |
| | **Mean =19.47 S.D= 2.20** | |
| **Mass media utilization** | | |
| | Low (Lesser than 9.00) | 9.00 |
| | Medium (9.00-11.00) | 68.00 |
| | High (Greater than 11.00) | 23.00 |
| | **Mean = 10.07 S.D= 1.084** | |
| **Number of trainings attended** | | |
| | Low (Greater than 10.00) | 9.00 |
| | Medium (11.00-14.00) | 21.00 |
| | High (Greater than 14.00) | 70.00 |

| | | |
|---|---|---|
| | **Mean = 12.16 S.D= 1.72** | |
| **Information sharing** | | |
| | Low (Lesser than 12.00) | 28.00 |
| | Medium (12.00-14.00) | 65.00 |
| | High (Greater than 14.00) | 7.00 |
| | **Mean = 12.88 S.D= 1.13** | |
| **Institutional support** | | |
| | Low (Lesser than 12.00) | 23.00 |
| | Medium (12.00-17.00) | 65.00 |
| | High (Greater than 17.00) | 12.00 |
| | **Mean =14.59 S.D= 2.23** | |

**Source: Primary data**

### 4.1.9 Scientific orientation

It was clear from the Table 3, that 62 per cent of the FFS participants belonged to medium level of scientific orientation, followed by low (21 %) and high level of scientific orientation (17 %).

Scientific orientation makes an individual to systematically proceed from problem identification to a solution, thus making the decision more effective. Medium to high scientific orientation is a promising trend in the study area. More exposure to newer technologies might have influenced the farmers to have high scientific orientation. It is imperative that the farmers with low scientific orientation should get themselves trained and also have information access to latest production technologies. Higher scientific orientation of the farmers leads to a desire to acquire more knowledge in order to keep themselves abreast with recent improved agricultural practices from various sources.

The results are in line with the findings of the study conducted by Kumar (2003) and Rabari (2006).

### 4.1.10 Extension participation

With regard to extension participation 68 per cent of the FFS participants belonged to medium extension participation category, followed by high (20%) and low level of extension participation category (12 %).

A perusal of Table 4 revealed that all the respondents had participated in group discussions organized during FFS sessions. Of which, 77 per cent and 23 per cent of the respondents had regular and occasional participation.

It can be observed from the Table 4 that, all the respondents in FFS had participated in 'demonstration programmes' organized by KVK and other agencies. About 63 per cent of respondents had regularly while the remaining 37 per cent had participated occasionally.

**Table 4 Distribution of respondents on the basis of their participation in different extension activities N=100**

| Extension activities | Nature of participation | | |
|---|---|---|---|
| | Regularly | Occasionally | Never |
| | Percentage | Percentage | Percentage |
| Group discussions | 77.00 | 23.00 | 0 |
| Demonstrations | 63.00 | 37.00 | 0 |
| Meetings on researchable issues | 18.00 | 67.00 | 15.00 |
| Kissanghoshti | 16.00 | 64.00 | 20.00 |
| Field visits | 52.00 | 47.00 | 1.00 |
| Field days | 35.00 | 60.00 | 5.00 |
| Expert sessions | 57.00 | 40.00 | 3.00 |
| Educational tours | 68.00 | 27.00 | 5.00 |

**Source: Primary data**

Regarding 'meetings on researchable issues' organised by KVK majority of the respondents (85 %) had participated, where 67 per cent of the respondents had participated occasionally followed by 18 per cent regularly .It was also observed that 15 per cent of the respondents had never participated at all.

About 80 per cent of the respondents had participated in '*kissanghoshtis*' organized by KVK .Among the total respondents 64 had participated occasionally, 16 per cent regularly and 20 per cent had not participated at all.

It can be observed that almost all the respondents (99 %) had participated in 'field visits' organized by different agencies. While, 52 per cent of the respondents had regular participation whereas, 47 per cent of the respondents had participated occasionally.

It was observed that 95 per cent of the respondents had participated in field days organized by KVK, whereas about 60 per cent of them had participated occasionally, followed by 35 per cent regularly. Only 5 per cent of the respondents had never participated in field days.

Most of the respondents (97 %) had participated in' expert sessions', during FFS, while 57.00 per cent had regular participation and 40.00 per cent had occasional participation .

Further, 95.00 per cent of the respondents had participated in 'educational tours' organized by different agencies, 68 per cent of the respondents (68.00%) participated regularly, whereas the remaining 27 per cent of them had participated occasionally.

It could be concluded that majority of the respondents had participated in all extension activities like group discussions, demonstrations, field visits, expert sessions , educational tours and field days as part of FFS activities. The probable

reason for above findings might be due to the educational status of the respondents and interest in participation of extension activities, which directly helps them to get information on relevant innovations, technologies and skills

The above findings are in concordance with the studies conducted by Patel (2005), Thorat (2005) and Desmukh *et al.* (2013).

### 4.1.11 Mass media utilization

Regarding the mass media utilization of the respondents 68 per cent of the respondents belonged to medium level of utilization category, followed by high (23 %) and low level (9 %), respectively.

It can be seen from the Table 5 that all the respondents have television, most of them (91 %) viewed to agriculture related programmes in TV regularly, less than 10 per cent watched TV occasionally relating to other programmes and agriculture related programmes.

Regarding possession of radio, 52 per cent of the respondents had possessed radio, further 14 per cent of respondents listens agricultural programmes regularly, while 38 per cent of the respondents listens radio occasionally for agricultural information and other programmes. Among the respondents 48 per cent had never listened to agricultural programmes and other programmes through radio.

All the participants in the FFS read newspaper, whereas 89 per cent and 11 per cent of the respondents read newspaper regularly and occasionally about agriculture related articles and also other articles respectively.

Regarding farm magazines, almost all the participants in FFS read farm magazines, of which 57 per cent of them read regularly, 41 per cent read occasionally.

An overall view of mass media participation revealed medium (68 %) to high participation (23 %) of respondents. Moreover, average educational qualification of respondents might have contributed to the importance of the mass media as a source to gather information. To be a successful farm entrepreneur one needs day to day information regarding market behaviour, government policies, technologies available etc. It might have contributed to the above results.

**Table 5 Distribution of respondents on the basis of their mass media exposure**

| Media | Extent of reading / listening /viewing | | |
|---|---|---|---|
| | Regularly | Occasionally | Never |
| | Percentage | Percentage | Percentage |
| Radio | 14.00 | 38.00 | 48.00 |
| News paper | 89.00 | 11.00 | 0 |
| Farm magazines | 57.00 | 41.00 | 2.00 |
| Television | 91.00 | 9.00 | 0 |

**Source: Primary data**

The probable reason for this trend might be due to the fact that, as majority of respondents were middle aged, better educated and had inclination towards better utilization of different mass media such as radio, Television, newspapers and magazines.

The results are in line with the findings of Venkataswarrao *et al.* (2012) and Desmukh*et al.* (2013).

### 4.1.12 Number of trainings attended

It could be noted from the Table 3 that 70 per cent of the FFS respondents belonged to high level of trainings received category, followed by medium (21 %) and low level (9 %).

The trainings might have contributed much to knowledge, skills and comprehension abilities of the farmers to understand process and apply the

information in their own fields. From the findings it can be concluded that majority of the respondents had participated in most of the trainings conducted by different organizations. The probable reason might be that majority of the respondents having education above high school and good contact with extension agencies like Krishibhavan, KVK and ATMA might have developed interest towards gain of first-hand knowledge about various eco-friendly technologies.

### 4.1.13 Information sharing

It was found that among participant farmers 65 % belonged to medium level of information sharing category, followed by 28 % under low level category. Only 7 % was under high level category.

Farmers' decisions 'to adopt' or 'not to adopt 'an innovation was not only based on economic and personal considerations, but also on the context of social interactions they maintain among themselves and with agents that promote change. Such agents may include buyers, input suppliers, agro-dealers, researchers, farmer associations and farmer groups. The sustainability of agricultural innovation is largely dependent on the action of farmers and their decision-making abilities, based on the level of knowledge and information that are available to them. Communicative learning takes place when farmers exchange views and share insights during group sessions such as field days, farmers' workshops, field visits.

The probable reason might be that majority of the farmers are members of the *padasekhara samithis,* where they would share their information regularly. The education level of the respondents and their participation in extension activities would have facilitated to get adequate knowledge on various aspects. The utilization of different mass media would have helped them to share their information.

### 4.1.14 Institutional support

From the Table 3 it is clearly observed that 65 % respondents availed moderate institutional support, 23 % & 12 % low and high support, respectively.

The probable reason might be that majority of the respondents were educated and most of them having good contact with extension agents. Moreover their innovativeness and scientific orientation would have helped them for getting good institutional support.

### 4.1.15 Group characteristics of members in FFS

**Group formation**

A Kruskal-Wallis H test was performed for the component of group dynamics and presented in the Table 6.1to 6.4. The result obtained showed that there was a statistically significant difference in group formation, among different FFS, Perumatty FFS ranked first with a mean rank score of 68.50 followed by Olassery (58.58), Kinnaserry (56.50). Manissery (44.98) and Koonathara (41.78) respectively.

**Table -6 Comparisons of group characteristics among FFS**

**Table 6.1 Group formation**

| Sl. No. | Name of the FFS | Mean rank | Rank |
|---|---|---|---|
| 1. | Koonathara | 41.78 | V |
| 2. | Kinaserry | 56.50 | III |
| 3. | Perumatty | 68.50 | I |
| 4. | Olaserry | 58.58 | II |
| 5. | Manissery | 44.98 | IV |

$\chi^2$ (4) = 23.90**

The probable reason might be that the members in FFS have different educational background, age groups, farming experience attitude of farmers, and the specific group rules and regulations led to statistical difference in the group formation among the FFS.

**Group interaction**

In case of group interaction the result obtained revealed that, there was a statistically significant difference among different FFS and the village Perumatty had ranked highest with a mean rank score of 65.08, followed by Olassery (59.85), Kinnaserry (46.95), Manissery (42.60) and Koonathara (33.02) respectively.

**Table 6.2 Group interaction**

| Sl. No. | Name of the FFS | Mean rank | Rank |
|---|---|---|---|
| 1. | Koonathara | 33.02 | V |
| 2. | Kinaserry | 46.95 | III |
| 3. | Perumatty | 65.08 | I |
| 4. | Olaserry | 59.85 | 11 |
| 5. | Manissery | 47.60 | IV |

$\chi^2$ (4) = 15.18**

The probable reason for higher interaction levels in Perumatty FFS might be their high educational level, extension contact, information sharing nature and high levels of scientific orientation. All the members would have expressed their views and feelings openly with other members which could lead to higher interaction levels. In the case of Koonathara and Manissery groups, low interaction levels might be due to the spatial difference between the members' houses and the introvert personality of some of the members.

**Group cohesiveness**

Regarding group cohesiveness the result presented in the Table 6.3 shows that there was a statistically significant difference in group cohesiveness among different FFS, with higher mean rank score for Perumatty FFS (71.45) , followed by Olassery (55.22), Kinnaserry (53.50), Koonathara and Manissery (39.28) respectively.

The major reason for higher interaction levels in case of Perumatty and Olassery might be that members have more or less same opinions, high interaction and most of the members in the group might have felt equally important about their roles. The low mean rank score levels in case of Koonathara and Manissery FFS were because differences in opinions among members. Ignorance of some members opinions in the group while taking decisions in planning and organising activities.

**Table 6.3 Group cohesiveness**

| Sl .No. | Name of the FFS | Mean rank | Rank |
|---|---|---|---|
| 1. | Koonathara | 45.60 | IV |
| 2. | Kinaserry | 53.50 | III |
| 3. | Perumatty | 71.45 | I |
| 4. | Olaserry | 55.22 | II |
| 5. | Manissery | 39.28 | V |

, $\chi^2$ (4) = 21.84**

**Group Dynamics Index (GDI)**

The Group Dynamics Index computed and presented in the Table 6.4 reveals that there was a statistically significant difference in GDI among different FFS and the FFS Perumatty ranked first with a mean rank score of 76.52, followed by Olassery (60.02), Kinnaserry (52.50), Koonathara (48.75) and Manissery (46.40) respectively.

**Table 6.4 Group Dynamics Index**

| Sl. No. | Name of the FFS | Mean rank | Rank |
|---|---|---|---|
| 1. | Koonathara | 48.75 | IV |
| 2. | Kinaserry | 52.50 | III |
| 3. | Perumatty | 76.52 | I |
| 4. | Olaserry | 60.02 | II |
| 5. | Manisserry | 46.40 | V |

$\chi^2$ (4) = 28.33**

The probable reason might be that differences observed in group formation stages, group interaction levels and group cohesiveness among different FFS might have led to variations in the mean rank scores among the FFS.

**Perception of the respondents on selected attributes of technologies**

The data related to perceived attributes of eco-friendly farm technologies in the rice farming were collected from the respondents and presented in the Table 7 result obtained revealed that application of *Pseudomonas* was ranked first by the respondents of FFS, followed by application of neem based pesticides (II), use of *Trichogramma* cards (III), application of *Trichoderma* (IV), use of pheromone traps (V), use of light traps (VI), application of *Beauveria* (VII) and PGPR ranked (VII).

## 4.2 Knowledge level of the FFS respondents about eco-friendly farm technologies in rice cultivation

With regard to extent of knowledge level of FFS participants on different eco-friendly farm technologies in rice cultivation presented in the Table 8, revealed that knowledge level of the FFS participant's. Out of the practices identified, application of *Pseudomonas* was ranked first with Mean Score Index (MSI) of 70.83 followed by application of *Trichoderma* (67.50), application of neem based pesticides and bio pesticides (64.33), use of light traps (62.50), use of *Trichogramma* cards (61.75), use of pheromone traps (59.50), application of PGPR (30.00) and use of *Beauveria* (29.00).

**Table 7 Perception of the respondents on selected attributes of technologies** **N=100**

| Sl. No. | Name of the technology | Perceived attributes | | | | | Rank |
|---|---|---|---|---|---|---|---|
| | | Relative Advantage | Compatibility | Complexity | Trialability | Observability | |
| | | Percentage | Percentage | Percentage | Percentage | Percentage | |
| 1. | Application of *Pseudomonas* | 76.00 | 75.00 | 30.00 | 80.00 | 81.00 | I |
| 2. | Application of neem based pesticides and bio pesticides | 68.00 | 78.00 | 24.00 | 80.00 | 74.00 | II |
| 3. | Use of *Trichogramma* cards | 63.00 | 59.00 | 32.00 | 74.00 | 75.00 | III |
| 4. | Application of *Trichoderma* | 62.00 | 58.00 | 54.00 | 56.00 | 52.00 | IV |
| 5. | Use of pheromone traps | 64.00 | 62.00 | 73.00 | 58.00 | 66.00 | V |
| 6. | Use of light traps | 35.00 | 26.00 | 80.00 | 55.00 | 36.00 | VI |
| 7. | Application of *Beauveria* | 30.00 | 28.00 | 80.00 | 27.00 | 22.00 | VII |
| 8. | Application of PGPR-I and PGPR-II | 26.00 | 31.00 | 84.00 | 24.00 | 26.00 | VIII |

**Source: Primary data**

**Application of *Pseudomonas***

In the case of application of *Pseudomonas,* the Mean Score Index (MSI) obtained was 70.83, which was higher than total average MSI (66.54), because majority of the farmers had good knowledge level on its use and application (90 %), quantity used for seed treatment (70 %), seedling root dip (69 %), time and stage of application (70 %). It was also noticed that farmers were much interested towards seed treatment but not on foliar spray due to the labour cost involved. This indicates that farmers had adequate knowledge on 'application of *Pseudomonas* 'which might be due to their past experience and peer group influence. Over and above these, simplicity of the practices for seed treatment might be the other reason for gaining correct knowledge.

**Table 8 Knowledge level of the respondents in different eco-friendly farm technologies** **N =100**

| Sl. No. | Technology | Mean Score Index (MSI) | Rank |
|---|---|---|---|
| 1. | Application of *Pseudomonas* | 70.83 | I |
| 2. | Application of *Trichoderma* | 67.50 | II |
| 3. | Application of neem based pesticides and bio pesticides | 64.33 | III |
| 4. | Use of light traps | 62.5 | IV |
| 5. | Use of *Trichogramma* cards | 61.75 | V |
| 6. | Use of pheromone traps | 59.5 | VI |
| 7. | Use of PGPR | 30.00 | VII |
| 8. | Application of *Beauveria* | 29.00 | VIII |
| | **Total** | **66.54** | |

**Application of *Trichoderma***

With regard to application of *Trichoderma*, the MSI worked out was 67.50. It was observed that majority of the farmers had adequate knowledge level on use

(89 %) and its application (86 %). The major reason might be that during the sessions of FFS demonstration of seed treatment with ***Pseudomonas*** and ***Trichoderma*** had done this might have influenced the knowledge level of respondents. Low cost of seed management practices also had served as other contributing factor.

**Application of neem based pesticides and bio pesticides**

The MSI for knowledge level of farmers on use of neem based pesticides and bio pesticides were 64.33. This is evident that majority of the farmers had knowledge on the use of neem based pesticides (91 %) and bio pesticides (65 %). It was learnt that during FFS session, utilization of locally available resource was given more thrust and advocated to reduce application of chemical pesticides. Hence, extension participation might have influenced the respondents in gaining correct knowledge.

**Use of light traps**

The MSI obtained with respect to knowledge level on the use of light tarp was 62.5 which was slightly lower than average MSI (66.54), Although 76% of the respondents were aware about the use of light traps, majority of the farmers had inadequate knowledge on Economic Threshold Level (ETL) of pests and the distance to be maintained between the traps.

**Use of *Trichogramma* cards**

With respect to the knowledge on *Trichogramma* cards, MSI obtained was 61.75. The probable reason accounted might be due to the fact that although 76 per cent of the respondents had correct knowledge on its usage, and 52 per cent of the respondents had correct knowledge on the number of *Trichogramma* cards to be used per hectare.

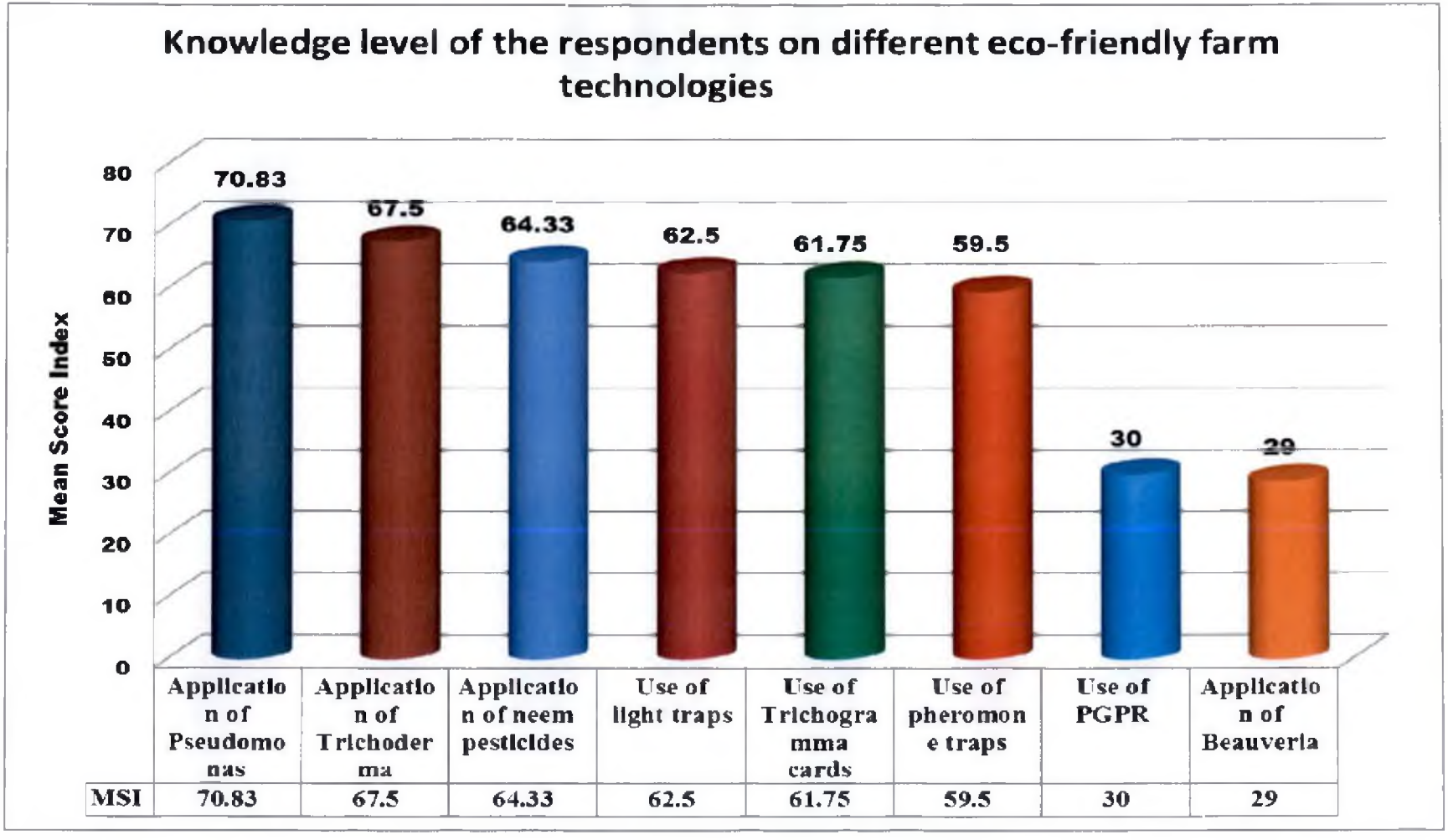


Figure 2: Knowledge level of the respondents on different eco-friendly farm technologies

**Use of pheromone traps**

It is noted from the Table 8, that the MSI knowledge level of farmers calculated was 59.5. It might be due to inadequate knowledge level of the majority of the respondents on inter trap distance (76.00%).and number of Pheromone traps to be placed per hectare (44.00%) .

**Application of PGPR**

In the case of application of PGPR lower (37.00) MSI levels might be due to the fact that 66 per cent of the respondents had inadequate knowledge level on its usage and application.

**Application of *Beauveria***

The probable reason for such a drastic reduction in MSI level (29.00), might be due to the poor knowledge levels of farmers exhibited on the quantity and time of application of *Beauveria.*

It is logical to derive from the above discussion that the practices which were complex and difficult to remember were least known to farmers, on the other hand those practices which were simple and being followed for a longer period were known to most of the farmers. The other reason could low cost of the technologies along with the personal characteristics such as education, farming experience, innovativeness and scientific orientation might have influenced the FFS participants to acquire correct knowledge about most of the eco-friendly technologies.

### 4.2.1 Overall knowledge level of the respondents about eco-friendly farm technologies

The results presented in Table 9 indicated that 61 per cent of the FFS respondents had 'medium level of knowledge about the eco-friendly farm technologies'. Whereas 21 per cent and 18 per cent of the FFS participants had 'low and high knowledge level about eco-friendly farm technologies.

The probable reasons for this trend might be due to the fact that participants had been trained well in eco-friendly farm technologies during FFS sessions. FFS is being conducted for one complete season with 7 to 11 sessions. FFS participants had enough opportunities to understand cultivation aspects of the crops with Agro Ecosystem Analysis (AESA). In AESA, after observing plant height, plant health, insect pests, predators, soil condition etc. farmers analyse the data and draw up their findings and recommendations with the help of the facilitator. Further, the personal and psychological traits of the FFS participants revealed that their education level was fairly good along with 'medium farming experience'.

This might have helped the respondents to gain high knowledge regarding eco-friendly practices. The other contributing factors were 'medium innovativeness', and 'high extension participation'. As evidenced by the correlation analysis, education, extension participation and innovativeness were significantly related with knowledge levels of the respondents and these variables might have influenced the knowledge on eco- friendly farm technologies.

Adequate knowledge of any improved practice is a pre-requisite for its adoption. Research studies have established that knowledge of an innovation would lead to its eventual adoption. The results expressed by the respondents regarding knowledge about eco-friendly farm technologies was at medium and high level to a greater extent. This trend evidently showed that the components, which were having relative advantage, observability and simplicity, were known by all farmers. While, the practices, which were costly, technically complex, and requiring special skills were unknown to few of the respondents.

The similar results are observed by Ranganath (2001) and Venkatashivareddy (2006)

**Table 9 Overall knowledge level of the respondents about eco-friendly farm technologies** **N =100**

| Sl. No. | Category | Percentage |
|---|---|---|
| 1. | Low | 21.00 |
| 2. | Medium | 61.00 |
| 3. | High | 18.00 |
| | **Mean -24.53** | **SD-3.50** |

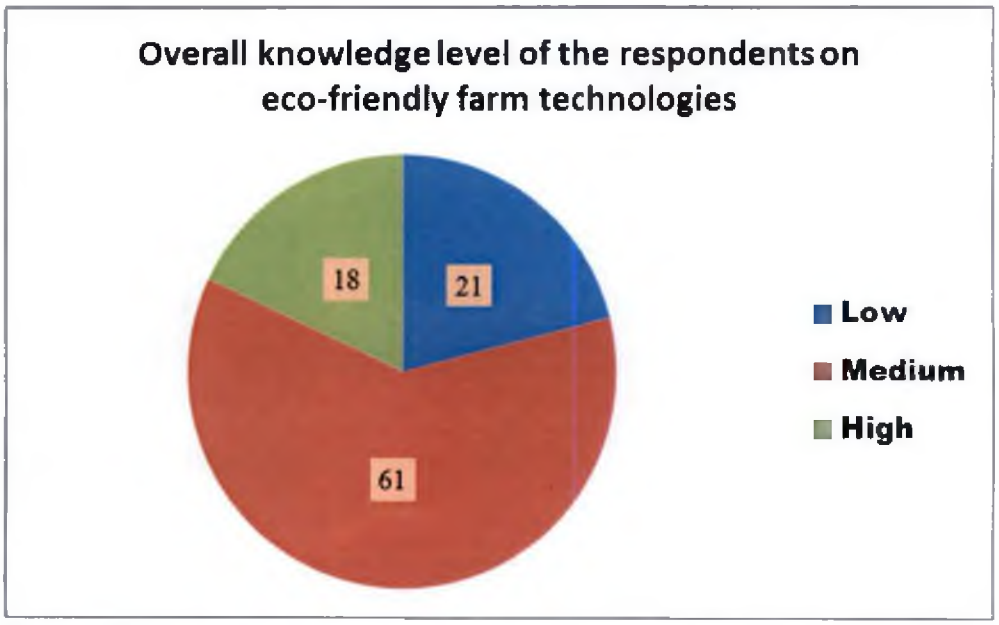


**Figure 3: Overall knowledge level of the respondents on eco-friendly farm technologies**

### 4.3 Adoption level of the eco-friendly farm technologies in rice cultivation by the FFS participants

**Application of *Pseudomonas***

It is noticed from the Table 10 that majority of the respondents (82.00%) had adopted the application of *Pseudomonas fluorescens* and 18 per cent were non-adopters.

Higher adoption rate of *Pseudomonas fluorescens* might be due to its attributes like compatibility with the prevailing system and trialability and also high knowledge index (70.83) of the farmers for this particular technology.

**Application of *Trichoderma***

It is clearly observed from the Table 10 that 76 per cent of the respondents had adopted the application of *Trichoderma*, whereas remaining 24 per cent of the respondents were non- adopters.

The attributes of the technology viz; relative advantage (62.00%) and compatibility (58.00%) and higher knowledge level (67.50) of the respondents might have promoted adoption of *Trichoderma.*

**Use of neem pesticides and bio-pesticides**

In case of bio pesticides, 72 per cent of the respondents were found to be adopters, and the remaining was found to be non-adopters.

It is obvious to note that the bio-control techniques are the innovative practices and require proper scientific knowledge about their use. The possible reasons might be medium to high level of innovativeness, high extension participation, mass media utilization and knowledge level (64.33) of the respondents and the attributes of technology viz; relative advantage (82 %), compatibility (86 %) and observability (83 %) might have encouraged the adoption process.

**Use of pheromone traps and light traps**

In the case of practices such as use of pheromone traps and light traps 72 per cent of the respondents were adopting pheromone traps and 49 per cent adopting light traps It was observed that 28 per cent and 51 per cent of the respondents were not adopting pheromone traps and light traps respectively.

The probable reason for adoption might be the FFS participants had opportunities to understand growth and production pattern of the crops and also important aspects like agro ecosystem analysis (AESA). The lessons learnt in AESA might have helped the farmers to know the importance of natural enemies and ETL levels of different pests based on which they had preferred to go for need based spraying.

**Table 10 Distribution of respondents on the basis of adoption of individual eco-friendly technologies** **N =100**

| Sl. No. | Technology | Adopters | Non-adopters |
|---|---|---|---|
| | | Percentage | Percentage |
| 1. | Application of *Pseudomonas* | 82.00 | 18.00 |
| 2. | Application of *Trichoderma* | 76.00 | 24.00 |
| 3. | Use of *Trichogramma* cards | 76.00 | 24.00 |
| 4. | Use of pheromone traps | 72.00 | 28.00 |
| 5. | Use on neem based pesticides and bio pesticides | 72.00 | 28.00 |
| 6. | Use of light traps | 49.00 | 51.00 |
| 7. | Application of *Beauveria* | 31.00 | 69.00 |
| 8. | Application of PGPR | 29.00 | 71.00 |

**Source: Primary data**

**Application of PGPR**

It was observed from the Table 10 that 72 per cent of the respondents were found to be in non-adopter category regarding and the remaining 28 per cent were found to be in adopter category.

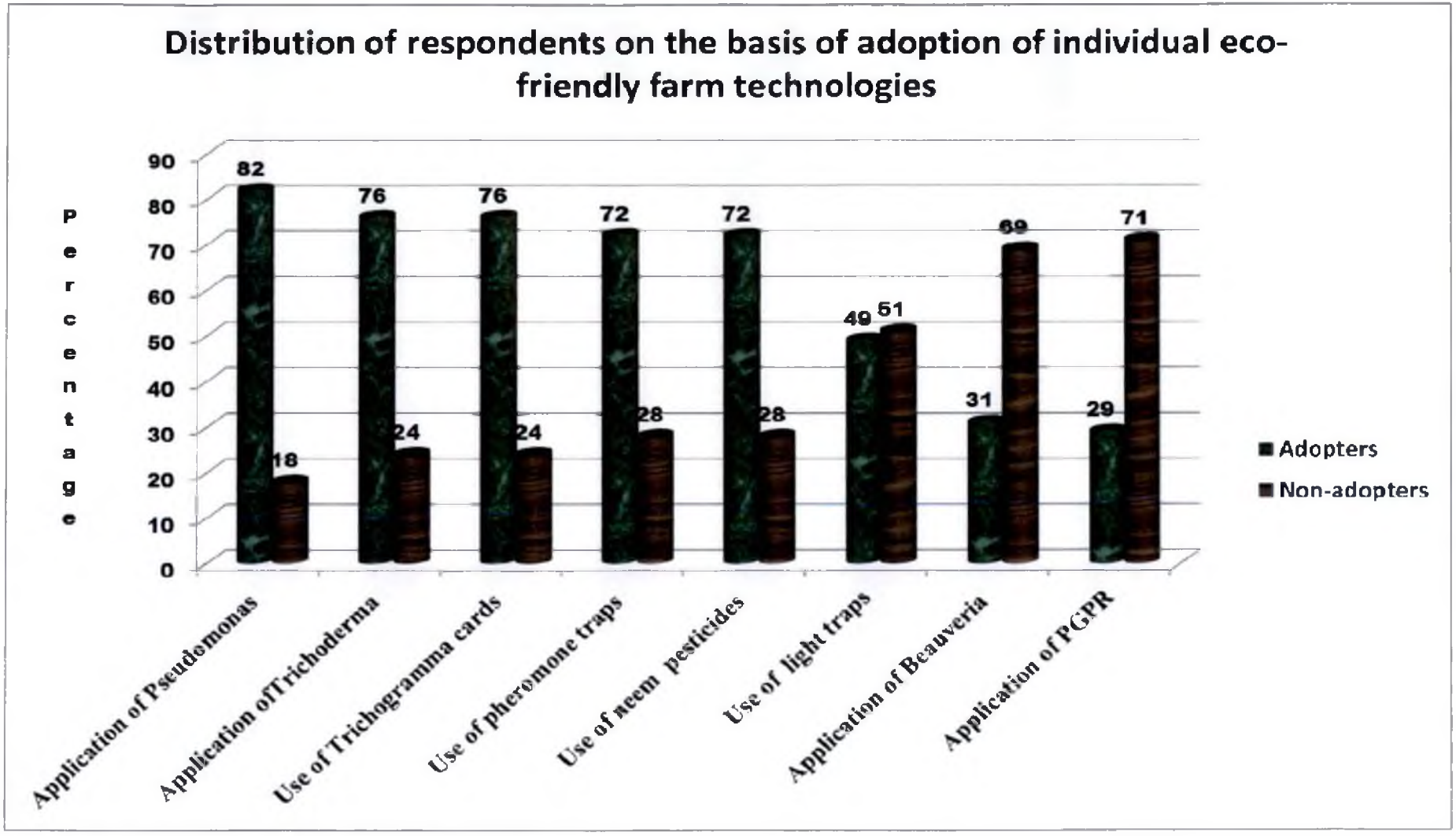


**Figure 4: Distribution of respondents on the basis of adoption of individual eco-friendly technologies**

The possible reason might be lack of adequate knowledge, non-availability and high cost of PGPR along with perceived complexity and low compatibility of the technology by the non-adopters.

**Application of *Beauveria***

With regard to application of *Beauveria,* 31 per cent had fully adopted the technology, while about 69 per cent had not adopted it.

This might be due to the fact that, non-adopters might have lacked technical skill in handling and using of *Beauveria* , its complexity and low compatibility had led to lower adoption. Moreover, the farmers might not have convinced about this practice due to slow impact on control of pests and intangible nature.

### 4.3.1. Overall adoption level of the respondents about eco-friendly farm technologies

The distribution of data in Table 11 reveals that nearly 70 per cent of the respondents belonged to medium adoption category whereas 26 per cent and 4 per cent of FFS respondents belonged to high and low adoption categories respectively.

| Sl. No. | Category | Percentage |
|---|---|---|
| 1. | Low (Less than 3.00) | 4.00 |
| 2. | Medium (4.00-6.00) | 70.00 |
| 3. | High (Greater than 6.00) | 26.00 |
| | **Mean - 4.62** | **SD- 0.73** |

Probable reason for the respondents to be in medium adoption category might be due to the medium to high knowledge possessed by majority (84 %) of the respondents. Since knowledge limits the action of individuals, as it is basic pre-requisite for any individuals to think of the pros and cons in making a decision, to either adopt or reject a practice. Other possible reason might be that, majority of

the respondents had participated in extension activities like, demonstrations, trainings, group discussions and field days.

The results are in line with the findings of Shashidhara (2006)

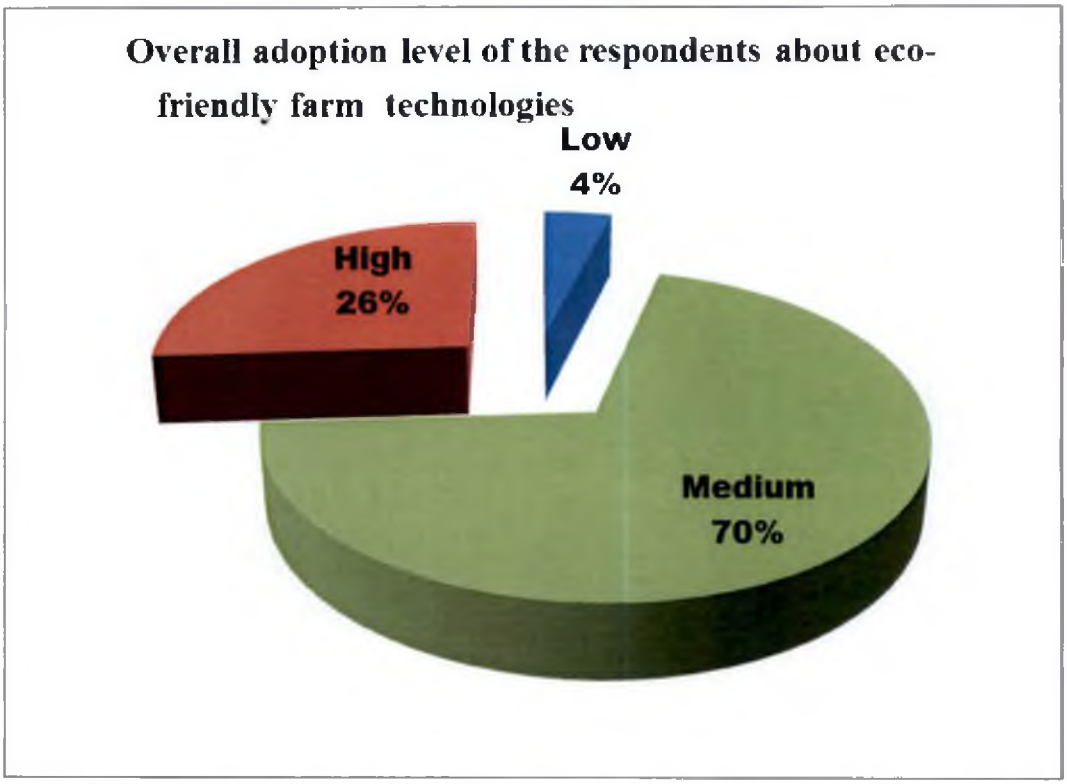


**Figure 5: Overall adoption level of the respondents about eco-friendly technologies**

### 4.4 Impact of eco-friendly farm technologies in rice cultivation as perceived by FFS participants

#### 4.4.1. Environmental impact

With regard to perceived environmental impact, knowledge about soil testing was ranked first with a mean score of 82.66 followed by favourable attitude towards conservation of natural enemies (72.33), decrease in the use of chemical fertilizer (69.66), awareness about crop rotation practices (69.33), awareness on judicious use of water (63.00) and knowledge on toxicity of pesticides (59.33).

**Knowledge about soil testing**

The probable reason for higher mean score levels (82.66) on knowledge about soil testing might be due to the fact that trainings and lectures conducted in the FFS might have influenced their knowledge levels. The other reasons might be the convergent attempt of KVK and Department of Agriculture focusing on balanced fertilizer application based on soil testing and promotion of soil health cards.

**Favourable attitude towards conservation of natural enemies ($E_2$)**

Different sessions of FFS and AESA might have helped the respondents to develop a positive attitude towards protection of natural enemies .These exposure had facilitated them to observe natural enemies in the field and analyse their effect on pest population had resulted in favourable attitude. The above possible reasons might have accounted for the higher mean score levels (72.33) in case of protection of natural enemies.

**Decrease in the use of chemical fertilizer**

Majority of the respondents had perceived decreased usage of fertilizer dose because most of the respondents in FFS had been using locally available resources like FYM, vermi-compost and goat penning. It was observed majority of the respondents had adequate knowledge on soil testing which might have influenced them for using correct fertilizer dose. Since farmers were more concerned about soil fertility, they were attending soil testing campaigns regularly.

**Awareness about crop rotation practices**

It was clearly observed that majority of the respondents were aware about crop rotation practices as it was evident that majority in FFS were cultivating green manure crops after second paddy season to improve soil fertility.

**Table 12 Distribution of respondents on the basis of their perceived environmental impact** N =100

| Indicator number | Indicator | Perceived impact | | | Perceived mean score | Rank |
|---|---|---|---|---|---|---|
| | | Lesser extent | Certain extent | Greater extent | | |
| | | % | % | % | | |
| $E_1$ | Knowledge about soil testing | 13.00 | 26.00 | 61.00 | 82.66 | I |
| $E_2$ | Favourable attitude towards conservation of natural enemies | 8.00 | 67.00 | 25.00 | 72.33 | II |
| $E_3$ | Decrease in the use of chemical fertilizer | 18.00 | 54.00 | 28.00 | 69.66 | III |
| $E_4$ | Awareness about crop rotation practices | 8.00 | 76.00 | 16.00 | 69.33 | IV |
| $E_5$ | Awareness on judicious use of water | 18.00 | 75.00 | 7.00 | 63.00 | V |
| $E_6$ | Knowledge on toxicity of pesticides | 40.00 | 42.00 | 18.00 | 59.33 | VI |
| | **Total perceived mean score** | | | | **70.95** | |

**Source: Primary data**

**Awareness on judicious use of water**

The probable reason for awareness on judicious use of water might be that during the sessions in FFS, they could understand the critical stages of irrigation and depth of water to be maintained in the field for a good crop stand. As a result majority of the farmers might have opted irrigation at critical stages irrespective of plenty of water availability.

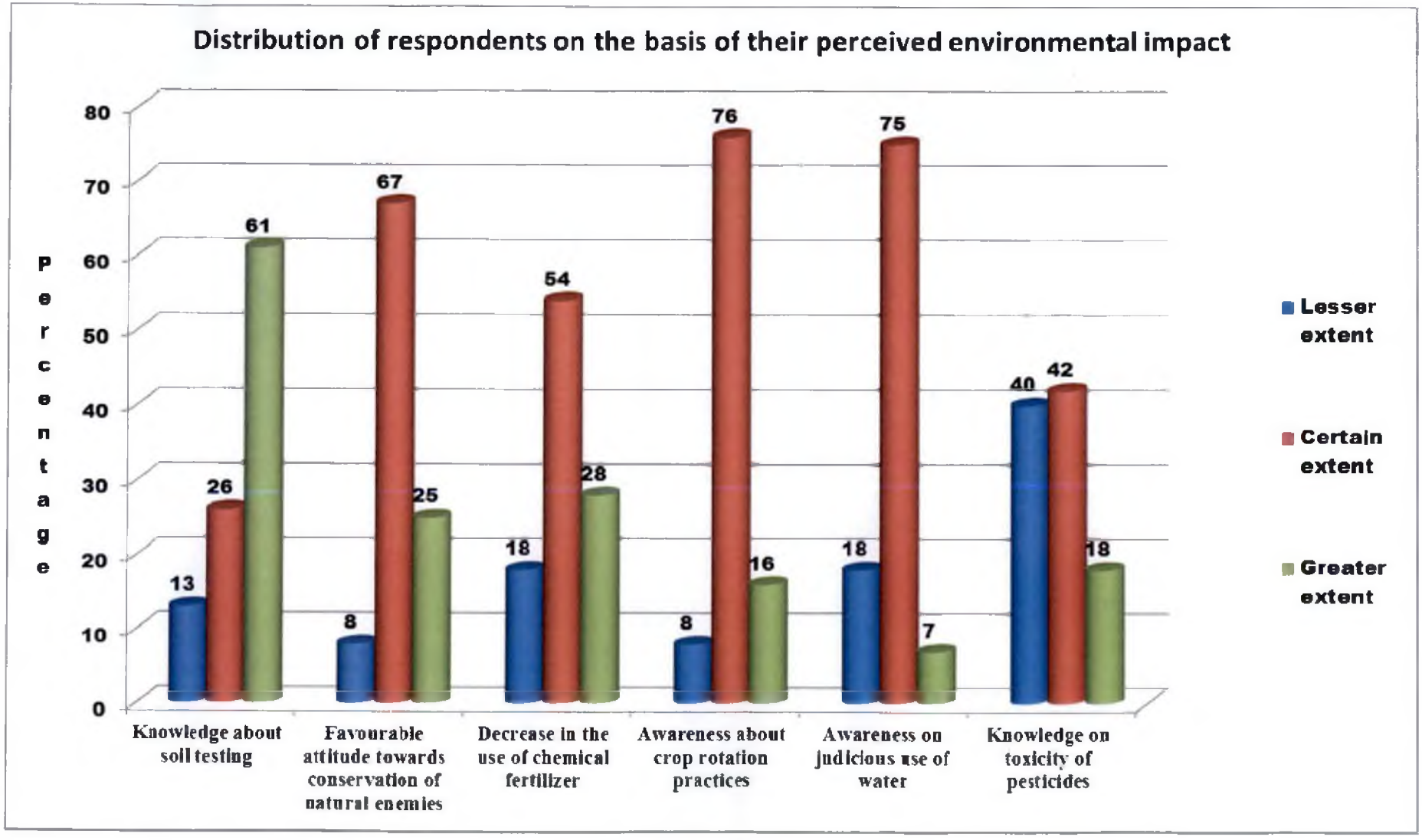


Figure 6: Distribution of respondents on the basis of their perceived environmental impact

**Knowledge on toxicity of pesticides**

It was observed that nearly two-third of the respondents in FFS had perceived increased knowledge on toxicity of pesticides and farmers were even aware about symbols and colours of labels of pesticides. Most of them had reported that they had reduced the consumption of pesticides which shows the increased knowledge on toxicity of pesticides.

### 4.4.2 Economic impact

In case of economic impact, decrease in the use of labour ranked first with a mean score of 93.66 followed by decrease in cost of cultivation (79.66), increase in income level of farmers (77.66), increase in yield levels (76.66), change in the price of the product (33.66) and improved marketability of the produce (33.66).

**Decrease in the use of labour**

The decrease in use of labour was perceived by majority of the respondents in FFS. One of the reasons might be reduction in the use of labour for spraying and fertilizer application as the majority of respondents had been adopting eco-friendly farm technologies. Since mechanisation had been promoted by different agencies, it had also influenced in the reduction in use of labour force.

**Decrease in cost of cultivation**

Decreased cost of cultivation was perceived by the FFS respondents because most of the practices involved were cost effective and making use of locally available eco-friendly internal resources like FYM, green manures, own seeds etc. It was observed that there was a decrease in cost of cultivation of about 15 per cent after adoption of eco-friendly farm technologies from an average cost of cultivation of Rs. 22,000 to Rs. 19,000 per acre as perceived by the respondents.

**Table 13. Distribution of respondents on the basis of their perceived economic impact** N =100

| Indicator number | Indicator | Perceived impact | | | Perceived mean score | Rank |
|---|---|---|---|---|---|---|
| | | Lesser extent | Certain extent | Greater extent | | |
| | | % | % | % | | |
| $EC_1$ | Decrease in use of labour | 7.00 | 5.00 | 88.00 | 93.66 | I |
| $EC_2$ | Decrease in cost of cultivation | 17.00 | 27.00 | 56.00 | 79.66 | II |
| $EC_3$ | Increase in income levels of farmer | 12.00 | 43.00 | 45.00 | 77.66 | III |
| $EC_4$ | Change in input costs | 7.00 | 54.00 | 39.00 | 77.33 | IV |
| $EC_5$ | Increase in yield levels | 10.00 | 50.00 | 40.00 | 76.66 | V |
| $EC_6$ | Improved marketability of the produce | 100.00 | 0 | 0 | 33.66 | VI |
| $EC_7$ | Premium support price | 100.00 | 0 | 0 | 33.66 | VII |
| | Total perceived mean score | | | | 66.71 | |

**Source: Primary data**

**Increase in income levels of farmer**

In eco-friendly agriculture due to application of locally available inputs, the cost of cultivation would be comparatively low and as per the experiences of the respondents they could perceive an increase in income level by 10 per cent where the income being Rs 43, 000 ad Rs 39, 000 per acre before and after the adoption of eco-friendly technologies.

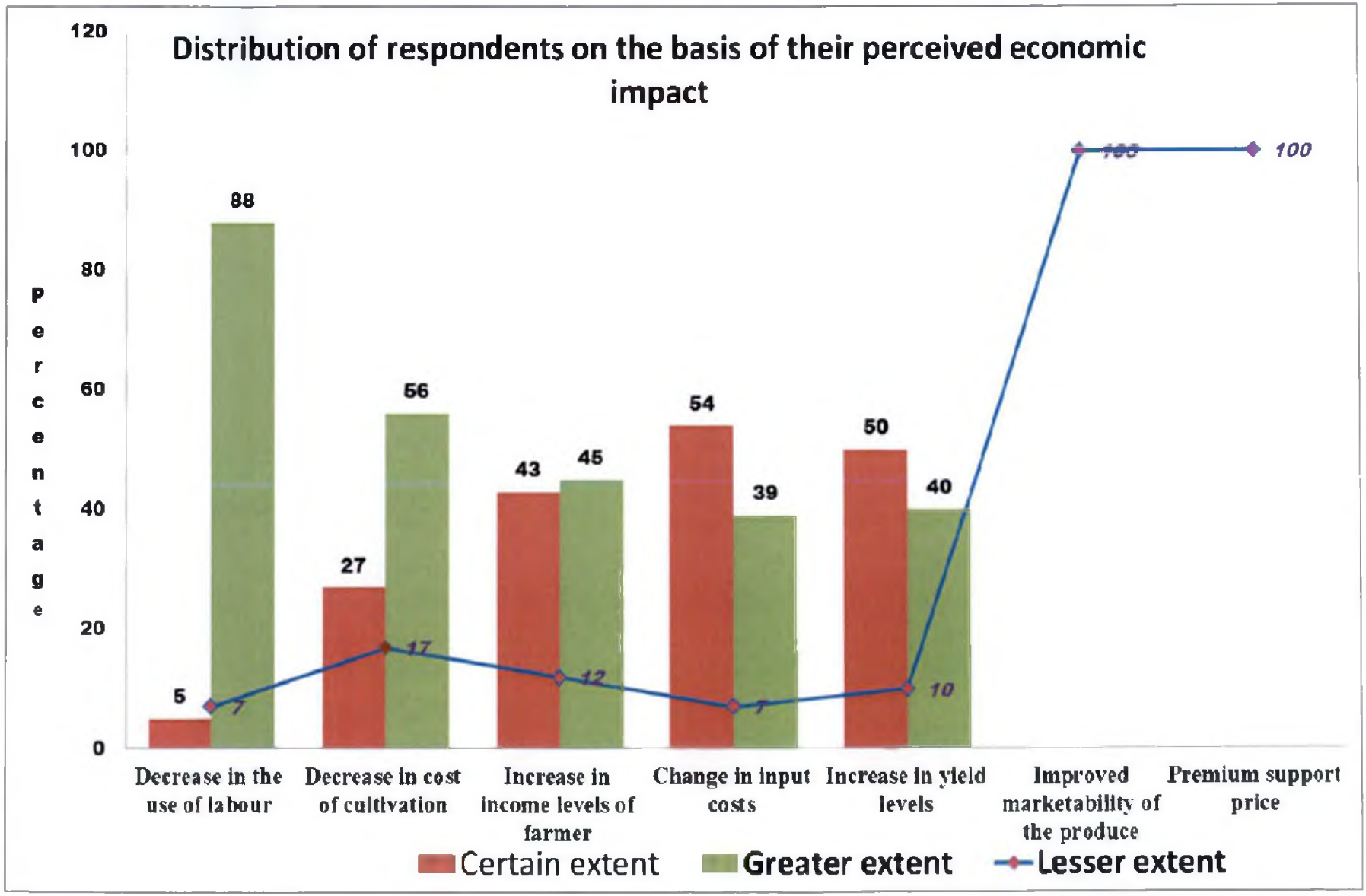


Figure 7: Distribution of respondents on the basis of their perceived economic impact

**Change in input costs**

Due to the transition towards eco-friendly farming with minimum use of external inputs might have led to reduction in the cost of inputs which can be evident from the decrease in cost of cultivation perceived by the respondents.

**Increase in yield levels.**

The probable reason might be that the farmers in the study area had been practising eco-friendly farming for the past four years and the yield would have stabilized. It was observed that there was increase in the yield levels by 10 per cent on an average of 1856 kg to 2068 kg per acre.

**Improved marketability and premium price of the produce**

With regards to improved marketability of the produce ($EC_6$) and premium price to the produce ($EC_7$) result revealed that almost all the respondents in FFS perceived no change in $EC_6$ and $EC_7$ and the total perceived mean scores calculated were 33.66 and 33.66 respectively.

Cent per cent of the respondents had perceived that there was no change in the marketability of the produce since procurement of paddy was being done by State Civil Supplies Department. Cent per cent of the respondents had perceived no change in the price obtained for the product, because the procurement of produce was done at MSP fixed by the government.

**4.4.3. Technological impact**

With respect to perceived technological impact, reduction in consumption of pesticides was ranked first with a mean score of 76.66 followed by improved knowledge about IPM/INM (74.66), orientation towards improved crop management practices (72.33), change in the usage of inputs (70.33) and shift towards conservation of environment (66.00).

**Reduction in consumption of pesticides**

The probable reason for reduction in consumption of pesticides might be due to the improved knowledge in distinguishing pests from its natural enemies and there by arriving at the fact that "all insects are not pests". It was evident from the data that there was a drastic reduction in the frequency of insecticide application after attending FFS. The number of sprayings came down to 1.5 times from 3.5 times per season per acre. This would have improved their ecosystems by reducing the use of highly toxic pesticides. The intervention had motivated and enabled rural people to promote eco-friendly farm technologies to reduce several environmental health risks.

The results are in conformity with the results obtained by Mancini *et al.* (2006) and George and Hegde (2009).

**Improved knowledge about IPM/INM**

With regard to "improved knowledge on IPM/INM practices majority of the respondents had reported good knowledge level. The probable reason might be that the unique methodology of FFS had made the respondents to learn IPM/INM practices by adopting agro ecosystem analysis (AESA). In AESA the respondents had an opportunity for keen observation, analysis of various pests, natural enemies and their ways to control. Discussion and sharing of observations had enhanced the knowledge level of respondents. The other reason might be that majority of the farmer's belonged to medium to high knowledge and adopter categories with respect to eco-friendly farm technologies.

**Table 14 Distribution of respondents on the basis of their perceived technological impact** N =100

| Indicator number | Indicator | Perceived impact | | | Perceived mean score | Rank |
|---|---|---|---|---|---|---|
| | | Lesser extent | Certain extent | Greater extent | | |
| | | % | % | % | | |
| $T_1$ | Reduction in consumption of pesticides | 17.00 | 36.00 | 47.00 | 76.66 | I |
| $T_2$ | Improved knowledge about IPM/INM | 9.00 | 58.00 | 33.00 | 74.66 | II |
| $T_3$ | Orientation towards improved crop management practices | 10.00 | 63.00 | 27.00 | 72.33 | III |
| $T_4$ | Shift toward the use of internally available resources | 12.00 | 59.00 | 29.00 | 72.33 | IV |
| $T_5$ | Change in the usage of inputs | 21.00 | 47.00 | 32.00 | 70.33 | V |
| $T_6$ | Shift towards conservation of environment | 19.00 | 64.00 | 17.00 | 66.00 | VI |
| **Total perceived mean score** | | | | | **76.04** | |

**Shift toward the use of internally available resources**

This is evident from the findings that two-third of the respondents (66.00%) in FFS belonged to the category of moderate to highly used category with respect to internally available resources. Besides farmers were also aware about the environmental hazards of chemicals which had encouraged shift towards use of internally available resources.

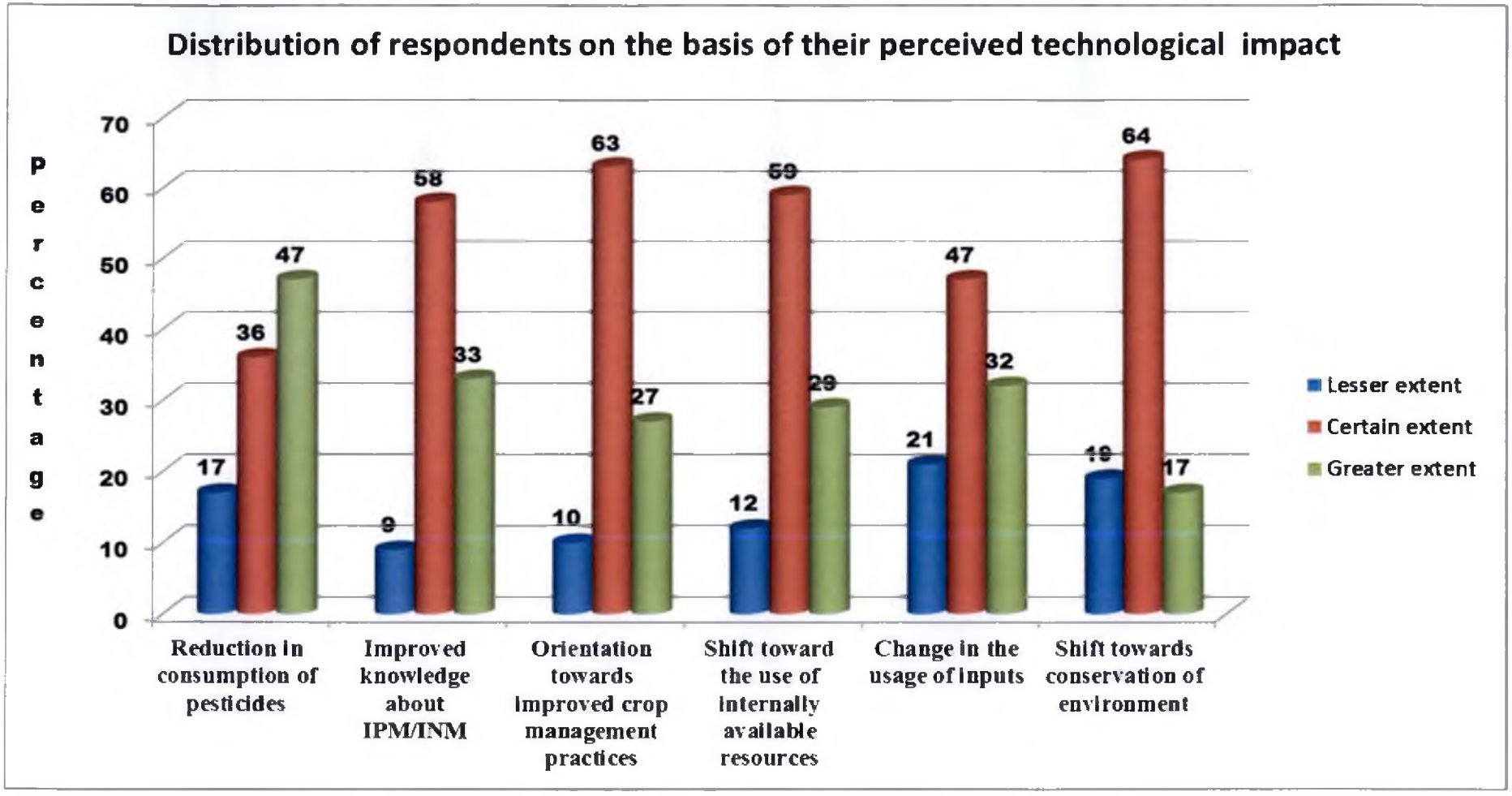


Figure 8: Distribution of respondents on the basis of their perceived technological impact

**Change in the usage of inputs**

The probable reason for change in the usage of inputs after attending FFS might be that majority of them had been using FYM (78 %) regularly, vermin-compost , own seeds and goat and sheep penning occasionally. The other reasons might be that majority of the respondents had livestock as their secondary enterprise and efforts of government to promote eco-friendly inputs had also influenced the respondents. Instead of dependence on external inputs, the practices promoted in FFS typically promote analysis and use of what is available in farmers' fields and local ecosystems.

**Shift towards conservation of environment**

This change had happened because of their awareness and exposure to the environmental issues like, increased soil erosion, erratic rainfalls, disappearance of traditional crops and varieties, intensive weed growth, increased temperature and ill effects of chemicals etc. All these issues might have promoted conservation of environment by adopting possible eco-friendly farm technologies.

**4.4.4 Social impact**

With regard to social impact, sharing of experiences and key learnings with other farmers was ranked first with a mean score of 86.66, followed by increase in social contacts (80.66), increased participation in training (79.66) developing group dynamics (75.33), becoming master trainer (69.33) increase in farmer to farmer communication (66.66) and joint responsibility in resource conservation (65.33).

**Sharing of experiences and key learning with other farmers**

Sharing of experiences and key learning with other farmers had ranked highest with mean score of 86.66. The major reason for this might be that majority of the respondents were the members of *padasekhara samithis*, where they meet regularly. The other reasons might be that majority of the farmers had medium to

high level of information sharing behavior, extension participation and high mass media utilization.

**Increase in social contacts**

The high level of their training experience might have encouraged them to interact with officials and participants by virtue of such process increase in social contacts were observed. The other reasons might be that majority of the participants had good educational level, extension contact and high institutional support to the farmers.

**Increased participation in training**

The probable reason for this might be that majority of the farmers had attended medium to high level of trainings in which the skill based knowledge on eco-friendly technologies which was highly beneficial might have motivated them to attend more trainings. Farmers were empowered by such training, in terms of increased self-regard, social skills and active interactions thereby practicing experimentation, community-based planning and farmer-to-farmer communication.

**Table 15 Distribution of respondents on the basis of their perceived social impact** **N =100**

| Sl. No. | Indicator | Perceived impact | | | Perceived mean score | Rank |
|---|---|---|---|---|---|---|
| | | Lesser extent | Certain extent | Greater extent | | |
| | | % | % | % | | |
| $S_1$ | Sharing of experiences and key learning with other farmers | 6.00 | 28.00 | 66.00 | 86.66 | I |
| $S_2$ | Increase in social contacts | 4.00 | 50.00 | 46.00 | 80.66 | II |
| $S_3$ | Increased participation in training | 6.00 | 49.00 | 45.00 | 79.66 | III |
| $S_4$ | Developing group dynamics | 5.00 | 64.00 | 31.00 | 75.33 | IV |
| $S_5$ | Becoming master trainer | 22.00 | 48.00 | 30.00 | 69.33 | V |
| $S_6$ | Increase in Farmer to farmer communication | 12.00 | 76.00 | 12.00 | 66.66 | VI |
| $S_7$ | Joint responsibility in resource conservation initiatives | 18.00 | 68.00 | 14 | 65.33 | VII |
| | **Total perceived mean score** | | | | 74.80 | |

**Source: Primary data**

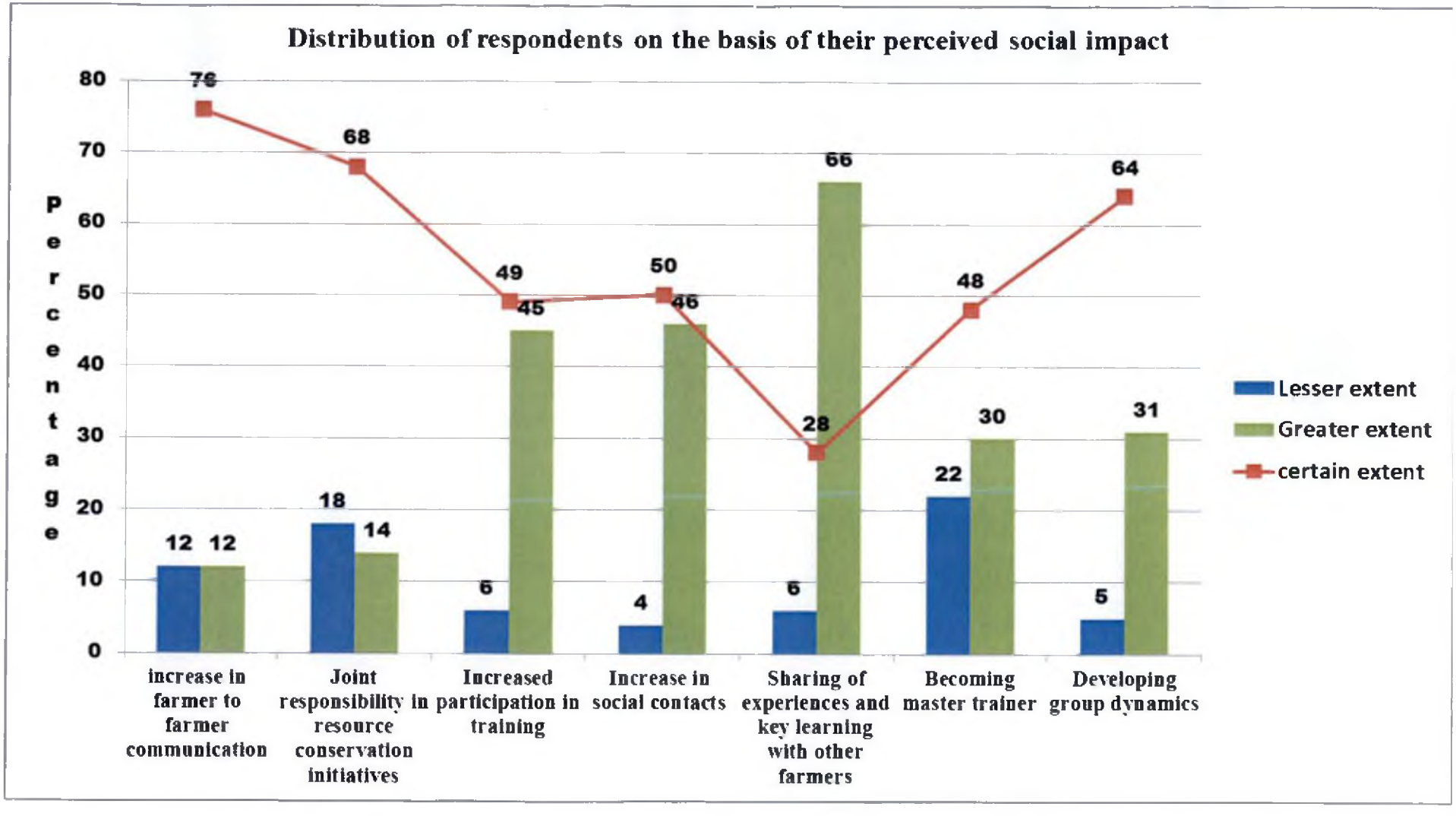


Figure 9: Distribution of respondents on the basis of their perceived social impact

**Developing group dynamics**

The trainings attended might have influenced communication behaviour, problem solving skill and leadership skills. Learning through such experiences could enhance leadership skills which would help to develop group dynamics among farmers. The other reasons for developing group dynamics might be due to the fact that majority of the respondents had high level of group cohesion and medium to high level of group interaction among all members.

**Becoming master trainer**

The main strategy of the FFS programme was that not to train all the farmers in the community, but rather to rely on the spread of knowledge through farmer-to-farmer diffusion process. Leadership skills developed through group dynamics and trainings might have influenced them to become master trainer to other farmers. The other reasons might be that majority of the respondents had medium to high level of information sharing behaviour, mass media utilization and extension participation.

**Increase in Farmer to farmer communication**

It is mainly due to the fact that FFS would help in promoting communication behaviour through conduct of various activities like group discussions and group dynamics exercises etc.

**Joint responsibility in resource conservation initiatives**

The probable reason for increase in joint responsibility in resource conservation initiatives might be due to the fact that all the members in FFS had an opportunity to participate in AESA where they analyse field situations with regard to pests, natural enemies, soil conditions, plant health, the influence of climatic factors and their interrelationship. Such an experiential learning on the field situations would have enabled the respondents for improving natural ecosystem conservation.

## 4.5 Relationship between profile characteristics of rice farmers in FFS with knowledge of eco-friendly farm technologies

The correlation co-efficient values of all the 14 variables inclusive of personal, socio-economic, psychological, communication and group dynamics variable with knowledge of eco-friendly farm technologies of FFS participants are furnished in the Table 16 revealed that the correlation co-efficient of nine characteristics *viz.*, education (0.185$^{*}$), innovativeness (0.257$^{**}$), scientific orientation (0.198$^{*}$), extension participation (0.375$^{**}$), institutional support (0.243$^{*}$), mass media utilization (0.161$^{**}$), trainings attended (0.192$^{*}$) and group interaction (0.275$^{**}$) exhibited positive and significant relationship with knowledge. But the characteristics like age (-0.072), annual income (0.137), land holding (0.150), farming experience (-0.043), risk orientation (0.141), and group cohesiveness (0.021), had non-significant relationship with knowledge on eco-friendly farm technologies.

**Education and knowledge**

The relationship between education and knowledge level of the respondents was found to be significant. Formal education of the respondents might have helped to a greater extent in understanding the complex ill-effects of agrochemicals. Education widens the horizons of the individuals to gain knowledge and become more receptive to new ideas.

**Innovativeness and knowledge**

Innovativeness was found to be significantly associated with knowledge level. Respondents awareness on the ill effects of agro-chemicals and different problems faced in controlling pests and diseases might have induced them to try new methods.

**Scientific orientation and knowledge**

Scientific orientation was found to be significantly related with the knowledge level of respondents. This might due to the fact that respondents with higher scientific orientation would try to gather more information, which would be applied at the field level, to solve the problem and thereby increasing crop yield.

**Extension participation and knowledge**

It was found that extension participation of farmers had significant relationship with knowledge of eco-friendly farm technologies. This might be due to the fact that, participation in the extension activities provided opportunities to the respondents in gaining knowledge about eco-friendly technologies.

**Mass media utilization and knowledge**

The relationship between mass media use and knowledge was found to be significant. It could be implied that majority of the farmers had possessed newspaper, farm magazines and television, of which many respondents might have listened and viewed agricultural programmes. As these media covers large areas of agricultural information, interested farmers must have gathered information, resulted in enhanced knowledge on eco-friendly technologies.

**Trainings attended and knowledge**

It was observed from the Table 16 that there was a significant association between trainings attended and knowledge level of the respondents. The reason

for higher knowledge of the FFS trained respondents might be due to the appropriateness of the subject matter related to eco-friendly farm technologies covered during the training sessions. During FFS trainings, farmers were exposed to the content of eco-friendly farm technologies through lectures, group discussion, experiential learning, field days and field visits. Another reason could be, higher training experience might have utilized different opportunities to clear their doubts with specialists and other farmers.

**Table 16 Correlation between characteristics of the FFS respondents and their knowledge of eco-friendly farm technologies N=100**

| Sl. No. | Variables | r values |
|---|---|---|
| 1. | Age ($X_1$) | -0.072 |
| 2. | Education ($X_2$) | 0.185* |
| 3. | Land holding ($X_3$) | 0.150 |
| 4. | Farming experience($X_4$) | -0.043 |
| 5. | Annual income($X_5$) | 0.137 |
| 6. | Innovativeness($X_6$) | 0.257** |
| 7. | Risk orientation ($X_7$) | 0.141 |
| 8. | Scientific orientation($X_8$) | 0.198* |
| 9. | Extension participation($X_9$) | 0.375** |
| 10. | Mass media utilisation ($X_{10}$) | 0.161** |
| 11. | Trainings attended ($X_{11}$) | 0.192* |
| 12. | Institutional support ($X_{12}$) | 0.243* |
| 13. | Group cohesiveness ($X_{14}$) | 0.021 |
| 14. | Group interaction($X_{15}$) | 0.275** |

**Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed)

**Institutional support and knowledge**

The relationship shown between the institutional support and knowledge level of the respondents was significant. This implied that, the institutional support had played a significant role in increasing knowledge of farmers by conducting

appropriate trainings and creating awareness on adoption of eco-friendly technologies.

**Group interaction and adoption**

The results furnished in the Table 16 revealed that, there was a positive and significant association between group interaction and knowledge, which implies that as interaction between members increases knowledge level of the respondent's increases. As majority of the respondents belonged to medium to high level of interaction category and their membership in *padasekhara samithis* would be the main reason for positive and significant association between group interaction and knowledge.

**4.6 Relationship between profile characteristics of rice farmers in FFS with adoption of eco-friendly technologies**

The correlation co-efficient were computed for the examination of the relationship between the independent variables and the adoption of eco-friendly technologies. The results obtained presented in Table 17 revealed that, out of 15 variables taken for the study eleven variables *viz.*, education ($0.258^{**}$) Innovativeness ($0.441^{**}$), scientific orientation ($0.339^{**}$), risk orientation ($0.262^{**}$), extension participation ($0.404^{**}$), institutional support ($0.288^{**}$), mass media utilization ($0.229^{*}$), trainings attended ($0.208^{*}$), group interaction ($0.303^{**}$) and knowledge ($0.494^{**}$) exhibited positive and significant relationship with adoption of eco-friendly technologies.

**Education and adoption**

Significant relationship existed between education and adoption. This inferred that, respondents with higher level of education adopted more of eco-friendly technologies. This might be, because generally the people with higher level of education have better knowledge and exposure regarding eco-friendly technologies. As farmers with high education are more receptive to new ideas and they always tend to change and attracted towards modern practices. Hence,

farmers with high level of education had shown interest towards the adoption of eco-friendly farm technologies. The probable reason for this might be that majority of the respondents had good educational level coupled with extension contact.

**Table 17 Correlation between characteristics of the FFS respondents and their adoption of eco-friendly farm technologies N=100**

| Sl. No. | Variables | r value |
|---|---|---|
| 1. | Age ($X_1$) | -0.053 |
| 2. | Education ($X_2$) | 0.258** |
| 3. | Land holding ($X_3$) | 0.062 |
| 4. | Farming experience($X_4$) | -0.119 |
| 5. | Annual income($X_5$) | 0.093 |
| 6. | Innovativeness($X_6$) | 0.441** |
| 7. | Risk orientation ($X_7$) | 0.262** |
| 8. | Scientific orientation($X_8$) | 0.339** |
| 9. | Extension participation($X_9$) | 0.404** |
| 10. | Mass media utilisation ($X_{10}$) | 0.229* |
| 11. | Trainings attended ($X_{11}$) | 0.208* |
| 12. | Institutional support ($X_{12}$) | 0.288** |
| 13. | Group cohesiveness ($X_{14}$) | 0.129 |
| 14. | Group interaction($X_{15}$) | 0.303** |
| 15. | Knowledge on eco-friendly farm technologies($X_{16}$) | 0.494** |

**Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed).

**Innovativeness and adoption**

From Table 17, it was observed that innovativeness and adoption was significantly associated. Innovativeness is associated with the individuals' earliness in the use of new practices. During any contingent situation farmers with

high levels of innovativeness experiment the new ways of doing things to change the existing situation. Generally person with more innovativeness would be looking for new ideas. The major reasons for this might be majority of the framers had good educational level, institutional support and extension participation.

**Risk orientation and adoption**

From Table 17, it was evident that coefficient of correlation value (r= 0.262) between risk orientation and extent of adoption of eco-friendly farm technologies by the respondents was positively and significantly related. Risk taking is the ability to take the right decision during uncertainties. The farmer who would like to take calculated risks during constraint situation, gain better results. It was observed that many farmers were taking risks due to peer pressure or situational demands. Timely guidance by the change agents and other sources of information and the anticipation of high profits from adoption of eco-friendly farm technologies might have influenced them to take risks in adopting the eco-friendly farm technologies by rice farmers in FFS.

**Scientific orientation and adoption**

Farmers having more scientific orientation will always search for new and advanced production technologies and have keen observation power to find out the cause effect relationship in any constraint situation. Most of the innovations will be adopted by the persons with more scientific orientation, who prefer new technologies. The major reason for this might be majority of the farmers had medium to high level of scientific orientation, innovativeness and risk taking ability might have influenced them to adopt eco-friendly technologies. Thus scientific orientation had positive relationship with the adoption of eco-friendly technologies.

**Extension participation and adoption**

Farmers with high level of extension participation were high adopters of eco-friendly farm technologies. There was significant association between extension

participation and adoption of eco-friendly technologies. The participation in extension activates had provided an opportunity for contrived experiences and served as reinforcement in adoption of eco-friendly technologies.

**Mass media utilization and Adoption**

The results showed that significant and positive correlation had existed between mass media exposure and extent of adoption of eco-friendly farm technologies by the respondents. The published and broadcasted farmer success stories of different mass media might have influenced the farmers to adopt eco-friendly technologies.

**Trainings attended and adoption**

Trainings attended had a significant relationship with adoption. Timeliness of training conducted by different organizations has led to increase in adoption of eco-friendly farm technologies and other improved crop management practices. Training might have inculcated technical competency, more exposure to the subject matter and convinced to adopt the eco-friendly technologies in the farms.

**Institutional support and adoption**

In the present study, the relationship between the institutional support and adoption of the respondents was significant. This implied that, the institutional support had played a significant role in adoption level of farmers regarding recommended practices. The probable reason might be that the FFS participants might have come across new ideas relating to eco-friendly technologies, when they participated in the activities of institutions like co-operative societies, gram panchayath, KVK, SAU, ATMA and *padasekhara samithis* which might have influenced them to adopt eco-friendly technologies.

**Group interaction and adoption**

Group interaction had a significant relationship with adoption. The major reason for this positive correlation might be the respondents in FFS had good

access to information through various mechanisms, such as extension agents, trainings, and mass media. Learning has been acknowledged, as another key source of information for farmers, and one that is fundamental for promoting adoption under uncertain conditions, because it helps to modify the perceived risk of innovations. The respondents in FFS get involved in diverse learning processes, either by experimenting in their own plots, before full adoption (learning by doing) or by actively or passively taking advantage of the experiences and performance of neighbors, friends, and relatives who have experimented with the innovation influences the adoption.

**Knowledge and adoption**

There existed a positive and significant relation between knowledge and adoption. Adequate knowledge of any improved practice is a pre-requisite for its adoption. Research studies have established that knowledge of an innovation would lead to its eventual adoption. The major reason for this might be that majority of the respondents had medium to high level of knowledge which might have influenced them to adopt eco-friendly technologies.

### 4.7 Constraints encountered in adoption of ecofriendly technologies

With regards to constraints encountered in adoption of eco-friendly farm technologies furnished in the Table 18 reveals that 'low marketability and inadequate price to the produce' was perceived as major constraint and ranked I with majority of the respondents in FFS (85.00), followed by complexity in technology (82.00), non-availability of inputs (78.00), lack of knowledge and skill for determining ETL (76.00), low practicability (68.00), lack of community participation (54.00), lack of skill (46.00) and adulteration of inputs (44.00).

"Low marketability and adequate price" of the product was perceived as the major constraint and ranked first in adoption of eco-friendly technologies. The major reason might be that there was no separate marketing channel and premium support price for the eco-friendly cultivated rice, as everything is procured by

Civil Supplies Department in the State made the farmers for not to adopt or discontinued technologies.

**Table 18 Ranking of the constraints in adoption N=100**

| Sl. No | Constraint | Frequency | Rank |
|---|---|---|---|
| 1. | Low marketability and inadequate price to the produce | 85 | I |
| 2. | Complexity in technology | 82 | II |
| 3. | Non–availability of inputs | 78 | III |
| 4. | Lack of knowledge and skill for determining ETL | 76 | 1V |
| 5. | Low practicability | 68 | V |
| 6. | Lack of community participation | 54 | VI |
| 7. | Lack of skill | 46 | VII |
| 8. | Adulteration of inputs | 44 | VIII |

**Source: Primary data.**

Complexity of technology" was perceived as one of the major constraints in adoption of eco-friendly farm technologies in rice and was ranked second by the rice farmers. Use of *Trichogramma* cards, seedling root dip with *Trichoderma* and *Pseudomonas,* foliar spray with *Beauveria,* Pheromone traps and PGPR were the major technologies being not adopted or discontinued by the rice farmers, because of its complexity nature perceived by farmers in adopting those technologies.

"Non-availability of inputs" was perceived as the one of the major constraint in adoption and was ranked three by the rice farmers. *Trichogramma*, Pheromone traps, Light traps and PGPR were the major technologies being not adopted or discontinued by the rice farmers due to non-availability of critical inputs.

"Lack of knowledge and skill for determining ETL levels" were perceived as one of the major constraint's in adoption and was ranked fourth by the rice farmers. Pheromone traps and Light traps were the major technologies being not adopted or discontinued due to the difficulty in remembering practical approach of ETL levels for each and every pest.

"Low practicability" was perceived as one of the major constraint in adoption of eco-friendly farm technologies in rice and was ranked fifth by the rice farmers. Pheromone traps, seedling root dip with *Trichoderma* and *Pseudomonas*, *Trichogramma*, foliar spray with *Beauveria* and Light traps were the major technologies being not adopted or discontinued by the rice farmers because of low practicability of those technologies at the contingent situation.

"Community participation" was perceived as minor constraint in adoption of eco-friendly farm technologies in rice cultivation and was ranked sixth by rice farmers, because all these practices should require co-operation and participation from neighboring farmers for achieving good results in compact area. Lack of community participation made slow down the process of diffusion.

"Lack of skill" was reported as the minor constraint in adoption of eco-friendly farm technologies in rice and was ranked seventh by the rice farmers. *Trichogramma*, Pheromone traps, seed treatment and PGPR were the major technologies being not adopted or discontinued by the rice farmers because of lack of skill perceived by the farmers in handling those technologies. The reason might be that, these technologies involve more of ability to carry out the technology for its better results.

"Adulteration of the inputs" was expressed as minor constraint in adoption of eco-friendly farm technologies and was ranked eighth by rice farmers. Neem cake, *Pseudomonas* and *Trichoderma* application were the major technologies

being not adopted or discontinued by the rice farmers because of lack of good quality inputs with outlets reduces the effectiveness of the technology.

### 4.8 Suggestions to enhance adoption of eco-friendly technologies

Based on the critical analysis of different constraints in adoption of eco-friendly farm technologies in rice, extension strategy is proposed to overcome the constraints for effective adoption of IPM technologies in rice.

**Imparting knowledge:** For the technologies like *Trichogramma*, Pheromone traps, light traps, dipping of nursery bundles in *Pseudomonas* , foliar spray of *Beauveria* , application of PGPR and for estimation of ETL levels the appropriate knowledge is the major input needs to be imparted, so as to have better transfer of technology leading to better adoption of the technologies. Hence, the extension activities like training programmes supplemented with farm literature in local language to be emphasized for these technologies.

**Imparting skills:** For the technologies like *Trichogramma*, Pheromone traps, seed treatment and application of PGPR which require more of doing ability, as the effectiveness of the technology depends on how qualitatively, the operation will be carried out by the person. Hence these technologies require more of skills to take up in an effective way so as to attain better results. More number of method demonstrations need to be conducted specifically to these technologies supplemented with the extension literature.

**Creating awareness:** For the technologies like application of PGPR to enhance fertilizer use efficiency, *Trichogramma*, *Beauveria* , Pheromone traps and Light traps there is a need for efficient utilization of mass media such as Radio, TV, newspaper for creating awareness on the existing technologies and their impact of crop production need to be explained. Hence the priority should be given for

creating awareness by utilizing different mass media and group and personal contacts.

**Input availability:** The technologies like *Trichogramma*, Pheromone traps, light traps, PGPR, *Beauveria* and bio pesticides. The major limitations of these technologies were that the critical inputs for these technologies, not been properly and timely available in the market. Hence such critical inputs need to be made available to the farmers.

**Subsidized supply:** The technologies like neem based chemicals, Pheromone traps, *Trichogramma* cards; PGPR and *Beauveria* were somewhat costly. Being small & marginal farmers, they could not be afford to buy such inputs and those technologies not been adopted by the farmers. Hence such critical inputs should be supplied at subsidized rates or can be supplied at fee of cost so that the adoption of technologies can be adopted.

**Technology assessment and refinement:** The technologies like Tricho cards, dipping of nursery bundles in bio control agents, Pheromone traps, application of right chemical with right dosage and method, application of PGPR , light traps may require further simplification at the field level. Because of its complexity, labour intensity and low practicability in adoption the farmers have ignored such technologies. Hence these technologies should be further refined in such a way that they are easy to adopt, involves less labour and also have more practicability.

**Credit availability**: Lack of money is the major constraint for the farmer. Because of lack of money, farmers could not be able to take up timely farm operations. Irrespective of size of land holding either own or leased, farmers need to be provided with timely credit for taking up farm operations. This facilitates in adoption of not only eco-friendly technologies, but also the other technologies which are useful for better productivity.

**Input quality standards:** The technologies like neem based chemicals; bio control agents, dipping of nursery bundles in solution of *Pseudomonas, Trichoderma* and foliar application of *Beauveria* require strict vigilance and inspection to maintain its quality standards. Hence, necessary steps to be initiated in that dimension and see that farmers should get quality inputs.

**Price of the product:** An exclusive price policy had to be formulated for the produce of eco-friendly farm technologies by the government. Promotion of Farmer Producer Companies for the processing and value addition of eco-friendly products had to be done for getting remunerative price to the farmers which enhances adoption for large scale expansion of eco-friendly farming in rice.


Summary

## 5. Summary

The modern agriculture has been successful in meeting the increased food needs of growing population. But, the problem associated with it are high cost of inorganic chemical fertilizers and plant protection chemicals, stagnated yield levels in the recent years and the mounting health and environmental hazards have forced many farmers and scientists to focus attention on ecologically sound, viable and sustainable farming. In order to mitigate these health hazards and bring out natural balance and protection of ecosystem, organic movement has started in several parts of the world, in which no chemical fertilizers and plant protection chemicals are used in the cultivation of field crops, vegetables and fruits. It is ascertained that the indiscriminate use of agro-chemicals and pesticides cause adverse changes in the ecological balance. This will call for re-orientation towards eco-friendly farming as a remedial measure.

Research in the field of agriculture has identified several environmental friendly technologies, of which mention can be made about eco-farming, eco-friendly pest management and eco-friendly nutrient management. The eco-friendly farming utilizes most efficiently the traditional practices of crop rotations with legumes, application of adequate organic matter to sustain, retain and release soil moisture, nutrient to match crop needs, use of bio fertilizers and bio pesticides, bio control agents for control of pests and diseases. There were hardly few research studies, which have attempted to investigate the impact of eco-friendly technologies.

Farmer's Field School is a non-formal; learner centred educational process and promising extension method for popularising eco-friendly farm practices as most of the practices are skill based so it can be disseminated through FFS. KVK is served as an institutional support system helping in large scale dissemination of eco-friendly farming practices among the farmers.

There are various factors influencing stakeholders of rice farming in the adoption of eco-friendly farm technologies. The role played by these factors is very significant in view of eco-system upkeep. With the above considerations the present study entitled "Impact of eco-friendly technologies in rice cultivation promoted through Farmers' Field Schools (FFS)" was conceived with the following **objectives**:

- To assess the impact of eco-friendly farm technologies in rice disseminated through FFS approach
- To identify the factors influencing the farmer's adoption behaviour of eco-friendly farm technologies in rice
- To elucidate the constraints encountered by the farmers on adoption and prescribe suggestions

**Methodology**

The study was conducted in the year 2014-15 in Palakkad district of Kerala state. A list of respondents participated in eco-friendly farm technologies in rice promoted through Farmers Field School were obtained from the Programme Coordinator of KVK Palakkad. Five Farmers Field Schools were selected based on the expert opinion. From that 20 farmers were selected from each FFS and thus the total sample size constituted to 100. A list of the eco-friendly farm technologies in rice promoted through Farmers Field School was also obtained from the Programme Coordinator of KVK Pattambi.

Ex-post facto research design and simple random sampling method were adopted for the study. The dependent variables studied were knowledge of respondents on eco-friendly technologies, adoption of eco-friendly technologies and their perceived impact of eco-friendly technologies measured in four dimensions viz., environmental, economical, technological and social impact based on the indicators selected by judges rating.

Scales developed by earlier researchers and exclusive procedures developed for the study were used to measure independent variables of the study. A structured pre-tested interview schedule was used to collect data from respondents in FFS by personal interview method. The statistical tools used were, percentages, correlation and Kruskal Wallis H test.

**Major findings of the study are as follows**

- Regarding the personal profile of the respondents in FFS more than half of them (53 %) were middle aged, all of them (100 %) educated above primary level, nearly half of the respondents (45%) belonged to small land holdings category (1.00-1.99 ha), three-fourth of the respondents(75 %) having medium level of farming experience, majority of them with medium level of income (80 %), nearly two-third of the respondents (62 %) moderately used internally available resources, 60 per cent with medium level innovativeness, 68 per cent with medium level risk orientation, 62 per cent with medium level scientific orientation, 68 per cent with medium level extension participation, 78 per cent with medium level mass media utilization, 65 per cent with medium level of information sharing, 65 per cent with moderate level institutional support and 70 per cent in the high category with respect to trainings attended.

- With respect to group formation, group cohesiveness and group interaction based on the analysis of Kruskal Wallis test, there were statistically significant differences noticed among the various FFS under study.

- With respect to perception of farmers of FFS on eco-friendly technologies *Pseudomonas* was ranked first based on the highly positiveness of the attributes, followed by neem based pesticides and bio pesticides, *Trichogramma* cards, *Trichoderma*, pheromone traps, light traps, *Beauveria* and PGPR.

- The results revealed that 61 per cent of the respondents had medium knowledge level on eco-friendly farm technologies with Mean Score Index (MSI) of 66.54. Out of the practices identified, application of *Pseudomonas* was ranked first with MSI of 70.83 followed by application of *Trichoderma* (67.50), application of neem based pesticides and bio pesticides (64.33), use of light traps (62.50), use of *Trichogramma* cards (61.75), use of pheromone traps (59.50), application of PGPR (30.00) and use of *Beauveria* (29.00).

- Majority of the respondents reported medium level of adoption of eco-friendly farm technologies (70%), in which application of *Pseudomonas* was reported by 82 per cent, followed by *Trichoderma* (76%), and *Trichogramma* cards (76%), pheromone traps (72%), neem pesticides and bio pesticides (72%), light traps (49%) application of *Beauveria* (31%) and PGPR (29%).

- With regard to perceived environmental impact, increased knowledge about soil testing was ranked first with a mean score of 82.66 followed by favourable attitude towards conservation of natural enemies (72.33) and knowledge on toxicity of pesticides (59.33). In case of economic impact, decrease in the use of labour ranked first with a mean score of 93.66 followed by decrease in cost of cultivation (79.66), increase in income level of farmers (77.66), change in the price of the product (33.66) and improved marketability of the produce (33.66).

- With respect to technological impact, reduction in consumption of pesticides was ranked first with a mean score of 76.66 followed by improved knowledge about IPM/INM (74.66), orientation towards improved crop management practices (72.33), and shift towards conservation of environment (66.00). With regard to social impact, increase in sharing of experiences and key learnings were ranked first with a mean score of 86.66, followed by increase

in social contacts (80.66), increased participation in training (79.66) and joint responsibility in resource conservation (65.33).

- Correlation of the profile characteristics with knowledge and adoption shows that education, innovativeness, scientific orientation, extension participation, institutional support, mass media utilization, number of trainings attended and group interaction exhibited positive and significant relationship with knowledge and adoption of eco-friendly farm technologies. On the other hand, characteristics like age, annual income, land holding, farming experience, and group cohesiveness had non-significant relationship with the knowledge and adoption of eco-friendly farm technologies.

- The major constraints encountered in adoption were low marketability, inadequate price, complexity of technology, non-availability of inputs, lack of knowledge and skill, low applicability, community participation and adulteration of inputs. The constraints could be overcome by imparting knowledge and skills, creating awareness, subsidizing supply of inputs at right time, technology assessment and refinement and ensuring adequate price.

**Implications of the study**

The following implications are made based on the important findings of the present study

- The teacher made test developed for measuring knowledge of respondent's on eco-friendly technologies was tested for its reliability, validity and its internal consistency. Therefore, the same could be used elsewhere for measuring the knowledge of eco-friendly technologies in general and eco-friendly management areas in particular


- The findings of the study indicated that two-third of the respondents had medium level of knowledge about eco-friendly technologies. Hence, it is imperative that the Integrated Pest Management Centre, State Department of Agriculture and State Agricultural University should make convergent and concrete efforts to provide the required knowledge about environmental hazards caused by excess use of agriculture chemicals. Hence to create awareness in these practices, there is a need to organize effective extension activities like regular training programmes, demonstration, campaigns and regular farmers' meetings by the State Department of Agriculture and other development departments concerned

- Study revealed that nearly three-fourth of the respondents were in medium level of adoption category and showed low adoption rates in case of Bauveria, PGPR and light traps Hence, there is an urgent need to raise the level of adoption of these practices in order to reduce the quantum of environmental hazards caused by agriculture chemicals, development of pest resistance, pollution etc., in the long run and also to provide the required facilities by the State Department of Agriculture, besides providing more technical guidance through conducting demonstration in each village and follow-up approach

- FFS proved that use of low cost technologies such as seed treatment, application of bio control agents and bio pesticides in paddy cultivation is successful. Hence, extension agencies should give more emphasis to low cost and local resource based technology for crop management

- FFS had shown positive impact on reducing the consumption of chemical fertilizers and pesticides, increasing the yield and income levels and decreasing the cost of cultivation. In the light of these findings, the Department of Agriculture should plan for more number of FFS on other crops and extend FFS approach to other areas of the state as well.

- Price and marketability of the produce was perceived as major constraint in adoption, hence an exclusive price policy and marketing channel has to be formulated for procurement of eco-friendly farm products at remunerative price

- Majority of the farmer respondents had suggested ensuring quality control measures for pesticides. Hence, it is necessary on the part of the manufacturing companies and their dealers to make only quality grade chemicals available at their stores. The Government must take necessary measures in this regard to ensure quality of agricultural chemicals

**Future line of work**

- The comparative study with respect to knowledge and adoption of eco-friendly technologies could be taken up with non-FFS participants to evaluate the intervention

- A research study on pesticides use and its usage pattern on different crops can also be taken

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# Appendices

**Appendix-I**

**Interview schedule**

**Impact of eco -friendly farm technologies in rice promoted through Farmers Field School (FFS)**

**A. General information:**

1) Name of the respondent:

2) Village:

3) District:

**B. Personal Information**

1. Age: _____years

2. Education:

Illiterate / Functionally Literate / Primary /Secondary /High school/ Collegiate

3. Farming Experience _____ Years

**C. Land holdings**

Area under paddy cultivation _____

**Land Utilization Pattern**

| Land type | Virippu | | | Mundakan | | | Punja | | |
|---|---|---|---|---|---|---|---|---|---|
| | Crop | Area | Irrigated | Crop | Area | Irrigated | Crop | Area | Irrigated |
| Wet land | | | | | | | | | |
| Garden land | | | | | | | | | |

**D. Use of internally available resources**

| Source | Extent of usage | | |
|---|---|---|---|
| | Regularly | Occasionally | Never |
| FYM | | | |
| Vermi compost | | | |
| Goat/ sheep/ poultry manure | | | |
| Bio fertilizers | | | |
| Own seeds | | | |

| | | | |
|---|---|---|---|
| Family labour | | | |
| Biopesticides | | | |
| Own machinery | | | |

**E. Annual income (in Rs.)**

1. From Agricultural sources :
2. From other sources ,if any (specify):.

**F. Psychological characteristics**

**I. Innovativeness**

**Please indicate your response for the following statements**

| **Statements** | **ML** | **LL** |
|---|---|---|
| A) 1. I try to keep myself up to date with information on new farm practices, but that' does not mean that I tryout all the new methods on my farm. | | |
| 2. I feel restless till I tryout a new farm practices, I have heard about | | |
| 3. The researchers talk of many new farm practices there days, but who knows if they are better than the old ones. | | |
| B) 4. From time to time I have heard of several new farm practices and I have tried out most of them in the last few years. | | |

| | | |
|---|---|---|
| 5. I usually want to see, what results my neighbors obtain before I tryout the new farm practice | | |
| 6. Somehow I believe that a traditional ways of farming are the best. | | |
| C) 7. I am cautious about trying a new practice | | |
| 8. After all our forefathers were wise in their farming practices and I don't see any reason for changing these old methods | | |
| 9.Often new farm practices are not successful, however, if they are promising I would surely like to adopt them | | |

Note: MS: Most Like LS: Least Like

**II. Risk orientation**

Please indicate the extent of agreement or disagreement with the following statements

| Statements | SA | A | DA | SDA |
|---|---|---|---|---|
| 1. I feel risk taking is an important quality of a farmer to progress. | | | | |
| 2. I prefer growing larger number of crops to provide insurance against risk involved in cultivating mono crops | | | | |
| 3. I take greater risk in farming than my fellow farmers to do financially better | | | | |
| 4. I take chance in making a high profit in farming by adopting Innovations without caring for their consequences. | | | | |
| 5. Forecasting events and planning based on past experience is a must in farming | | | | |

Note: SA: Strongly agree, A: Agree, DA: Disagree, SDA: Strongly Disagree

**III. Scientific orientation**

**Please indicate the extent of agreement or disagreement with the following statements**

| Statements | SA | A | DA | SDA |
|---|---|---|---|---|
| 1. New methods of farming give better results to farmer than the old methods. | | | | |
| **2. The way our forefathers practiced farming is still the best way even today** | | | | |
| 3. Even a farmer with lot of experience should are use new methods of cultivation | | | | |
| 4. Though it takes time for a farmer to learn ecofriendly methods in rice growing it is worth efforts | | | | |
| 5. A good farmer experiments with new ideas in farming enterprises | | | | |
| 6. Chemical methods of farming have to be changed in order to maintain a sustainable production of paddy | | | | |

Note: SA: Strongly agree, A: Agree, DA: Disagree, SDA: Strongly Disagree

**G. Group characteristics**

**I. Group formation**

**a. Forming** Please indicate the extent of agreement or disagreement with the following statements

| Sl. No | Statement | SA | A | DA | SDA |
|---|---|---|---|---|---|
| 1. | Members having same attitude and characteristics come together to form a group | | | | |
| 2. | When there is anxiety we depend on the leaders to find out the nature of situation | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 3. | Members depend on other members or preexisting standards when a team is to be formed | | | | |
| 4. | Members gain familiarity with each other and with the groups task at the initial stage of team formation | | | | |
| 5. | Members share professional information with each other and start to know and accept one another and begin turning their attention towards group tasks | | | | |
| 6. | Tensions and anxieties in group are reduced as fellow workers are trusted | | | | |

Note: SA: Strongly agree, A: Agree, UD: Undecided, SDA: Strongly Disagree

**b. Storming**

| Sl. No. | Statement | SA | A | DA | SDA |
|---|---|---|---|---|---|
| 1. | I compete for our ideas to get into consideration | | | | |
| 2. | Team members discuss issues such as what problems they are really to solve | | | | |
| 3. | I am interfered by the external pressure and tensions rising between individuals as they assert themselves | | | | |
| 4. | I tolerate when an unpleasant situation arise in our group | | | | |
| 5. | Group members open out to each other and confront each other's ideas and perspective | | | | |
| 6. | I face differences and disagreement in the group and members are not cooperative in nature | | | | |

Note: SA: Strongly agree, A: Agree, DA: Disagree, SDA: Strongly Disagree

**c. Norming**

Please indicate the extent of agreement or disagreement with the following statements

| Sl. No. | Statement | SA | A | DA | SDA |
|---|---|---|---|---|---|
| 1. | Group cohesion is developed when we resolve conflicts | | | | |
| 2. | Members express standard mode of behavior | | | | |
| 3. | I express our feelings and views openly | | | | |
| 4. | Members show mutual support and cooperation when a task is to be performed | | | | |
| 5. | Group reflects close relationships and cohesiveness and represents a strong sense of group identity | | | | |
| 6. | Members compromise and show harmony as they share attitudes and common values | | | | |

Note: SA: Strongly agree, A: Agree, DA: Disagree, SDA: Strongly Disagree

**d. Performing**

Please indicate the extent of agreement or disagreement with the following statements

| Sl. No. | Statement | SA | A | DA | SDA |
|---|---|---|---|---|---|
| 1. | Group members become independent when their task is clear | | | | |
| 2. | All the group members are supportive and they help in making most of the necessary decisions | | | | |
| 3. | Members have greater freedom to communicate and they are more informal | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 4. | Members tend to feel a sense of shared responsibility for group goals | | | | |
| 5. | Each members roles are flexible and functional in group | | | | |
| 6. | Members make a constructive attempts to complete tasks and they support for effective work | | | | |

Note: SA: Strongly agree, A: Agree, DA: Disagree, SDA: Strongly Disagree

**II. Group interaction**

Please indicate the extent of agreement or disagreement with the following statements

| Sl. No. | Statements | SA | A | DA | SDA |
|---|---|---|---|---|---|
| 1 | The members of my group are friendly towards each other | | | | |
| 2 | Agrees with each other | | | | |
| 3 | Gives opinion freely | | | | |
| 4 | Ask for information freely | | | | |
| 5 | Gives information freely | | | | |
| 6 | Ask for opinion freely | | | | |
| 7 | Gives suggestions freely | | | | |
| 8 | Ask for suggestion freely | | | | |
| 9 | Disagree with each other | | | | |
| 10 | Seems unfriendly | | | | |

Note: SA: Strongly agree, A: Agree, DA: Disagree, SDA: Strongly Disagree

**III. Group cohesiveness**

Indicate your response to the following statements in appropriate column

| Sl. No | Statements | Always | Most of the time | Some times | Rarely | Never |
|---|---|---|---|---|---|---|
| **1** | **Contradictions in opinions are common during the time of group decision making** | | | | | |
| **2** | **Since the differences in my opinion exceeds its limits it becomes difficult to arrive at wise decisions** | | | | | |
| 3 | All the members of the group use to take the part in various group activities | | | | | |
| 4 | When the plans are being implemented all the group members feel alike and equally important | | | | | |
| 5 | When the group activities are being appraised all the members of feel alike and equally important | | | | | |
| 6 | During the evaluation of various activities of the group members used to have a common opinion and common conclusion | | | | | |

**H. Extension participation**

**Please indicate the extent of participation in extension activity**

| Sl. No. | Extension activities | Extent of participation | | |
|---|---|---|---|---|
| | | Regular | Occasional | Never |
| 1 | Group discussions | | | |
| 3 | Demonstrations | | | |
| 4 | Researchable issues meeting | | | |
| 5 | Kissan ghoshti | | | |
| 6 | Field visits | | | |
| 7 | Field days | | | |
| 8 | Lectures | | | |
| 9 | Educational tours | | | |
| 10 | Others, if any (specify) | | | |

**I. Attending Trainings**

| Organised by | Extent of participation | | |
|---|---|---|---|
| | Regularly | Occasionally | Never |
| KVK | | | |
| ATMA | | | |
| Krishi bhavans | | | |
| LEADS | | | |
| RARS Pattambi | | | |
| Others, if any specify | | | |

**J. Mass media utilization**

| Sl. No. | Media | Extent of reading / listening / viewing | | |
|---|---|---|---|---|
| | | Regular | Occasional | Never |
| 1 | Radio | | | |
| 2 | News paper | | | |
| 3 | Farm magazines | | | |
| 4 | Television | | | |
| 5 | Any other if (specify) | | | |

**K. Information sharing**

| Sl. No. | Type of information | Frequency of sharing | | |
|---|---|---|---|---|
| | | Regularly | Occasionally | Never |
| 1. | Information about rural development programmes and subsidies | | | |
| 2 | Weather information | | | |
| 3 | Marketing information | | | |
| 4 | Latest packages of practices | | | |
| 5 | Input prices and availability | | | |
| 6 | Others, if any( specify) | | | |

**L. Attributes of technology**

| Sl. No. | Technology | Attributes of technology | | | | |
|---|---|---|---|---|---|---|
| | | R | CO | C/F | T | O |
| **1.** | Use of *Pseudomonas* | | | | | |
| **2.** | Use of *Trichoderma* | | | | | |
| **3.** | Use of pheromone traps | | | | | |
| **4.** | Use of light traps | | | | | |
| **5.** | Use of Bauveria | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **6.** | Use of Trichogarmma cards | | | | | |
| **7.** | Use of bio pesticides | | | | | |
| **8.** | Use of PGPR-I and PGPR-II | | | | | |

R-Relative Advantage, CO- Compatibility C-Complexity/Feasibility T-Trialability O-Observability

**M. Institutional support**

| Sl. No. | Institution | Extent of support | | |
|---|---|---|---|---|
| | | High | Medium | Low |
| 1 | KVK | | | |
| 2 | Krishi bhavan | | | |
| 3 | State Horticultural Mission (SHM) | | | |
| 4 | NGOs | | | |
| 5 | ATMA | | | |
| 6 | State Agricultural Universities | | | |
| 7 | Research stations | | | |

**N. Adoption**

| Sl. No. | Technology | Adopted | Not adopted | Reasons for adoption | Reasons for non-adoption | Suggestions |
|---|---|---|---|---|---|---|
| 1. | Use of *Pseudomonas* | | | | | |
| 2. | Use of *Trichoderma* | | | | | |
| 3. | Use of pheromone traps | | | | | |
| 4. | Use of light traps | | | | | |
| 5. | Use of Bauveria | | | | | |
| 6. | Use of Trichogarmma cards | | | | | |
| 7. | Use of PGPR-I and PGPR-II | | | | | |
| 8. | Use of Bio pesticides | | | | | |

# Cost of cultivation

Season:

Variety:

Area:

Main product

By product:

Total yield:

| Sl no | Operation | Quantity | Rate / unit | Bullock power | | Machine power | | Human power | | Total labour cost |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | No of pairs | Cost | No of hours | Cost / hr | Male | Female | |
| **1.** | **Nursery** | | | | | | | | | |
| | Field preparation | | | | | | | | | |
| | Seed treatment | | | | | | | | | |
| | Seeds and sowing | | | | | | | | | |
| | Fertilizers | | | | | | | | | |
| | Plant protection chemicals | | | | | | | | | |
| | Weeding | | | | | | | | | |
| | Irrigation | | | | | | | | | |
| **2.** | **Main field** | | | | | | | | | |
| | Application of FYM | | | | | | | | | |
| | Ploughing | | | | | | | | | |
| | Puddling | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Transplanting | | | | | | | | | |
| | Fertilizers | | | | | | | | | |
| | Plant protection chemicals | | | | | | | | | |
| | Weeding | | | | | | | | | |
| | Irrigation | | | | | | | | | |
| | Harvesting and threshing | | | | | | | | | |
| | Transportation and marketing charges | | | | | | | | | |
| | Other charges if any specify | | | | | | | | | |
| | Total cost of cultivation | | | | | | | | | |

**Environmental impact**

| Sl. No. | Indicator | Perceived Impact | | | Remarks |
|---|---|---|---|---|---|
| | | Greater extent | Certain Extent | Lesser Extent | |
| 1. | Change in the usage of fertilizer dose | | | | |
| 2. | Change in the use of quantity of pesticides | | | | |
| 3. | Awareness about Crop rotation practices | | | | |
| 4. | Attitude towards conservation of natural enemies | | | | |
| 5. | Knowledge on toxicity of pesticides | | | | |
| 6. | Knowledge about soil testing | | | | |
| 7. | Awareness on usage of water judiciously | | | | |

**Economic Impact**

| Sl. No. | Indicator | Perceived Impact | | | Remarks |
|---|---|---|---|---|---|
| | | Greater extent | Certain Extent | Lesser Extent | |
| 1. | Change in income levels of farmer | | | | |
| 2. | Change in yield levels | | | | |
| 3. | Change in cost of cultivation | | | | |
| 4. | Increased opportunity for marketing of farm produce | | | | |
| 5. | Marketability of the produce | | | | |
| 6. | Change in the price of the product | | | | |
| 7. | Change in input costs | | | | |
| 8. | Change in the usage of labour | | | | |

**Technical Impact**

| Sl. No. | Indicator | Perceived Impact | | | Remarks |
|---|---|---|---|---|---|
| | | Greater extent | Certain Extent | Lesser Extent | |
| 1. | Change in the usage of inputs | | | | |
| 2. | Change in consumption of pesticides | | | | |
| 3. | Change in improved crop management practices | | | | |
| 4. | Shift towards mechanization | | | | |
| 5. | Shift towards conservation of environment | | | | |
| 6. | Shift toward the use of internally available resources | | | | |
| 7. | Improved knowledge about IPM/INM | | | | |

**Social impact**

| Sl. No. | Indicator | Perceived Impact | | | Remarks |
|---|---|---|---|---|---|
| | | Greater extent | Certain Extent | Lesser Extent | |
| 1. | Change in Farmers to farmers communication | | | | |
| 2. | Resource conservation knowledge | | | | |
| 3. | Extent of participation in training | | | | |
| 4. | Increase in social contacts | | | | |
| 5. | Sharing of experiences and key learning with other farmers | | | | |
| 6. | Becoming master trainees | | | | |
| 7. | Developing group dynamics | | | | |

**Impact of ecofriendly farm technologies in rice promoted through Farmers Filed Schools (FFS)**

## കാർഷിക വിജ്ഞാന പരീക്ഷ

1. നെല്ലിലെ ബ്ലാസ്റ്റ് രോഗം നിയന്ത്രിക്കാൻ ഉപയോഗിക്കുന്ന ജൈവാണുക്കൾ? ( )
   a) ട്രൈക്കോഡർമ്മ b) ട്രൈക്കോഗ്രാമ c) പിത്തിയം ഒലിഗാൻഡ്യം
2. ട്രൈക്കോഡർമ്മ ഉപയോഗിക്കുന്നത് എങ്ങനെ? ( )
   a) അടിവളം b) വിത്ത് പരിചരണം c) തളിക്കൽ (സ്പ്രേ ചെയ്യൽ)
   d) പോക്കറ്റ് പ്ലെയ്സ്മെന്റ് (പ്രത്യേക സ്ഥലങ്ങളിൽ ഇട്ടുകൊടുക്കൽ)
3. വിത്ത് പരിചരണത്തിന് ആവശ്യമായ ട്രൈക്കോഡർമയുടെ അളവ് എത്രയാണ്? .....
4. തൈകളുടെ വേര് മുക്കിവെക്കുന്നതിനായി വേണ്ടിവരുന്ന ട്രൈക്കോഡർമയുടെ അളവ്? ( )
   a) 40 ഗ്രാം/ലി. b) 30 ഗ്രാം/ലി. c) 20 ഗ്രാം/ലി. d) 10 ഗ്രാം/ലി.
5. ഏതു രോഗത്തിന്റെ നിയന്ത്രണത്തിനാണ് 'സ്യൂഡോമോണാസ്' ഫ്ളൂറസൻസ് ഉപയോഗിക്കുന്നത്? ( )
   a) ഇലപ്പുള്ളി രോഗം b) പോള അഴുകൽ c) ബ്ലാസ്റ്റ് രോഗം d) ബാക്ടീരിയൽ വാട്ടം
6. സ്യൂഡോമോണസ് ഉപയോഗിക്കുന്നത് എങ്ങനെയാണ്? ( )
   a) വിത്ത് പരിചരണം b) തളിക്കൽ c) വേര് മുക്കൽ d) മുകളിൽ പറഞ്ഞവയെല്ലാം
7. വിത്ത് പരിചരണത്തിനായി ഉപയോഗിക്കുന്ന സ്യൂഡോമോണസ്സിന്റെ അളവ്? .....
8. തൈകളുടെ വേര് മുക്കിവെക്കുന്നതിനായി ഉപയോഗിക്കുന്ന സ്യൂഡമോണസ് ഫ്ളൂറസൻസിന്റെ അളവ്? (
   a) 200ഗ്രാം/750മി.ലി. b) 250ഗ്രാം/750മി.ലി. c) 350ഗ്രാം/750മി.ലി. d) 450ഗ്രാം/750മി.ലി.
9. ഇലകളിൽ തളിക്കുന്നതിനായി ഉപയോഗിക്കുന്ന സ്യൂഡോമോണസ് ഫ്ളൂറസൻസിന്റെ അളവ്? ( )
   a) 40 ഗ്രാം/ലി.b) 30 ഗ്രാം/ലി. c) 20 ഗ്രാം/ലി. d) 25 ഗ്രാം/ലി.
10. നെല്ലിന്റെ ഏത് ഘട്ടത്തിലാണ് സ്യൂഡോമോണസ് ഫ്ളൂറസൻസ് ഇലകളിൽ തളിക്കുന്നതിനാ
    ഉപയോഗിക്കുന്നത്? ( )
    a) ഞാറ് പറിച്ച് നട്ട് 25-30 ദിവസത്തിനുള്ളിൽ b) ഞാറ് പറിച്ച് നട്ട് 15-30 ദിവസത്തിനുള്ളിൽ
    c) ഞാറ് പറിച്ച് നട്ട് 20-25 ദിവസത്തിനുള്ളിൽ d) ഞാറ് പറിച്ച് നട്ട് 30-45 ദിവസത്തിനുള്ളിൽ
11. എന്തിനെ നിയന്ത്രിക്കാനാണ് ബ്യൂവേറിയ ഉപയോഗിക്കുന്നത്? ( )
    a) ഇലചുരുട്ടിപുഴു b) ഗാളീച്ച c) മുഞ്ഞ (BPH) d) തണ്ടുതുരപ്പൻ
12. ബ്യൂവേറിയ ഉപയോഗിക്കുന്നതിന്റെ അളവ് ..... ആണ്.
13. ട്രൈക്കോഗ്രാമ കാർഡുകൾ എന്തിന്റെ നിയന്ത്രണത്തിനാണ് ഉപയോഗിക്കുന്നത്? ( )
    a) മുഞ്ഞ b) തണ്ടുതുരപ്പൻ c) ഗാളീച്ച d) ഇലചുരുട്ടിപ്പുഴു
14. ഒരു ഏക്കർ നെൽപ്പാടത്തിൽ എത്ര ട്രൈക്കോ കാർഡുകൾ / കഷണങ്ങൾ ഉപയോഗിക്കാം? .....
15. എന്തിനെ ഫലപ്രദമായി നിയന്ത്രിക്കാനാണ് ഫിറമോൺ കെണികൾ ഉപയോഗിക്കുന്നത്? ( )
    a) ഇലചുരുട്ടിപ്പുഴു b) മുഞ്ഞ c) തണ്ടുതുരപ്പൻ d) കുഴൽപ്പുഴു
16. ഒരു ഏക്കർ നെൽപ്പാടത്തിൽ എത്ര ഫിറമോൺ കെണികളാണ് ഉപയോഗിക്കേണ്ടത്? .....
17. നെൽപ്പാടങ്ങളിൽ ഉപയോഗിക്കുന്ന ഒരു ജൈവവളം? ( )
    a) ഡൈ അമോണിയം ഫോസ്ഫേറ്റ് b) യൂറിയ c) മുൻസിപ്പൽ മാലിന്യം d) കാലിവളം
18. നെൽപാടങ്ങളിൽ ഉപയോഗിക്കേണ്ട ജൈവവളത്തിന്റെ അളവ് ..... ആണ്.
19. മണ്ണിന്റെ അമ്ലഗുണം കുറയ്ക്കുന്നതിനായി എന്താണ് പ്രയോഗിക്കേണ്ടത്? ( )
    a) കുമ്മായം b) ജിപ്സം c) വേപ്പിൻ പിണ്ണാക്ക് d) കാലിവളം

20. നെൽപ്പാടങ്ങളിൽ ഉപയോഗിക്കേണ്ട കുമ്മായത്തിന്റെ അളവ് ..... ആണ്. (ഹെക്ടറിൽ/ഏക്കറിൽ/ സെന്റിൽ)

21. നെൽകൃഷിക്ക് ഉപയോഗിക്കാവുന്ന ഒരു പച്ചിലവളം. .....

22. നെൽപ്പാടങ്ങളിൽ പൊതുവെ കാണപ്പെടുന്ന ഒരു മിത്രകീടം? .....

23. വേനൽക്കാലത്ത് നെൽപ്പാടങ്ങൾ ഉഴുതുമറിക്കുന്നതെന്തിനാണ്? ( )

a) കീടനശീകരണം b) മണ്ണ് ഉഴുത് മറിക്കുന്നതിന് c) കളനശീകരണം d) a യും c യും

24. നെൽപ്പാടവരമ്പുകൾ ചെത്തി മിനുക്കുകയോ വരമ്പുകളിൽ ചെളിമണ്ണ് പൊത്തുകയോ ചെയ്യുന്നത് എന്തിനാണ്? .....

25. ഏത് സമയത്താണ് ട്രൈക്കോഗ്രാമ കാർഡുകൾ നെൽപ്പാടങ്ങളിൽ സ്ഥാപിക്കേണ്ടത്? .....

26. ട്രൈക്കോഗ്രാമ കാർഡുകൾ പാടങ്ങളിൽ സ്ഥാപിക്കുന്നതിനുള്ള ഇടവേള? ( )

a) 30 ദിവസത്തിനുള്ളിൽ b) 15 ദിവസത്തിനുള്ളിൽ

c) ഒരാഴ്ച ഇടവിട്ട് d) 10 ദിവസത്തിനുള്ളിൽ

27. നെൽപ്പാടങ്ങളിൽ ഉപയോഗിക്കാവുന്ന ജൈവകീടനാശിനി? ( )

a) കിലുക്കാംപെട്ടി b) പൊൻഗാമിയ c) ശീമക്കൊന്ന d) വേപ്പ്

28. താഴെ പറയുന്നവയിൽ ഏതാണ് പ്രകൃതിദത്ത ശത്രു/മിത്ര കീടം? ( )

a) എട്ടുകാലി b) ചിത്രശലഭം c) നിശാശലഭം d) പുൽച്ചാടി

29. നെൽച്ചെടികളുടെ മുകൾഭാഗത്തുകൂടി കയർ വലിച്ചുനീക്കി ഏത് കീടത്തെ നിയന്ത്രിക്കാൻ കഴിയും? ( )

a) തണ്ടുതുരപ്പൻ b) ഇലചുരുട്ടിപ്പുഴു c) ഗാളീച്ച d) ഇലച്ചാടി

30. ബ്യൂവേറിയ എങ്ങനെയാണ് പ്രയോഗിക്കുന്നത്? ( )

a) വേര് മുക്കൽ b) വിത്ത് പരിചരണം c) തളിക്കൽ d) വിതറൽ

31. താഴെ പറയുന്നവയിൽ ഏതിന്റെ പ്രഭാവമാണ് വളം കൂടുതൽ വലിച്ചെടുക്കാൻ ചെടികളെ സഹായിക്കുന്നത്? ( )

a) ട്രൈക്കോഡർമ്മ b) വേപ്പ് c) കാലിവളം d) PGPR

32. വെളിച്ച കെണികൾ (പ്രകാശ കെണികൾ) ഉപയോഗിക്കുന്നത് ഏതു കീടത്തെപ്പറ്റിയുള്ള വിവരം ലഭിക്കാനാണ്? ( )

a) ഇലചുരുട്ടിപ്പുഴു b) തണ്ടുതുരപ്പൻ c) പുൽച്ചാടി d) കുഴൽപുഴു

33. എത്ര അകലത്തിലാണ് ഫിറമോൺ കെണികൾ സ്ഥാപിക്കേണ്ടത്? .....

34. നെൽപ്പാടങ്ങളിൽ എലികൾക്കെതിരെയുള്ള ശത്രു ഏതാണ്? ( )

a) പട്ടി b) പൂച്ച c) പാമ്പ് d) അണ്ണാൻ

27. നെല്ലിലെ രോഗങ്ങൾക്കെതിരെ ഫലപ്രദമായി ഉപയോഗിക്കുന്ന ഒരു സൂക്ഷ്മാണു? ( )

a) സ്ട്രെപ്റ്റോമൈസിസ് b) NPV c) ബാസിലസ്സ്

## Appendix-II

### INTRODUCTORY LETTER TO JUDGES FOR INDICATOR RATING

**KERALA AGRICULTURAL UNIVERSITY**
**College of Horticulture**
**Department of Agricultural Extension**

Dr. Sendilkumar, R.
Associate Professor

Vellanikkara
Date: 6-12-2014

Dear Sir /Madam

Attached with this is the list of impact indicators prepared by my student, Naveen Kumar, G as a part of his M.Sc. (Ag) thesis work. His work entitled **"Impact of eco-friendly farm technologies in rice promoted through Farmers Field Schools (FFS)"** tries to look out the impact created by the technologies in farming community.

I would like to request you to spare a little of your valuable time to go through them and rate them according to their relevance, so as to retrieve the final list of impact indicators to be conducted for research to measure the technological, economic, environmental, and social impact of the technology.

Thank you in advance
With best regards

**Sendilkumar**

**ENVIRONMENTAL IMPACT**

| Sl. No. | Component /indicator | Judges rating | | | Relevancy index |
|---|---|---|---|---|---|
| | | Most relevant | Relevant | Irrelevant | |
| 1. | Contamination of water bodies | | | | 75.33 |
| 2. | Use of erosion control techniques | | | | 62.33 |
| 3. | Safeguarding soil fertility | | | | 70.33 |
| 4. | Knowledge about soil testing | | | | 85.66 |
| 5. | Use of inorganic source of fertilizers | | | | 56.33 |
| 6. | Transition towards ecological agriculture | | | | 80.00 |
| 7. | Reduced insect damage | | | | 55.33 |
| 8. | Decrease in dependency on chemicals | | | | 80.00 |
| 9. | Improvement in crop biodiversity | | | | 73.33 |
| 10. | Use of water conservation methods | | | | 85.33 |
| 11. | Awareness on environmental issues in rice farming | | | | 80.00 |
| 12. | Attitude towards conservation of natural enemies | | | | 84.00 |
| 13. | Awareness about biodiversity | | | | 85.33 |
| 14. | Awareness on climate change | | | | 88.00 |
| 15. | Cropping pattern | | | | 76.00 |

**ECONOMIC IMPACT**

| Sl. No. | Component /indicator | Judges rating | | | Relevancy index |
|---|---|---|---|---|---|
| | | Most relevant | Relevant | Irrelevant | |
| 1. | Increased savings at the end of the season | | | | 68.00 |
| 2. | Reduced expenses / High net income | | | | 89.33 |
| 3. | Change in cost of cultivation | | | | 86.66 |
| 4. | Increased opportunity for marketing of farm produce | | | | 85.33 |
| 5. | Increased/ decreased production | | | | 85.33 |
| 6. | Increased / decreased productivity | | | | 62.33 |
| 7. | Good /poor marketability for the produce | | | | 67.33 |
| 8. | New avenues for collective marketing | | | | 77.33 |
| 9. | Input costs | | | | 88.00 |
| 10. | Increased/ decreased usage of labour | | | | 90.00 |
| 11. | Cost –benefit ratio | | | | 76.00 |
| 12. | Change in house hold expenditure | | | | 77.33 |

**TECHNOLOGICAL IMPACT**

| Sl. No. | Component /indicator | Judges rating | | | Relevancy index |
|---|---|---|---|---|---|
| | | Most relevant | Relevant | Irrelevant | |
| 1. | Usage of low inputs | | | | 63.33 |
| 2. | Shifts towards IPM/INM/IWM | | | | 96.00 |
| 3. | Increased resource use efficiency | | | | 52.00 |
| 4. | Improved crop management | | | | 85.33 |
| 5. | Decrease in use of pesticides | | | | 92.00 |
| 6. | Use of locally available internal resources like FYM, green manure , vermicomposting | | | | 85.33 |
| 7. | Dependency on external resources like fertilizers | | | | 64.66 |
| 8. | Knowledge about toxicity | | | | 87.33 |
| 9. | Use of resistant varieties | | | | 68.00 |
| 10. | Radical shift from inorganic to organic inputs | | | | 60.00 |
| 11. | Identifying natural enemies ‘ | | | | 60.66 |
| 12. | Improved knowledge about IPM/INM | | | | 84.00 |

**SOCIAL IMPACT**

| Sl. No. | Component /indicator | Judges rating | | | Relevancy index |
|---|---|---|---|---|---|
| | | Most relevant | Relevant | Irrelevant | |
| 1. | Change in Farmers to farmers communication | | | | 84.00 |
| 2. | Increase / decrease in farmer to researcher communication | | | | 77.33 |
| 3. | Use of family labour | | | | 76.00 |
| 4. | Reduced migration | | | | 68.00 |
| 5. | Increase in social contacts /participation | | | | 88.66 |
| 6. | Developing group dynamics | | | | 88.66 |
| 7. | Assuming new responsibilities | | | | 72.00 |
| 8. | Localiteness and Cosmo politeness | | | | 77.33 |
| 9. | Benefit sharing | | | | 78.66 |
| 10. | Performing multiple tools | | | | 80.00 |
| 11. | Sharing of experiences and key learning with other farmers | | | | 86.00 |
| 12. | Becoming master trainees | | | | 88.00 |
| 13. | Opportunity for learning and doing | | | | 65.33 |
| 14. | Scope for participation in planning monitoring and evaluation | | | | 62.00 |

**Appendix-III**

## Item analysis

| Sl. No. | Item | Difficulty index | Discrimination index |
|---|---|---|---|
| 1. | Bio control agent used for the control of paddy blast is _____( *Trichoderma*) | 80.76* | 0.11* |
| 2. | How do we apply *Trichoderma* ____?(Seed treatment ) | 65.38* | 0.69* |
| 3. | What is the quantity of *Trichoderma* used for seed treatment is _____? (10g/kg seed) | 23.07* | 0.34* |
| 4. | The quantity of *Trichoderma* used as seedling root dip is____ g/l of water (20g/l ) | 57.69* | 0.11* |
| 5. | *Pseudomonas* is used against for the control of ___? (Bacterial Leaf Blight ) | 34.61* | 0.23* |
| 6. | How can we apply *Pseudomonas*_____? (Seed treatment) | 15.38 | 0.11 |
| 7. | The quantity of *Pseudomonas* used for seed treatment is _____g/kg seed (10 g/kg ) | 19.23 | 0 |
| 8. | What is the quantity of *Pseudomonas* used as root dip of seedlings is _____ | 26.92 | 0 |

| | | | |
|---|---|---|---|
| | g/l of water (250g/750ml) | | |
| 9. | The quantity of *Pseudomonas* used as foliar is_____? g/l of water (20g/l) | 61.53 | -0.11 |
| 10. | Foliar spray of *Pseudomonas* is applied at the age of_____? (30-45 DAT) | 7.69 | 0.11 |
| 11. | *Beauveria* is used for the control of_____? (Leaf roller ) | 34.61 | -0.11 |
| 12. | The quantity of *Beauveria* used _____? (20g/l) | 61.53* | 0.46* |
| 13. | Trichogrammacards are used for the control of_____? (Stem borer ) | 69.23* | 0.34* |
| 14. | How many Tricho cards or pieces are to be placed in an acre of rice fields _____? (5cc/ha) | 61.53* | 0.34* |
| 15. | Pheromone traps are used effectively for the control of_____? (Yellow stem borer) | 61.53* | 0.46* |
| 16. | How many Pheromone traps are to be placed in an acre of rice fields_____ ? ( 8/acre) | 19.23 | -0.11 |
| 17. | Mention one organic manure used in rice fields _____ (FYM) | 96.15 | 0.11 |

| | | | |
|---|---|---|---|
| 18. | What is the quantity of organic manure that has to be applied in rice fields___? (5 tonnes/ha) | 53.84* | 0.11* |
| 19. | What do we apply to the soil when it is acidic_____? (Lime) | 92.30 | 0.23 |
| 20. | What is the quantity of lime that has to be applied to a hectare/acre/cent ___? (600kg/ha) | 38.46* | 0.34* |
| 21. | Name one green-leaf manureused in rice cultivation _____? (Daincha) | 96.15 | 0.11 |
| 22. | Mention any one natural enemy of insects commonly seen in rice fields____?(Spider) | 76.92* | 0.34* |
| 23. | What is the use of summer ploughing in rice field's _____? ( To kill insects) | 80.76* | 0.34* |
| 24. | Why do we plaster and trim the bunds in the rice field's _____? ( To kill grasshopper) | 57.69* | 0.11* |
| 25. | When should be the Trichogramma released in rice fields ____? (30DAT) | 11.53 | -0.23 |
| 26. | What should be the frequency of the release of Trichogramma ____? (7 days interval) | 34.61 | -0.11 |
| 27. | Name a botanical pesticide effectively used in rice___? (Neem) | 80.76* | 0.34* |

| | | | |
|---|---|---|---|
| 28. | Name a natural enemy commonly seen ___?(Damson fly) | 61.53* | 0.11* |
| 29. | What is the insect-pest against which passing of rope is effective in the control of _____? (Leaf folder) | 57.69* | 0.57* |
| 30. | How do we apply Bauveria _____? (Foliar spray) | 76.92* | 0.23* |
| 31. | Which of the following enhances the fertilizer use efficiency in rice ___? (PGPR) | 73.07* | 0.237* |
| 32. | Light traps are used for monitoring ___? (Stem borer and leaf folder ) | 46.15* | 0.34* |
| 33. | The distance to be maintained for placing each Pheromone traps is_____? (60mt) | 19.23 | 0.23 |
| 34. | Which is the major natural enemy of rodent population in rice fields___? (Snake) | 96.15 | 0.11 |
| 35. | Name a microbial formulation effective against many diseases in rice__? (Bacillus) | 30.76* | 0.23* |

# IMPACT OF ECO -FRIENDLY FARM TECHNOLOGIES IN RICE PROMOTED THROUGH FARMERS' FIELD SCHOOL (FFS)

by

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## ABSTRACT OF THE THESIS

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## Abstract

Modern agriculture has been successful in meeting the increased needs of population, but the problems associated with it are high cost of external inputs, destruction of natural eco-systems and stagnated yield levels. Hence the current thrust is on eco-friendly farm technologies, whose objective is to minimise the use of external inputs to prevent degradation of eco-system. Farmers' Field School (FFS) have been found to be an efficient mechanism for promotion of eco-friendly farm technologies and it involves non-formal learner centred educational process which is predominantly skill based.

The study primarily intended to assess the impact of eco-friendly farm technologies in rice disseminated through FFS approach. It also attempted to explore the factors influencing adoption of eco-friendly farm technologies in rice and elucidate the constraints encountered by the participant farmers. The study also tried to prescribe suggestions to overcome these constraints. The findings of the study would help farmers formulate appropriate interventions to create awareness on eco-friendly farming and promote sustainable development.

The study was conducted in the Palakkad district of Kerala State. Five FFSs were selected based on the opinion of the Programme Coordinator of KVK, Palakkad. Twenty farmers were selected from each FFS through simple random sampling method to make the sample size 100. A pretested interview schedule was used for data collection.

The results revealed that 61 per cent of the respondents had medium knowledge level on eco-friendly farm technologies with Mean Score Index (MSI) of 66.54. Out of the practices identified, application of *Pseudomonas* was ranked first with MSI of 70.83 followed by application of *Trichoderma* (67.50), application of neem based pesticides and bio pesticides (64.33), use of light traps (62.50), use of *Trichogramma* cards (61.75), use of pheromone traps (59.50),

application of PGPR (30.00) and use of *Beauveria* (29.00). Majority of the respondents reported medium level of adoption of eco-friendly farm technologies (70%), in which application of *Pseudomonas* was reported by 82 per cent, followed by *Trichoderma* (76%), and *Trichogramma* cards (76%), pheromone traps (72%), neem pesticides and bio pesticides (72%), light traps (49%) application of *Beauveria* (31%) and PGPR (29%).

With regard to perceived environmental impact, increased knowledge about soil testing was ranked first with a mean score of 82.66 followed by favourable attitude towards conservation of natural enemies (72.33) and knowledge on toxicity of pesticides (59.33). In case of economic impact, decrease in the use of labour ranked first with a mean score of 93.66 followed by decrease in cost of cultivation (79.66), increase in income level of farmers (77.66), change in the price of the product (33.66) and improved marketability of the produce (33.66).

With respect to technological impact, reduction in consumption of pesticides was ranked first with a mean score of 76.66 followed by improved knowledge about IPM/INM (74.66), orientation towards improved crop management practices (72.33), and shift towards conservation of environment (66.00). With regard to social impact, increase in sharing of experiences and key learnings were ranked first with a mean score of 86.66, followed by increase in social contacts (80.66), increased participation in training (79.66) and joint responsibility in resource conservation (65.33).

Correlation of the profile characteristics with knowledge and adoption shows that education, innovativeness, scientific orientation, extension participation, institutional support, mass media utilization, number of trainings attended and group interaction exhibited positive and significant relationship with knowledge and adoption of eco-friendly farm technologies. On the other hand, characteristics like age, annual income, land holding, farming experience, and group

cohesiveness had non-significant relationship with the knowledge and adoption of eco-friendly farm technologies.

The major constraints encountered in adoption were low marketability, inadequate price, complexity of technology, non-availability of inputs, lack of knowledge and skill, low applicability, community participation and adulteration of inputs. The constraints could be overcome by imparting knowledge and skills, creating awareness, subsidizing supply of inputs at right time, technology assessment and refinement and ensuring adequate price.

Eco-friendly technologies promoted through FFS had shown positive impact on reducing the consumption of chemical fertilizers and pesticides, increase in yield and income levels and decrease in cost of cultivation. In the light of these findings, Department of Agriculture should plan for more number of FFS on other crops and extend FFS approach to other areas of the state as well.