TECHNOLOGY UTILISATION OF BITTERGOURD IN THIRUVANANTHAPURAM DISTRICT

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TECHNOLOGY UTILISATION OF BITTERGOURD IN THIRUVANANTHAPURAM DISTRICT

by

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(2014-11-121)

THESIS

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KERALA, INDIA

2016

DECLARATION

I, hereby declare that this thesis entitled **"TECHNOLOGY UTILISATION OF BITTERGOURD IN THIRUVANANTHAPURAM DISTRICT"** is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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CERTIFICATE

Certified that this thesis entitled **"TECHNOLOGY UTILISATION OF BITTERGOURD IN THIRUVANANTHAPURAM DISTRICT"** is a record of research work done independently by Mrs. Noobiya Basheer, under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

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Noobiya Basheer

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LIST OF ABBREVIATIONS

%	:	Percentage
ADA	:	Assistant Director of Agriculture
et al.	:	and co – workers/ co –authors
FFS	:	Farmer Field School
FGD	:	Focus Group Discussion
Fig.	:	Figure
HYV	:	High Yielding Variety
ICAR	:	Indian Council of Agricultural Research
IPM	:	Integrated Pest Management
KAU	:	Kerala Agricultural University
No.	:	Number
OECD	:	Organisation for Economic Co-operation and Development
PARC	:	Pakistan Agricultural Research Foundation
POP	:	Package of Practices
UNFCCC	:	United Nations Framework Convention on Climate Change

INTRODUCTION

CHAPTER I
INTRODUCTION

Vegetables are an important source of food and nutrition. Vegetable production constitutes roughly two-third of the total production of horticulture crops. Although India is the second largest producer of vegetables in the world, our productivity levels are abysmally low. To address this, several hybrids and improved varieties of seeds have been developed. At present, area under vegetable hybrids is only about 0.5 million ha. Therefore, there exist a huge potential promotion of region specific cultivars to ensure higher productivity and quality of produce (GOI, 2012). Cucurbits are vegetable crops, belonging to the family cucurbitaceae, which primarily comprises species consumed as food worldwide. Rahman (2003) reported that cucurbits are excellent vegetables in nature having composition of all the essential constituents required for good human health and profitability of the crop.

Bittergourd which is an important cucurbitaceous crop is widely cultivated in South India. It is very rich in vitamins and minerals. GOK (2015) has reported 58 hectares of cucurbitaceous vegetables in the 11 blocks of Thiruvananthapuram district, of which 37 per cent of area is under bittergourd cultivation. There is 2302 hectares of area under bittergourd cultivation in Kerala (GOK, 2015). The considerable high area under bittergourd cultivation reflects the significance of this vegetable in Kerala. Bittergourd production not only generates higher returns in short duration but also supplements food consumption (Baksh *et al.*, 2007). Hence it becomes necessary to increase the yield potential of bittergourd by adopting the standardized agro-techniques and plant protection measures.

Most small-scale farmers in Kerala operate in relatively complex farming systems. Farmers in different agro ecological zones need access to a wide variety of locally validated technologies if they are to increase their productivity

(Swanson *et al.,* 1997). Agricultural technology is a complex blend of materials, processes and knowledge (Thomas, 2004). It includes those applications in the field that will enhance the productivity and add to the income of the farmers. Because of the crop-specific complexity of agricultural technology, different institutional arrangements are needed to transfer different types of technology to technology users (Thomas *et al*., 2013). Despite all the technological innovation transfer, there is a wide gap between levels of production which research contents are attainable and that which farmers actually achieves (Oladele, 2004). Hence it becomes imperative to determine the levels of adoption of its improved production technologies introduced by KAU and factors affecting the rate of adoption.

Adoption models are generally based on the theory that farmers make decisions in order to maximize their expected profits or utility. On the other hand, farmers' utility is dependent on optimizing productivity and minimizing the cost of cultivation to attain maximum profits. Feder and O'mara (1985) stated that farmers adopt or practice new technologies when they expect a more profitable outcome than that gained from existing technology. Hence, adoption factors affecting the rate of adoption and constraints during the process of adoption of technologies for vegetable crops assume significance.

Since vegetable crops are a part of the total agro-eco systems, their growth cannot be considered in seclusion. With the land area getting inadequate for farming, farmers are cultivating vegetables mostly as intercrops that indicate a broad scheme for possible personal and technological interventions. This will be constructive in improving the settings within which individual farmer must pursue cost-effective and lucrative scientific cultivation practices of bittergourd. For this it is essential for the farmers to select remunerative vegetables and its concerned technology.

The detailed study on technology adoption by bittergourd farmers were conducted to identify the important and effective technologies as well as the

factors contributing to the adoption. Hence, the present study was taken up with the following objectives:

i. To analyse the social and personal characteristics of bittergourd farmers.

ii. To assess the level of adoption of selected KAU production technologies of bittergourd.

iii. To establish the relationship of social and personal characteristics of bittergourd farmers with the extent of adoption of production practices.

iv. To identify the constraints experienced as perceived by bittergourd farmers and suggestions for refinement.

1.1 SCOPE AND IMPORTANCE OF THE STUDY

To increase the crop yield, level of adoption of recommended practices ought to be increased. This study becomes important since it is aimed at assessing the level of adoption and the various factors contributing to the adoption of selected practices in bittergourd.

Technology adoption studies are important in the context of knowing the effectiveness of research and development wing of any system. In fact it acts as a feedback mechanism where the response of the success of any technology is obtained from the study thereby helping in the refinement of available technologies. Technology needs assessment is relevant in this context. When the rate of adoption is slow, it results in a loss of benefits of sustainable practices to the cultivators and the public. This is the main reason why so much attention has been given to try and understand what drives adoption of new technologies among farmers (Rogers, 2005 and Pannell *et al*., 2006).

The research also focuses on location-specific and need-based technologies as perceived by the farmers. This study will therefore help in assessing the technology needs and factors therein for the system sustainability of bittergourd production technologies. Hence, it can be presumed that the results of the study will provide information for further research in the release of new varieties and cultivation practices.

1.2 LIMITATIONS OF THE STUDY

The research was part of the post graduate programme which is done in a short period and therefore there were limitations in finance, and other resources. The area of study was confined to only three blocks of Thiruvananthapuram district. Another major limitation was that the farmers restricted the bittergourd cultivation during 'Onam' season since it fetches them more profit and hence only few current fields could be observed. The data were collected by personal interview with the respondents. Most of the responses were from the recall memory of the farmers and not based on written records. Inspite of the above limitations the researcher took every effort to make the research objective, systematic and reliable.

1.3 ORGANISATION OF THE THESIS

The entire thesis is presented in five chapters:

The 'introduction' chapter which is the first, explains the importance of the topic, objectives, scope and limitation of the study. Second chapter, 'Review of literature' deals with the perusal that includes previous works and findings in accordance with the objective of study. Third chapter 'methodology' describes the sampling design, the study area, measurement of independent and other variables, method of data collection and statistical tools used. Fourth chapter 'results and discussion' explains the results of the study with inferences and the 'summary' chapter which is the final one summarises the salient findings of the work that is done and explains the implications based on the results of the study. At the end, the references, abstract and appendices of the thesis are given.

REVIEW OF LITERATURE

CHAPTER - II
REVIEW OF LITERATURE

A novel study on a topic will not materialise out of nowhere. They built upon the findings of the previous works. Review of literature shows how the study fits with what was done before and puts into a theoretical framework. The ideas and concepts gathered from the reviewing of existing literature will help to develop a theoretical and conceptual framework for the study. Review of literature also helps in operationalising the variables on the ground on which data collection can be done. For this purpose the available works and studies that are related to the topic of research from various sources are extensively reviewed. The literatures based on the objectives of the present study are presented in this chapter under the following sub headings.

2.1 Studies on adoption of bittergourd cultivation technologies

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2.2.2 Technology assessment.

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2.2.4 Extent of adoption and relationship with independent variables.

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2.1 STUDIES ON ADOPTION OF BITTERGOURD CULTIVATION TECHNOLOGIES

In India vegetables are typically grown in field conditions as opposed to the vegetable cultivation in developed countries where protected cultivation using green houses is mostly practiced. The lack of availability of good quality planting materials and the low adoption of hybrid seeds are also typically seen in the vegetable sector (Gopalakrishnan, 2007).

A study done by Islam *et al.* (2012) revealed that about 84% of the IPM farmers used pheromone trap in bittergourd cultivation in all the areas. About 94% of the IPM farmers were planning to increase the IPM practices. Majority

(93%) of the respondents reported that reduction in pesticide cost was the major reason behind the increase of IPM practices in future followed by increase in income (88%) and less harm to vegetables (83%).

Jayapalan and Sushama (2001) reported that about 77.5 per cent of farmers were having knowledge about the exact seed rate of bitter gourd, 65 per cent of farmers had knowledge about the exact waiting period (harvesting of the fruits 10 days after fungicidal application) while the recommended practice of spraying 0.5 % nitrophenol against powdery mildew was not known by anybody.

It was observed that during the process of spread of bittergourd cultivation practices, farmers with higher network scores were early adopters of bitter gourd cultivation practices according to Goswami and Basu (2006) on a study on information network spread and its influence on adoption of cultivation.

Imbalanced use of fertilizer is very common among vegetable growers and particularly in the case of bittergourd farmers according to Bakhsh *et al.* (2007).

Iqbal and Nawab (2013) reported that the yield of bittergourd and thereby the income of the farmers were considerably influenced by Farmer Field School (FFS) based on a study done on FFS and its effect on bittergourd productivity.

2.2 TECHNOLOGY ASSESSMENT ON THE PRODUCTION PRACTICES IN BITTERGOURD FARMERS IN TERMS OF EXTENT OF ADOPTION AND ITS RELATIONSHIP WITH INDEPENDENT VARIABLES

Many works were carried out in technology assessment and impact study regarding improved technologies that are disseminated to the farming community. A critical appraisal of the previous works carried out in this field is presented below under appropriate headings.

2.2.1 Technology

Technology is the systematic knowledge and action, usually of industrial processes, but, applicable to any recurrent activity (Mc Graw, 1982).

According to Raju (1982) a new technology in the context of agriculture means all forms of new farm inputs, practices and services such as fertilizers, insecticides, herbicides, tube-well water, improved farm machines and equipments and agricultural extension services.

Rogers (1982) stated that technology is a design for instrumental action that reduces the uncertainity in the cause-effect relationship involved in achieving the desired outcome.

Agricultural technology is understood in its broad sense to encompass plant varieties, animal breeds, farming practices, agricultural production, processing tools, specific mental constructs, cultural codes, forms of management and cooperation (Okali *et al*., 1994).

Kaplan (1996) stated that out of the two types of technology adopters', 'deterministic technology adopters' assume that successful adoption is a result of technology's superiority.

Instrumentalists' technology adopters believe that the causes of change are in human aspirations and social conditions for change and improvement (Surry and Farquar, 1997).

The basis for increasing agricultural productivity and promoting agricultural development is technological change (OECD, 2001).

Technique was differentiated from technology by Ingold (2002). According to him technique refers to skills, regarded as capability of particular human subjects, and technology means a corpus of generalized, objective knowledge as it is capable of practical application. He stressed that transfer of technology is that which includes all efforts to make sure that the farmers adopt new technology. It must embrace inputs, support, advice and other essentials so that the farmer would have no reason to reject the technology.

According to Truong and Ryuichi (2002) farmers prefer those technologies with low input but high benefit, and ensure high productivity.

The attributes of the technologies including the cost and net returns (Rehman *et al*., 2007) and labour intensiveness (De Graaff *et al*., 2008; Yila and Thapa, 2008) might have an influence on adoption.

Knowledge about the farmers' perceptions towards a given technology is crucial in generation and diffusion of new technologies (Uaiene, 2011).

2.2.2 Technology Assessment

Griliches (1957) was one of the first scholars to study adoption and diffusion of technological innovations.

Several scholars have studied adoption of improved technologies in agriculture and the factors influencing adoption behavior among farming households (Abdulai and Huffman, 2005; Deressa *et al*., 2009; Akinola and Owombo, 2012; Howley *et al*., 2012; Mariano *et al.*, 2012).

Research and extension systems that have derisory information flows, adverse (example, top down and non participatory) incentive structures and exceedingly intricate organizational structures can prevent the effective design and execution of even technically sound interventions (Kelly *et al.*, 2003).

Inclusive monitoring and evaluation of technologies is needed to elucidate how technologies contribute to building adaptive capacity and pliability (Clements *et al*., 2011). The technology assessment in a whole can serve as a useful feedback to the research system for designing technologies useful to the small and marginal farmers for large-scale recommendation so as to share the benefits of development. It will aid in technology change and improvement in any sphere, increases economic returns and enhance development process of the state (Thomas *et al.*, 2013).

In the context of technologies for adaptation in agriculture, it may involve identification and assessment of agricultural practices and technologies that

enhance productivity, food security and resilience in specific agro-ecological zones and farming systems (UNFCCC, 2014a).

2.2.3 Extent of Adoption

Adoption process is the mental process that an individual passes from his/her first hearing about an innovation to its final adoption (Rogers, 1982).

Rogers (1983) studies how various characteristics, either real or perceived, of a certain technology affected its adoption. Profitability was reported as one component that was influencing adoption.

The adoption process is influenced upon by an interrelated series of personal, cultural, social and institutional factors, including the five stages of adoption awareness, interest, evaluation, trial, and adoption. Technology adoption is also affected by the development, dissemination and application at the farm level of old and novel biological, chemical and mechanical techniques, all of which are encompassed in farm capital and other inputs. Other factors which influenced adoptions are education, training, advice and information which formed the basis of farmers' knowledge (OECD, 2001).

Neupane *et al.* (2002) revealed that farmers' perception of technology attributes have significant effect on the technology adoption.

Majority of the respondents (64%) had medium level of adoption followed by low (19%) and high (17%) levels of adoption in the case of adoption of organic farming practices in vegetable cultivation (Jaganathan, 2004).

According to Sasane *et al.* (2010) almost all brinjal growers fully adopted soil and preparatory tillage practices. Majority of growers had complete adoption about intercultural operations (93.34%), irrigation management (92.20%), harvesting (89.17%), nursery management (42.50%), fertilizer management (35.00 %) and transplanting (52.50 %).

Ram *et al.* (2012) in the study of 'Adoption Level of IPM Practices in Cabbage and Cauliflower growers of Manipur' revealed that majority of the respondents had medium level of adoption of IPM practices while equal per cent of respondents (20%) had high and low level of adoption, respectively.

Mahmood *et al.* (2013) in a study on the adoption of wheat sowing recommendations stated that levels of adoption of the improved technologies differed among technology types and adoption areas.

According to Sharma and Sidhu (2013) due to the complexity in various technologies, farmers might find it hard to understand and remember all the operations, and hence they lag behind in the adoption of improved technologies.

Adoption rates of technologies to reduce pesticides and artificial fertilizers were high in the study of role of risk-related latent factors in the adoption of new production technology in the case of Japanese greenhouse vegetable farmers (Kurihara *et al.*, 2014).

Maraddi *et al.* (2014) found that around half the groundnut growers belonged to partial and full adoption category in a study conducted on the extent of adoption of improved technologies by groundnut farmers,

It is also perceptible that less risk averse farmers are more likely to adopt a technology and become 'opinion leaders' who ultimately persuade and encourage the wider community to adopt the technology as well (UNFCCC, 2014b).

2.2.4 Extent of Adoption and Relationship with Independent Variables

Social and personal characteristics of farmer respondents are the major factors influencing the adoption of improved technologies.

According to Rao and Rao (1996) factors such as age, farming experience, training received, socio-economic status, cropping intensity, aspiration, economic

motivation, innovativeness, source of information and agent credibility have been found to have positive and significant association with adoption.

Traore *et al.* (1998); Caswell *et al.* (2001); Daberkow and McBride (2003); Diederen *et al*. (2003); Gillespie *et al.* (2004); Rahelizatovo and Gillespie (2004); Gillespie *et al.* (2007) and Banerjee *et al*. (2008) stated that human capital characteristics, such as age, education, and experience, represent other frequently identified factors influencing technology adoption

The extent of adoption of organic farming practices was greatly influenced by knowledge, environmental orientation and awareness of vegetable growers (Bourdillon *et al*., 2002).

Strong associations between the scale of the operation and adoption of new technologies were documented by various authors (Miyatake, 2001; Konya *et al*., 2002; Naka and Fujimoto 2002 and Kawasaki 2010).

Loganandhan and Singh (2003) reported that adoption behavior of farmers is influenced by their socio-economic characteristics such as education, land holding, social participation and communication skills.

The rate of adoption of an innovation depend on the personal characteristics of the potential adopter, the nature of the social system, the type of adoption decision, the extent of the change agent's promotion efforts and the specific attributes of the innovation itself that determine its usefulness for the potential adopter (Rogers, 2003).

The extent of adoption of organic farming practices was greatly influenced by knowledge, environmental orientation and awareness of vegetable growers (Jaganathan, 2004).

According to Rogers (2005) the adoption of new technologies is a prime step towards any constructive advancement. The adoption rate depends on the

various characteristics like cost, benefits and socio cultural norms which further determines acceptability of the innovations.

Rousan (2007) showed that attitude towards change, educational level, farm income, farmers' exposure, and income level are the important socio-economic factors influencing adoption of farm innovations.

Boz *et al.* (2011) stated that since adoption is as a result of the decision made by an individual, it is influenced by the different characteristics of the individuals.

Chanu *et al.* (2014) found that socioeconomic attributes like education, land holding, annual income, attitude towards modern agricultural technology, mass media exposure, extension contact, information sources used, value added product management show the positive and significant relation with adoption level of pineapple growers

2.3 SOCIO- PERSONAL VARIABLES SELECTED FOR THE STUDY

Farmers' adoption of improved technologies can be influenced by various factors. It is important in deciding the potential factors that influences the decision to adopt a technology (Farid *et al.*, 2015). The socio personal factors are among such factors that play a prime role in the individual's decision to adopt a technology or not. Several literatures are present citing such factors influencing adoption of technologies by farmers.

2.3.1 Age

Age is the number of years completed by the farmer respondents at the time of data collection.

Quazi and Iqbal (1991) in a study conducted in a village in Faizalabad district, Pakistan, indicated that age was inversely related as a determinant of innovation adoption.

Jayapalan (1999) according to the study done on Techno- Socio-Economic assessment of farmers' practices in bittergourd cultivation, found that there was no interrelation between age and extend of adoption.

Caswell *et al.* (2001) stated that with the progress in the age of farmers, they find that the returns from adopting the technology will take lot of time and hence the interest in adoption also reduces.

Despite the years of experience in farming was more, older farmers were often reluctant to adopt new technologies and practices (Gillespie *et al.*, 2004).

Jaganathan (2004) observed that majority of the vegetable growers (48%) belonged to old age category.

Van den Berg (2013) reported that there was no significant relationship between farmer's age and adoption of technology of the irrigation scheme.

Farid *et al.* (2015) stated that adoption of farm practices is not determined by the age of the respondents.

2.3.2 Education

Education refers to the extent of formal learning possessed by the bittergourd farmer respondent at the time of interview.

Waller *et al*. (1998) and Caswell *et al.* (2001) stated that an approving attitude towards information- intensive and management- intensive practices is reflected to be formed with education that helps in the adoption of such practices.

Better appraisal of the technology can be made by farmers with high educational status as stated by Ekwe and Nwachukwu (2006).

Education is one of the important factors affecting adoption of new technologies in farming system according to Truong (2008).

The negative influence of education was put forward by Johnson *et al.* (2010). According to him, educational level beyond high school affected the use of futures, options and/or cash contracts negatively.

Singh *et al.* (2010) found that education was highly significantly correlated with the adoption of vegetable practices. With more education the chance of adoption of improved cabbage cultivation technology also increased.

Al-Shadiadeh (2012) opined that information sources used in the educational process have a significant influence on the adoption of agricultural innovations.

According to Amponsah *et al*. (2013) farmers with high education level are more inclined to adopt improved technologies than their counterparts.

Makarau *et al.* (2013) opined that the adoption of improved technologies and farm practices is facilitated by education.

2.3.3 Farm Size

Farm size in this study refers to the area under cultivation by the farmer measured in acres. Important research findings from various authors are presented below.

Feder *et al.* (1985) opined that farm size may be a proxy for other factors, such as wealth, risk preferences, and access to credit, scarce inputs, or information which in turn might influence adoption of agricultural innovations.

Farm size has a positive effect on adoption of newly introduced technologies by fish farmers of Tanzania (Wetengere, 2009).

Kafle (2011) reported that farm size was a significant factor that influenced the adoption of organic vegetable farming.

Farm size is considered as one of the most reliable and consistent factor that exhibited positive statistical significance with adoption as stated by Raghu *et al.* (2014).

2.3.4 Area under Bittergourd Cultivation

Area under bittergourd cultivation is operationalised as the area utilized for cultivating bittergourd which was measured in acres.

Bavalatti and Sundaraswamy (1990) have reported that there is positive and significant relation between area and extent of adoption in a study conducted on adoption of dry land practices.

There is no significant relation between area under bittergourd cultivation and extent of adoption (Jayapalan, 1999).

2.3.5 Occupation

Occupation for this study is operationalised as the vocation of the farmer respondents at the time of interview. A number of review statements made by various authors from different studies are present of which few relevant ones are presented below.

There was no significant relationship between occupation and extent of adoption of scientific practices in irrigated cotton and millets according to Krishnamoorthy (1988).

Jayapalan (1999) reported no significant relationship between occupation and adoption of farmers' practices in bittergourd.

Daberkow and McBride (2003) noted a positive association between full time farming activities and adoption of precision farming activities.

Kafle (2011) stated that occupation, be it primary or secondary, did not have any influence on organic vegetable production.

2.3.6 Annual Income

Annual income refers to the annual on farm and off farm income earned by the farmer respondents. Important research findings from various authors are presented below.

Hossain *et al.* (2003) found the adoption of improved rice varieties had positive effect on wealthy households, but negatively affected poor households in Bangladesh.

Mendis and Udomsade (2005) reported income was one of the factors affecting adoption of recommended crop management practices in paddy cultivation.

Wealthier farmers can more likely manage and apply expensive inputs for increasing productivity, from which it can be concluded that income influenced technology adoption positively (Tiamiyu *et al.*, 2009).

Annual income of the respondents had significant and positive relationship with their technology adoption of selected enterprises (Singha *et al.*, 2012).

Amponsah *et al.* (2013) stated that on -farm income and off - farm income indicates the financial capability of a farmer in buying external inputs.

Annual income about household of farmers was not associated with the farmers' participation in Rural Social Endowment Insurance according to Kai-Xia Wang *et al.* (2011).

2.3.7 Farming Experience

Farming experience is operationalised as the experience of the farmer in bittergourd cultivation expressed in terms of number of years. Relevant statements cited by different authors are presented below.

Rapid adoption of farm innovations is possible with more farming experience as is evident from the increase in farm productivity with experience (Obinne, 1991).

Farming experience significantly influenced adoption of protected tomato practices and was important in predicting adoption behavior according to Al- Shadiadeh (2012).

Zanu (2012) noted that there was a positive and significant relation between farming experience and adoption of improved technologies by farmers.

2.3.8 Market Orientation

Market orientation is operationalised as the degree to which farmers are oriented towards marketing to obtain reasonable gains from selling the produce.

Market orientation is one of the three sub-scales of the scale measuring management orientation, which is operationally defined as the degree to which a farmer is oriented towards scientific farm management comprising planning, production and marketing functions/activities of his farm enterprises (Samantha, 1977).

Thomas (1998) reported that market orientation was significantly related to the knowledge and adoption of medicinal plants.

Jaganathan (2004) reported that more than half of the respondents (55%) had medium level of market orientation. He also stated that respondent's awareness and attitude towards the organic farming practices had a positive and significant relationship with market orientation.

There is no significant association between marketing orientation and adoption of the eco-friendly management practices of the vegetable growers as noted by Patel *et al.* (2013).

Appropriate market management is a prime aspect in promotion of commercial vegetable production (Chalermphol *et al.,* 2014).

Krishnan (2013) opined that the specialised homegarden farmers have a positive attitude that will lead to higher market orientation due to the diversity in the products available to the homegardens.

2.3.9 Extension Orientation

Extension orientation refers to the extent of contact a farmer had with different extension agencies and his participation in various extension activities. It is an important determinant of adoption since a farmer gets acquainted with an innovation through the various extension sources.

According to Ganghadharan (1993) there exist a significant relation between extension orientation and adoption of improved agricultural practices in pepper

Mendis and Udomsade (2005) reported that extension activities, extension officer visits and membership of farmer organizations were found to be important factors affecting adoption of recommended crop management practices in paddy cultivation.

Devi and Ponnarasi (2009) indicated that number of contacts with extension agencies positively and highly influence the adoption behaviour of the farmers.

High contact with various extension agents will enable the farmers to be more familiar and knowledgeable about the use of improved agricultural innovations (Tiamiyu, 2009).

One of the important factors associated with organic agriculture and adoption of organic practices were farmer's participation in organic farming related trainings (Kafle, 2011).

Islam *et al*. (2012) reported that around half of the IPM farmers reported that they were highly influenced by IPM schools to adopt IPM practices followed

by extension worker (48%). About 19% of the IPM farmers reported that they were influenced by neighbors, relatives and mass media to some extent.

Farmers' exposure to extension personnel of the department of agriculture becomes more with higher level of extension contact and hence their accessibility to scientific guidance becomes easier (Singha, 2012).

2.3.10 Irrigation Potential

Irrigation potential refers to the extent to which the irrigation water was available for use in the operational holding.

Geethakutty (1993) reported that there is no significant relationship between irrigation index and adoption in a study conducted on fertilizer use behavior of rice farmers.

Thomas (2004) operationalised the irrigation potential in terms of physical water scarcity, economic water scarcity and little or no water scarcity.

Krishnan (2013) reported that half of the homegardens fell in the category of "little or no water scarcity".

Jacob (2015) reported that there is no significant relationship between irrigation potential and adoption in the production practices of homegardens.

2.3.11 Innovativeness

Innovativeness refers to the relative earliness in adopting an innovation.

Jayapalan (1999) reported that there is no significant relationship between innovativeness and adoption of farmers' practices in bittergourd.

Goswami *et al*. (2010) stated that innovativeness of fish farmers had positive significant relationship with their scientific fish culture practices.

Innovativeness influenced the adoption of artificial insemination by dairy farmers according to Rezaei and Bagheri (2011).

2.3.12 Economic Motivation

Economic motivation is operationalised as the drive of the respondent to obtain profit and the relative value placed on economic ends.

There is no significant relationship between economic motivation and adoption of farmers practices in bittergourd as stated by Jayapalan (1999).

Talukdar and Sontaki (2005) and Singha and Baruah (2011) stated that there is positive relationship between economic motivation and adoption behaviour of farmers.

Economic motivation was one of the main factors on technology adoption of rice cultivation, vegetable cultivation, dairy farming and fisheries (Singha *et al.,* 2012).

2.4 AWARENESS AND KNOWLEDGE OF FARMERS OF KAU PRACTICES.

2.4.1 Level of Awareness

Level of awareness in this study refers to the extent or level to which farmers are aware about the recommended practices in bittergourd cultivation.

Floyd *et al.* (1999) noted that awareness about technologies is consistently and significantly affected by extension input levels.

Majority of respondents had medium level of awareness (46.00%), followed by low (31.00%) and high level (22.00%) of awareness on eco friendly management practices in vegetable cultivation (Buddhibhuvaneswari, 2005).

Elizabeth and Zira (2009) reported that awareness was high for vegetable production technology as weeding, seed source, disease management, pest control, harvesting, market information and fertilizer use. Farmers were less aware about the use of improved land preparation technologies, water management and storage methods.

According to Priya (2006) awareness is the things known to an individual presented as cognitive domain. Also stated that inorder to completely understand the aspects behind IPM technology it is necessary to be aware about such practices and also its relative advantage.

Awareness is the first stage of adoption before the respondents developing an interest in the technology and later decided on adoption (Okunlola, 2010).

The probability of a farmer's awareness of at least one improved pigeonpea variety was higher among younger farmers, whereas adoption propensity was higher among older farmers and women (Simtowe *et al.*, 2015)

2.4.2 Knowledge

Knowledge refers to the understanding of different scientific production practices as stated in the recommended package of practices.

Schultz (1964) reported that the decision on adoption is influenced by farmers' knowledge and perceptions about how to use scientific knowledge.

Jayapalan and Sushama (2001) have inferred that all the farmers had knowledge about recommended practices coming under seed selection, spacing, land preparation, fertilizer application, intercultural operations and plant protection measures in the study on knowledge of farmers about bittergourd cultivation.

Jayapalan and Sushama (2001) reported that scientific farming demands a thorough understanding of the package of practices to be followed as well as the indigenous practices in their farming and that they are not giving prime importance to recommended practices.

All the respondents (100%) had medium level of knowledge about eco friendly practices in gourd cultivation according to Buddhibhuvaneswari (2005).

2.5 CONSTRAINTS IN ADOPTION OF BITTERGOURD CULTIVATION

The problems and difficulties faced by the farmers during the course of cultivation of bittergourd are included as constraints for the present study.

Hicks and Johnson (1974) as cited by Obuobisa-Darko (2015) reported that a higher rural labour requirement explained non adoption of intensive rice varieties in Taiwan.

Patnaik (1996) reported that a higher rural labour requirement explained non adoption of intensive rice varieties.

Incidence of pests and diseases is the most important constraint in bittergourd cultivation (Jayapalan, 1999).

Non availability of inputs, transportation, finance and lack of market information are the major constraints in cowpea cultivation (Ongusumi *et al.*, 2002).

According to Thomas (2004) surplus cannot be marketed in homegarden components.

Yamamoto *et al.* (2005) identified perceived risks of environmental change within and without the operation as decision making factors for the adoption of new technology. The most important constraint to adoption of improved varieties is the availability of seed as reported by Dontsop-Nguezet *et al.* (2011).

Thomas (2004) and Krishnan (2013) identified surplus but inadequate for marketing, low price of produce, high labour cost, lack of markets for homegarden products and lack of extension service as the major constraints in specialised homegardens.

2.6 REASONS FOR NON ADOPTION AS PERCEIVED BY THE NON ADOPTERS

Non adoption of improved technologies can be attributed to many reasons. Many authors have cited varied reasons for not adopting an innovative practice of which few relevant ones are presented below.

Price fluctuation of vegetables was an important reason for lower adoption of various improved vegetable production technology according to Birthal and Sant (2004); Singh *et al.* (2010).

Non-availability of plant protection inputs and lack of technical knowledge regarding plant protection measures are important reasons for the poor adoption of plant protection measures (Thippeswamy *et al*., 2008).

The major reasons of non adoption of recommended technology were perceived as unawareness, not availability of HYV seed at sowing time, high cost of improved seeds, unawareness about recommended seed rate, method and time of seed sowing etc. (Singh, 2012).

According to Miah *et al.* (2015) a good percentage of farmers (47.7%) reported the lack of awareness and technical know-how about the bed technology behind their non-adoption of raised bed technology.

Unawareness about pest and disease management techniques, non availability of labour and high cost of chemicals might be the reason of non adoption of recommended pest and disease management techniques in paddy (Oinam and Sudhakar, 2014).

Lack of knowledge about IPM practice which also included the use of pheromone traps that is most applicable to cucurbits is one of the most important reason or barrier to adoption (Kabir, 2015).

METHODOLOGY

CHAPTER III
METHODOLOGY

This chapter deals with the brief description of methods and procedures that were used for meeting the objectives set forth in this study. The methodology followed in the study is presented under the following sub-headings:

3.1 Research design

3.2 Locale of the study

3.3 Selection of the respondents

3.4 Selection of recommended practices

3.5 Operationalisation and measurement of the variables

3.5.1 Distribution of the farmer respondents based on their personal and social characteristics.

3.5.2 Awareness and Knowledge of farmers about recommended POP practices.

3.5.3 Technology assessment on production aspects in bittergourd cultivation and production preferences, perceived usefulness and effectiveness of selected KAU production technologies

3.5.4 Constraints experienced by bittergourd farmers..

3.5.5 Reasons for non - adoption as perceived by the non- adopters of recommended practices

3.5.6 Suggestions for refinement

3.6 Data collection procedure

3.7 Statistical tools used in the study

3.1 RESEARCH DESIGN

Research design is the process of planning the research to effectively address the research problem. Kerlinger (2004) stated that research design is the plan, structure and strategy of investigation conceived so as to obtain answers to the research questions and to control variance.

After reviewing the existing literature and based on the objectives of study certain personal and socio economic variables were selected to be included in the study. Survey research was adopted for obtaining the primary data from the farmer respondents from the field based on the *ex post - facto* approach.

According to Kerlinger (2004) an *ex post - facto* investigation seeks to reveal possible relationship by observing an existing condition or state of affairs and searching back in time for plausible contributing factors. In other words, it is a systematic inquiry in which the scientist does not have direct control over the independent variables because their manifestations have already occurred or because they are inherently not manipulable (Kerlinger, 1983). This research design was resorted in this study, as there was no scope for manipulation of any variables under study. Inferences about relations among variables are made without direct intervention.

3.2 LOCALE OF THE STUDY

The study was conducted in Thiruvananthapuram district of Kerala. Predominant bittergourd growing tracts were purposively selected for the study. Thiruvananthapuram district was selected as the locale since:

1. Thiruvananthapuram district is one among the top districts with maximum area under bittergourd (Area –58 ha, Source: GOK, 2015).
2. There are traditional farmers, pockets of potential bittergourd cultivation and research oriented cultivation in the district (Jayapalan, 1999).

3. According to marketing agencies bittergourd from the district is extensively exported.
4. Convenience for data collection due to the proximity of the area to the researcher.

Three blocks with predominant bittergourd cultivation was selected for study, which included Nemom (11.96 ha), Vamanapuram (6.28 ha), and Nedumangad (5.15 ha). Three panchayats from each block was then selected to obtain the list of farmers. It included Kalliyoor panchayat, Manickal panchayat, and Vembayam panchayat respectively. Map showing the area of study is presented in Fig.1. The panchayats were selected on the basis of rating by the concerned Assistant Director of Agriculture (ADA) of the concerned blocks.

3.3 SELECTION OF RESPONDENTS

The respondent group comprised of bittergourd growing farmers of Thiruvananthapuram district. From each block, 30 farmers each was selected from the predominant panchayats making a sample size of 90 farmers. For this, the researcher contacted the Agricultural Officers of the respective panchayats and got list of farmers, who had comparatively high area and production in bittergourd. Ninety farmers were randomely selected from the list. The sampling frame of the study is shown in Fig. 2.

Fig. 1. Location Map of study area

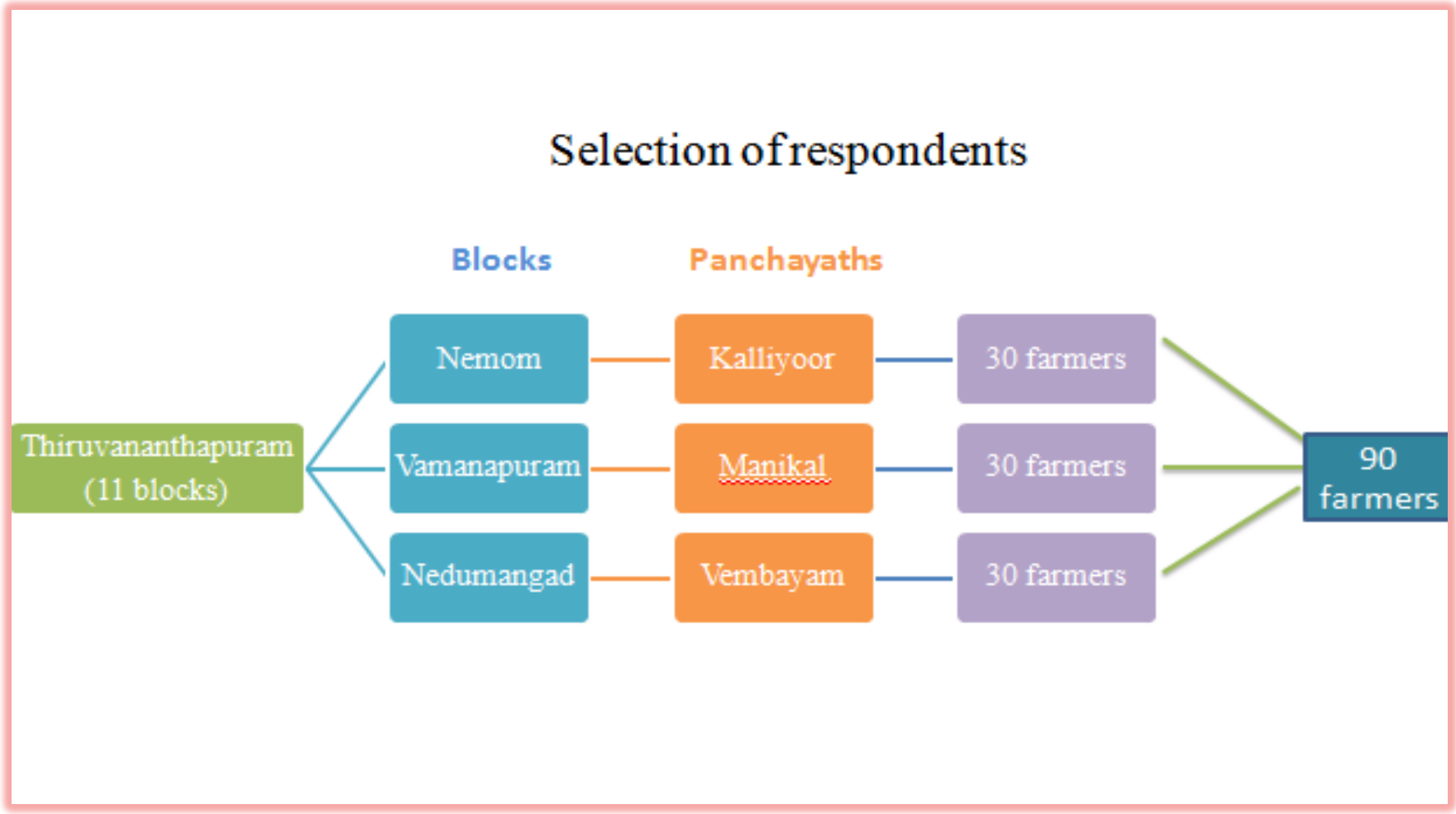


Fig. 2. Sampling frame of the study

3.4 SELECTION OF RECOMMENDED PRACTICES

Sixteen recommended practices both from organic POP (KAU, 2009) and POP (KAU, 2011) in bittergourd were selected after discussing with subject matter specialists. Of the sixteen practices, nine were production practices and seven were plant protection practices.

3.5 OPERATIONALISATION AND MEASUREMENT OF VARIABLES

The objective of the study was to assess the impact of KAU technologies in bittergourd in terms of the two impact indicators, namely, the adoption of varieties cum the selected production practices of the farmers and constraints in the process of adoption, if any with suggestions for refinement.

Some other variables found to be useful during the course of the study were selected and included to satisfy the objectives.

Operationalisation and measurement of variables have been included in the following subheads:

3.5.1 Distribution of bittergourd farmers based on their personal and social characteristics.

3.5.2 Awareness and Knowledge of farmers about recommended POP practices.

3.5.3 Technology assessment on production aspects in bittergourd cultivation and production preferences, perceived usefulness and effectiveness of selected KAU production technologies

3.5.4 Constraints experienced by bittergourd farmers.

3.5.5 Reasons for non - adoption as perceived by the non adopters of recommended practices.

3.5.6 Suggestions for refinement.

3.5.1 Distribution of Bittergourd Farmers Based on their Personal and Social Characteristics

In order to assess the influence of the profile characteristics of the bittergourd farmer respondents, the characteristics of the farmers were identified as detailed below:

A list of 34 independent variables related to the personal characteristics of the bittergourd farmer respondents were collected after detailed review of literature and discussion with subject matter specialists in tune with the objectives of study. The lists of variables were then sent to 30 judges comprising extension scientists and other experts (Appendix- I). They were asked to examine the variables critically and to rate the relevancy of each variable on a five-point continuum ranging from most relevant, more relevant, relevant, less relevant and least relevant with weightages of five, four, three, two and one, respectively. Out of 30 judges only 27 responded. The final variables were selected based on the criterion of mean relevancy score, which was obtained by summing up the weightages obtained by variable and dividing it by the number of judges, responded. Those variables garnering a score more than the mean score was selected for the study. The variables with the mean relevancy scores are presented in Appendix II. The personal and social characteristics of the bittergourd respondents which constituted the independent variables thus selected for the study were age, education, occupation, farm size, area under bittergourd cultivation, farming experience, annual income, irrigation potential, extension orientation, economic motivation, innovativeness and market orientation. Along with the selected variables, two additional variables like extent of awareness and knowledge were also included purposively

The selected 14 independent variables and their measurement for study are presented in Table 1.

Table 1. Selected independent variables and the corresponding measurement procedure

Sl. No	Independent variables	Measurement
1.	Age	Actual chronological age and classification based on census report (2011).
2.	Education	Method developed by Thomas (2004).
3.	Occupation	Vocation of the farmer respondent at the time of interview.
4.	Farming experience	Experience of the farmer in bittergourd cultivation expressed in terms of number of years.
5.	Farm size	Actual farm area in acres.
6.	Area under bittergourd cultivation	Area utilised for bittergourd cultivation measured in acres.
7.	Annual Income	Test developed for the study.
8.	Irrigation potential	Method developed by Thomas (2004).
9.	Extension orientation	Method developed by Bhaskaran (1979).
10.	Economic motivation	Method developed by Prasad (1983).
11.	Innovativeness	Method developed by Selvanayagam (1986).
12.	Market orientation	Method developed by Samantha (1977).
13.	Extent of awareness	Method developed by Mathialagan and Senthil Kumar with slight modifications (2012).
14.	Knowledge	Teacher made test.

3.5.1.1 Age

Total number of years completed by the farmer respondent at the time of study was measured as age and was classified based on the classification method of Census report (2011).

Age category	Years
Young	< 35 years
Middle aged	35-55 years
Old aged	> 55 years

The respondents were categorised into different groups and expressed as frequency and percentage.

3.5.1.2 Education

Education was operationalised as the extent of formal learning possessed by the respondent at the time of interview. The scoring procedure adopted by Thomas (2004) with slight modification was used for the study and is as follows. To every triumphant completion of formal schooling one score was added and the respondent farmers were grouped based on their level of education into different categories.

Category	Code
Illiterate	0
Primary	1-4
Middle	5-7
High School	8-12
Collegiate	>13

The respondents were put into different categories based on their level of education and expressed as frequency and percentage.

3.5.1.3 Occupation

Occupation for this study was operationalised as the vocation of the farmer respondent at the time of interview.

Category	Score
Primary (Agriculture alone)	2
Secondary (Other job + Agriculture)	1

The respondents were grouped into different categories based on their vocation and expressed as frequency and percentage.

3.5.1.4 Farm Size

Farm size in this study refers to the area under cultivation by the farmer respondent measured in acres. The respondents were grouped into different categories and expressed as frequency and percentages.

Category	Score
<1 acre	1
1-2 acre	2
>2 acre	3

3.5.1.5 Area under Bittergourd Cultivation

Area in this study refers to the area utilised for bittergourd cultivation measured in acres. The respondents were grouped into different categories and expressed as frequency and percentages.

Category	Score
0 – 0.50 acre	1
0.51- 1 acre	2
> 1 acre	3

3.5.1.6 Farming Experience

In the present study farming experience is operationally defined as the experience of the farmer in bittergourd cultivation expressed in terms of number of years. The actual number of years of experience in farming was considered as the score.

Category	Score
<10 years	1
10-20 years	2
>20 years	3

3*.5.1.7 Annual Income*

Annual Income refers to the total annual earnings from the on farm and off farm activities of the farmer. This was measured in terms of lakhs of rupees per year as expressed by the bittergourd farmer respondents.

The respondents were grouped into different categories and expressed as frequencies and percentages.

Category (in lakhs)	Score
< 1	1
1 to 2	2
>2	3

3.5.1.8 Irrigation Potential

Irrigation potential was operationally defined as the extent to which irrigation water was obtainable in the farm holding and the extent of area irrigated using this available water. It was measured based on the availability of irrigation water for irrigating the field and the scoring method developed by Thomas (2004) was used and categorised as:

Category	Score
Physical water scarcity	3
Economic water scarcity	2
Little or no water scarcity	1

The score for irrigation potential was the score obtained by the respondent. The score range that could be received by the respondent was 'three' and 'one' as maximum and minimum respectively.

Physical water scarcity refers to the farmers' perception that the water available in the field is not adequate for irrigation purpose. Economic water scarcity refers to the perception of farmer that the water is available in the field but it has to be used very judiciously inorder to meet the irrigation requirements in the field. Little or no water scarcity refers to the perception of farmer that the water is copiously available in the field.

3.5.1.9 Extension Orientation

Extension Orientation was operationally defined as the extent of contact a farmer had with different extension agencies and also his participation in various extension activities or programmes organised by this agencies.

Extension orientation was measured by considering both extension contact and extension event participation. Scoring pattern developed by Bhaskaran (1979) was used for this purpose.

The extension contact was measured as follows:

Response	Score
Very Often	2
Often	1
Never	0

There were five items coming under the extension agents who included Agricultural Officer, scientists at KAU, and scientists at other ICAR institutions, personnels of other institutions/commodity boards and progressive farmers. The total score was obtained by summing up the values for different extension contacts. The maximum score that could be obtained by a respondent was 10 and minimum was zero.

The extension participation was measured by summing up the scores obtained by a farmer for participating in various extension activities. The scoring procedure is as follows.

Response	**Score**
Whenever conducted	2
Sometimes	1
Never	0

There were six items coming under extension events which included study tours, seminars, melas, meetings, Farmer Field School and demonstrations. The total score for extension orientation for a respondent was obtained by summing up the scores for both extension contact and extension participation. The maximum score that could be obtained by a respondent was 12 and minimum was zero. The scores obtained in both extension contact and extension event participation was used as the criteria of measurement of extension orientation of the respondents. Based on the quartiles, the respondents were categorised as cited below with respect to their extension orientation. A box plot was also plotted to denote the distribution diagrammatically.

Category	**Criteria**
Low	< Q1
Medium	Between Q1 and Q3
High	> Q3

3.5.1.10 Economic Motivation

Economic motivation was operationalised as the drive of the respondent to obtain profit and the importance given to economic matters. It was measured using Supe's scale as modified by Prasad (1983). In the scale developed by Supe, 5 point continuum of response was used. But in the modified scale a dichotomy of 'yes' or 'no' response pattern was used. Six statements were included in the scale of which 5 are positive and the final one is a negative statement. Score of one was given to every 'yes' response and zero for 'no' response in the case of positive statement. The scoring procedure was reversed in the case of negative statement. The scores obtained for each statement was summated to get the total score for economic motivation for a respondent. The maximum score that could be obtained by a respondent was six and minimum zero.

3.5.1.11 Innovativeness

Innovativeness was operationally defined as the relative earliness in adopting an innovative idea by the respondent.

The scoring procedure developed by Singh and Choudary (1977) and used by Selvanayagam (1986) was adopted to measure the innovativeness of the farmer respondents. The farmers were enquired as to when they would like to adopt an improved technology or practice in farming. The scoring was done as presented below.

	Score
1. As soon as it is brought to my knowledge	1
2. After I have seen other farmers tried successfully in the farm	2
3. I prefer to wait and take my own time	3

The classification procedure adopted was based on high innovativeness (3), medium innovative (2) and low innovative (1).

3.5.1.12 Market Orientation

Samantha (1977) developed market orientation which was one of the three sub-scales of the scale used for measuring management orientation. Management orientation was defined as the degree to which a farmer is oriented towards scientific farm management comprising planning, production and marketing functions/activities of his farm enterprises. The sub scale used to measure marketing orientation consisted of six statements, three positive and three negative statements. In the case of positive statements, a score of 'one' was given for agreement and 'zero' for disagreement. For negative statements, the pattern was reversed. The total score obtained by the respondent was taken as his score for market orientation. The maximum and minimum score that could be attained by the respondent was 'six' and 'zero', respectively.

Sl.No	Statements	Response	
1.	Market is not useful to a farmer	A	DA
2.	A farmer can get good price by eliminating the middle man		
3.	One should sell his produce to the nearest market irrespective of price		
4.	One should purchase his inputs from shops where his friends or relatives purchase		
5.	One should grow those crops which have more market demand		
6.	Co-operatives can help a farmer to get better price for his produce		

3.5.2 Awareness and Knowledge of farmers about recommended POP practices.

3.5.2.1 Level of Awareness

Awareness indicated whether the farmers were aware about the existence about a recommended practice or technology. Level of awareness was operationalised as the extent or level to which farmers were aware about the recommended practices in bittergourd cultivation. Priya (2006) defined awareness as the things known to an individual presented as cognitive domain.

The method developed by Mathialagan and Senthil Kumar (2012) with slight modifications was used for measuring level of awareness.

Sixteen recommended practices from POP and organic POP were included after conducting focus group discussion to discern the awareness level of the farmers. Awareness was measured on a three point continuum, that is, very much aware, aware and not aware with a score of 2, 1 and 0 respectively. The maximum score that an individual could obtain was 32 and minimum was zero. The total awareness score for each respondent was calculated by summing up the scores for each practice. Based on the quartiles, the respondents were categorised into high, medium and low with respect to the awareness about recommended practices.

3.5.2.2 Knowledge

Knowledge was operationalised as the level of understanding of different scientific production practices as stated in the recommended package of practices. It indicated the in-depth understanding about a practice by the farmer. The variable was measured using teacher made test for the study. Sixteen recommended practices from POP and organic POP were finalised after judge's opinion and were included for measuring the knowledge. Each respondent was given a score of one for the practice that is known to him/her and zero score for the practice which the farmer does not know. The total knowledge score for each respondent was calculated by summing up the scores for each practice. The maximum score that could be obtained by a respondent was 16 and minimum zero. Based on the quartiles, the respondents were categorised into high, medium and low with respect to the awareness about recommended practices.

3.5.3 Technology Assessment on Production Aspects in Bittergourd Cultivation and Production Preferences, Perceived Usefulness and Effectiveness of Selected KAU Production Technologies

Production and plant protection technology assessment was made in terms of:

i. Extent of adoption of selected scientific production technology practices for bittergourd cultivation as perceived by farmers.

ii. Extent of adoption of scientific production practices by bittergourd farmers and its relationship with the personal characteristics of the bittergourd farmers.

iii. Production preferences, perceived usefulness and effectiveness of selected KAU bittergourd production technologies.

iv. Technology needs for the selected bittergourd practices as perceived by farmers.

i. Extent of adoption of selected scientific production technology practices for bittergourd cultivation as perceived by farmers.

Extent of adoption was referred to as making full use of the recommended practices in bittergourd cultivation by the bittergourd farmers. This was the dependent variables used in the study.

The extent of adoption was calculated using adoption quotient for measuring adoption behaviour as developed by Chattopadhyay (1963) and modified by Singh and Singh (1967).

$$AQ = \frac{\sum_{i=1}^{n} \frac{ei}{pi}}{N} \times 100$$

Where,

AQ = Adoption quotient

ei = Extent of adoption of i^{th} practice

pi = Potentiality of adoption of i^{th} practice

N = Total number of practices selected.

Different scoring procedures were undertaken for measuring the adoption quotient of various practices. The original numerical data was given as extent of adoption (ei) for quantifiable data like seed rate, spacing etc. and the recommended practice was considered as the potentiality of adoption of that practice.

Few practices were measured in terms of different stages of adoption. Level of adoption of each farmer was indicated on a 15 point adoption scale. The weighted values corresponding to the response categories were non- adoption (0), awareness (1), interest (3), evaluation (6), trial (10) and adoption (15).

Those practices which could not be quantified were scored dichotomously as 'Yes' or 'No' with the maximum score '1' for the response 'Yes' and minimum score '0' for 'No' response.

After calculating the adoption quotient for various practices the adopters were categorized and compared with the standard Rogers (1982) curve.

ii. Extent of adoption of scientific production practices by bittergourd farmers and its relationship with the personal characteristics of the bittergourd farmers.

Simple correlation was used to find the relation of selected independent variables with the adoption quotient of each farmer.

iii. Production preferences, perceived usefulness and effectiveness of selected KAU production technologies.

Production preferences for the selected production practices were identified. Different production criterions were selected after pilot survey and on discussion with subject matter specialists. The criterions were: cost effectiveness,

family needs, market preference, availability of inputs, value addition, less management, more sustainable, low cost of cultivation and resource utilisation.

The selected criterion from the practices were ranked in the decreasing order of preferences, that is, highest rank for the most preferred reason and the lowest rank for the least preferred reason. The mean score for each criterion were worked out for identifying the production preference for the different components. Perceived effectiveness and usefulness of KAU production practices were categorised as 'very effective', 'effective', 'not effective' and 'very useful', 'useful' and 'not useful' as perceived by the bittergourd farmers. The perceived effectiveness and usefulness are expressed as percentages.

iv. Technology needs for the selected production practices as perceived by farmers

Technology needs of the bittergourd farmer regarding various scientific production practices were worked out after a pilot survey and after discussion with experts.

Scoring procedure for technology needs assessment as done by Thomas (2004) was:

Criteria	Score
Technology not available	1
Technology available but not applicable	2
Technology available but not sustainable	3
Technology available, applicable sustainable	4

The adoption of managerial practices varies with different practices. Hence the needs and demands of the farmers also vary. Technology needs were calculated for the different selected parameters namely variety, spacing, nutritional requirements, irrigation, organic manure, harvesting, plant protection measures including management of fruit fly, epilachna beetle, downey mildew and vector; value addition and post harvest technology like drying, pickling and others.

The maximum and minimum scores obtained by the respondent were '48' and minimum score '12'. The parameters with the minimum score were considered as the most needed technology for the farmers undertaking bittergourd cultivation.

3.5.4 Constraints Experienced by Bittergourd Farmers.

After extensive review of literature, discussion with experts and pilot survey done on a non sampled population, a list of constraints was collected. It was an open ended list so that the farmers could add more constraints faced by them. The response of the respondents were recorded in a four point continuum as 'most important', 'important', 'less important', and 'least important' which were scored 'four', 'three', 'two', and 'one' respectively.

3.5.5 Reasons for Non-Adoption as Perceived by the Non Adopters of Recommended Practices

Various general reasons were delineated after review of literature, discussion with the experts and non sample respondents and a list was prepared which was administered to the respondents for scoring. The reasons were ranked from 10 to 1 with the highest score for the most important reason. Mean of the score was found out for each reason and ranked from highest to lowest. The reasons were ranked based on the mean score. High mean score means it was the most important reason for non adoption of KAU practices.

3.5.6 Suggestion for Refinement

Suggestions for refinement as perceived by the farmers were delineated through Focus Group Discussions (FGD) and the major strategies were screened and presented after discussing with experts.

3.6 DATA COLLECTION PROCEDURE

A well-structured interview schedule prepared was used for data collection (Appendix III). After preparation of a draft interview schedule it was pre-tested

by conducting a pilot study in a non sample population and suitable modifications were made in the interview schedule which was finalized after review by subject matter specialists. It was then directly administered to the bittergourd farmers by the investigator. The survey instrument that was used to collect data consisted of 19 questions. There were open ended questions, multiple choice questions and questions that had rating scale. The respondents were interviewed in their local language. The responses were recorded in the appropriate column in the field itself. Agricultural Officers and Agricultural Scientists were included as respondent categories in the study, only for the collection of data to obtain the various independent variables.

Focus Group Discussions (FGD) were conducted to obtain information regarding the constraints experienced and to delineate the suggestions for refinement as perceived by the farmers.

3.7 STATISTICAL TOOLS USED IN THE STUDY

The collected data were scored, tabulated and analysed using statistical methods as described below.

3.7.1 Mean

The respondents were grouped into categories with reference to the mean as check of the selected independent variables. After grouping the respondents into categories, their percentages were worked out.

3.7.2 Percentage Analysis

After grouping the farmers into various categories based on the extent of adoption of agricultural technologies, simple percentage was worked out to find out percentage distribution of the farmers. It was also used to interpret the results of independent variables selected for the study.

3.7.3 Quartile Deviation

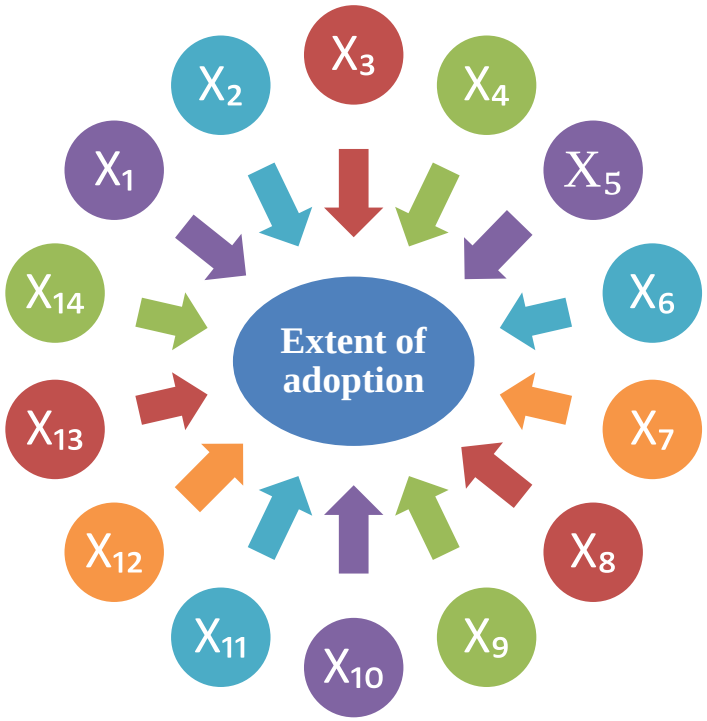
Quartile deviation was used to find out the quartiles inorder to divide the data set into three quarters. This was used to categorise the respondents based on extension orientation, level of awareness and knowledge about the recommended practices. It was also used to divide the recommended practices into high, medium and low based on the knowledge and adoption by the respondents.

3.7.4 Standard Deviation

Standard deviation is a measure that is to quantify the amount of dispersion of a data set. Standard deviation was used along with mean to categories the respondents based on the extent of adoption.

3.7.5 Correlation Analysis

Correlation analysis was done to explain the relationship between the dependent and independent variables of the study. Correlation coefficient is a measure of the relation or association between the dependent variable and the different independent variables. The significance of the correlation coefficient was tested for 5 per cent and 1 per cent levels of significance.



X_1 - Age

X_2 - Education

X_3 – Occupation

X_4 – Farm size

X_5 - Area under bittergourd cultivation

X_6 - Farming Experience

X_7 - Annual Income

X_8 - Irrigation Potential

X_9 - Extension Orientation

X_{10} - Economic Motivation

X_{11} – Innovativeness

X_{12} - Market Orientation

X_{13} - Level of Awareness

X_{14} – Knowledge

Fig. 3. Conceptual model of the relationship between variables

RESULTS & DISCUSSION

CHAPTER - IV

RESULTS AND DISCUSSION

This chapter deals with the results and discussion based on the analysis of data obtained after survey research. The results and discussions are presented under the following heads.

4.1 Distribution of Respondents based on their Personal and Social Characteristics of Bittergourd Farmers

4.1.1 Age

4.1.2 Education

4.1.3 Occupation

4.1.4 Farm Size

4.1.5 Area under Bittergourd Cultivation

4.1.6 Farming Experience

4.1.7 Annual Income

4.1.8 Irrigation Potential

4.1.9 Economic Motivation

4.1.10 Innovativeness

4.1.11 Market Orientation

4.1.12 Extension Orientation

4.2 Awareness about Recommended Practices in Bittergourd Cultivation

4.2.1 Distribution of Farmers Based on their Awareness about Recommended Practices in Bittergourd Cultivation

4.2.2 Level of Awareness about Recommended Practices by Farmers

4.3 Knowledge of Selected Recommended Practices

4.5.10 Relation between the Extent of Adoption of Farmers' Practices with the Selected Characteristics of the Respondents.

4.5.11 Technology Needs Assessment for the Production Practices as Perceived by Bittergourd Farmers.

4.6 Constraints Experienced by Bittergourd Farmers and Suggestion for Refinement as Perceived by the Farmers.

4.7 Reasons for Non - Adoption of Recommended KAU Practices in the Cultivation of Bittergourd

4.8 Suggestions for Refinement

4.1 DISTRIBUTION OF RESPONDENTS BASED ON THEIR PERSONAL AND SOCIAL CHARACTERISTICS OF BITTERGOURD FARMERS

The distribution of bittergourd farmer respondents based on their personal and social charachterisitics selected through judges rating are presented below.

4.1.1 Age

Age was the number of years completed by the bittergourd farmer respondent at the time of interview. The result on distribution of respondents based on their age is illustrated in Table 2.

Table 2. Distribution of respondents based on age

N=90

Category (Years)	Kalliyoor (n-30)		Manikal (n-30)		Vembayam (n-30)		Total	
	No.	%	No	%	No	%	No.	%
< 35	2	6.66	3	10.00	2	6.66	7	7.77
35-55	11	36.67	15	50.00	16	53.33	42	46.67
>55	17	56.67	12	40.00	12	40.00	41	45.56

On analysis of Table 2 it was evident that 46.67 per cent of the farmers surveyed belonged to middle age category, followed by old age (45.56 %) and young aged farmers (7.77 %).

On screening the Panchayat wise distribution of respondents based on age, in Manikal and Vembayam Panchayats there were 50.00 and 53.33 per cent of respondents under middle aged category. In Kalliyoor Panchayat the respondents mostly belonged to old age category with 56.67 per cent followed by 36.67 per cent respondents under middle age category.

Respondents belonging to young age category were very less in all the three Panchayats with 6.66, 10.00 and 6.66 per cent respectively in Kalliyoor, Manikal and Vembayam.

Hence it was concluded that majority of the bittergourd farmers belonged to the category of middle and old age and only less than 10.00 per cent of respondents were young farmers.

This distribution of farmers is a typical representation of Kerala farming situation where majority of farmers belong to middle age or old age category.

This condition prevailing in Kerala agriculture might be presumably due to the non-lucrative nature of existing farming scenario to the youngsters. This calls for an adequate policy and support system that ensures better profit and living conditions for farmers in Kerala for motivating and attracting youngsters to take pride in farming. The results are in agreement with the findings of Jaganathan (2004), Thomas (2004) and Jacob (2015).

4.1.2 Education

Education was the extent of formal learning possessed by the respondent at the time of interview. The respondents were grouped based on the education level into different categories like illiterate, primary, middle, high school and collegiate. The results of the distribution of respondents based on education level are projected in Table 3.

Table 3. Distribution of respondents based on education

N = 90

Category	Kalliyoor (n-30)		Manikal (n-30)		Vembayam (n-30)		Total	
	No.	%	No.	%	No.	%	No.	%
Illiterate	0	0.00	0	0.00	0	0.00	0	0.00
Primary	3	10.00	1	3.33	2	6.66	6	6.66
Middle	5	16.67	6	20.00	5	16.67	16	17.78
High school	20	66.67	23	76.67	20	66.67	63	70.00
Collegiate	2	6.66	0	0.00	3	10.00	5	5.56

On analysis of Table 3, it was inferred that all the respondents were literate with educational qualification ranging from primary level to collegiate level. Seventy per cent of the farmers went to high school followed by middle school, primary and collegiate level with 17.78, 6.66 and 5.56 per cent respectively.

Area wise distribution of respondents on education also reflected this finding where, farmers with high school level education was more. Manikal was the Panchayat with more number of respondents with high school education, that is, 76.67 per cent compared to the other two areas. Collegiate education was more in Vembayam with 10.00 per cent. No respondents in Manikal had collegiate education.

Therefore, it was concluded that 93.34 per cent farmers had educational qualification from middle school to collegiate level. The high level of literacy in the state might be an influence in the overall higher educational level of the respondents at large. The findings that majority of the respondents possess higher level of education is in conformity with the studies of Oommen(2007), Krishnan (2013) and Jacob (2015).

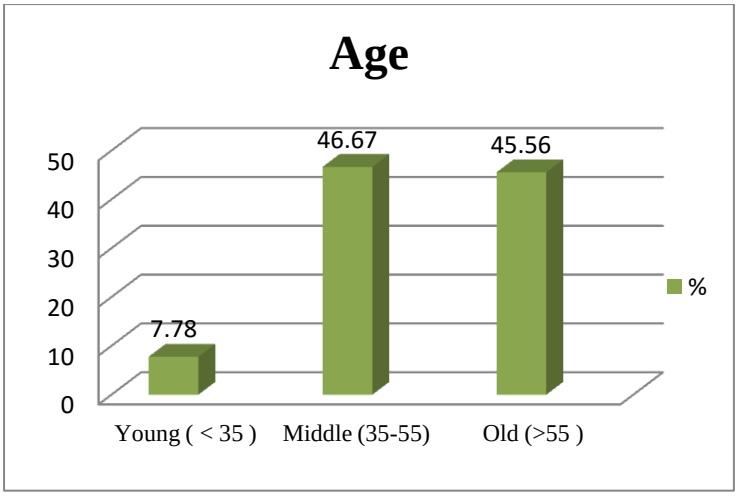


Fig. 4. Distribution of respondents based on age

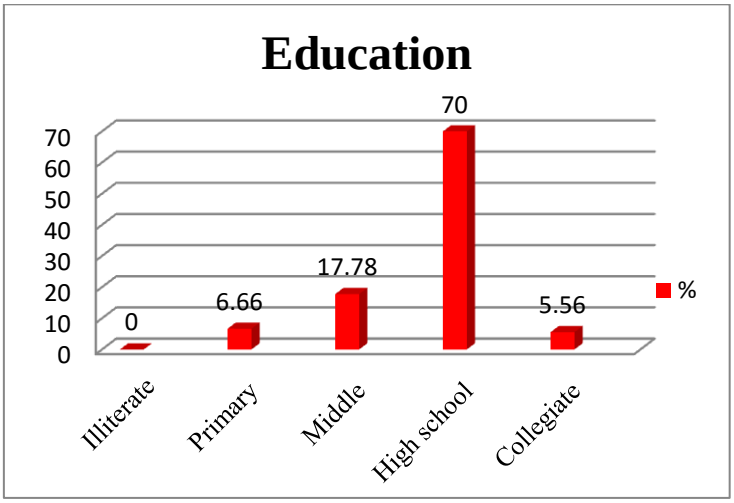


Fig. 5. Distribution of respondents based on education

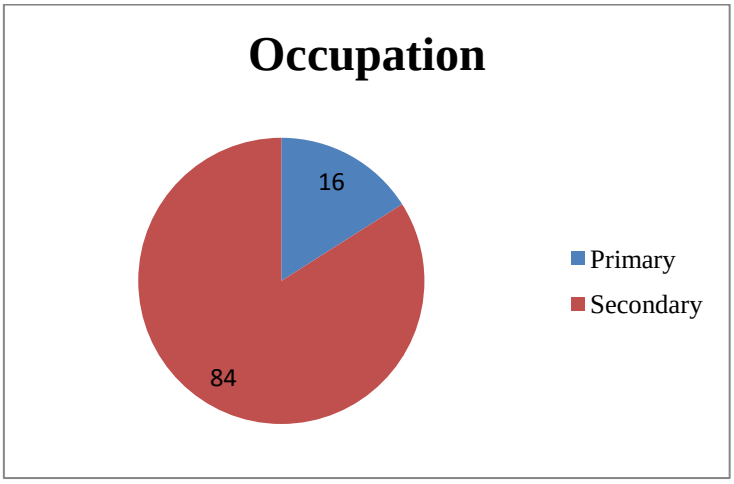


Fig. 6. Distribution of respondents based on occupation

4.1.3 Occupation

Occupation was the vocation of the farmer respondents at the time of interview. The respondents were grouped based on the occupation and illustrated in Table 4.

Table 4. Distribution of respondents based on occupation

N=90

Category	Kalliyoor (n-30)		Manikal (n-30)		Vembayam (n-30)		Total	
	No.	%	No.	%	No.	%	No.	%
Primary (Agriculture)	24	80.00	24	80.00	28	83.33	76	84.44
Secondary (Others+ agriculture)	6	20.00	6	20.00	2	16.66	14	15.56

A perusal of Table 4 showed that most of the respondents (84.44 %) had agriculture as their only occupation while about 15.56 per cent of the respondents took other jobs along with farming. All the three Panchayats had about equal distribution of farmers as the total in primary and secondary category.

The results are significant in a way that more than 80 per cent of bittergourd farmers directly depend on agriculture as a means of livelihood. The results are in agreement with the findings of Jayapalan (1999) and Kafle (2011).

4.1.4 Farm Size

Farm size in this study referred to the area under cultivation by the farmer measured in acres. The respondents were grouped into different categories and expressed as frequency and percentages which is given in Table 5.

Table 5. Distribution of respondents based on farm size

N=90

Category	Kalliyoor (n-30)		Manikal (n-30)		Vembayam (n-30)		Total	
	No.	%	No.	%	No.	%	No.	%
< 1 acre	6	20.00	13	43.33	12	40.00	31	34.44
1-2 acre	19	63.34	13	43.33	14	46.67	46	51.12
>2 acre	5	16.66	4	13.33	4	13.33	13	14.44

It was evident from Table 5 that 51.12 per cent of the farmers had farm size between 1 and 2 acres. Only 14.44 per cent of the farmers had farm size more than 2 acre and 34.44 per cent of the farmers had farm size less than 1 acre.

Except for Kalliyoor, where more than half of the respondents had farm size of 1-2 acre (63.34%), Manikal and Vembayam Panchayats had 43.33 and 46.67 per cent respondents respectively with farm size 1-2 acres. However respondents with farm size more than 2 acre were comparatively less with 16.66, 13.33 and 13.33 per cent respectively for the three Panchayats.

Hence it was summarised that majority of the bittergourd farmers are marginal farmers and farmers concentrate on crops that are remunerative. The results are in confirmatory with the findings of the study done by Al-Shadiadeh (2012) and Jacob (2015).

4.1.5 Area under Bittergourd Cultivation

Area under bittergourd cultivation in this study was referred to as the area utilised for bittergourd cultivation measured in acres. The respondents were categorized into various categories based on area under bittergourd cultivation and presented in Table 6.

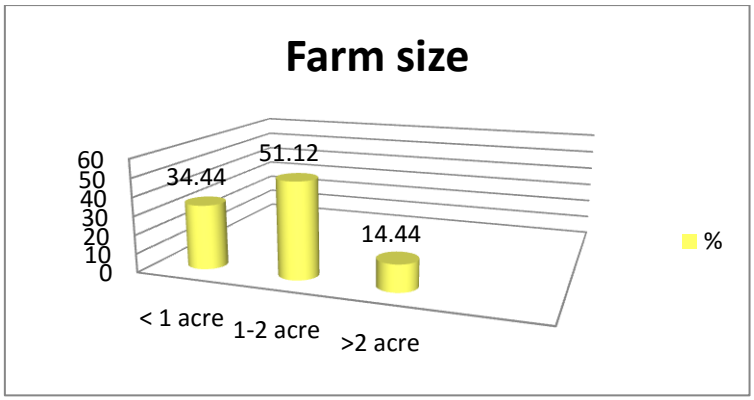


Fig. 7. Distribution of respondents based on farm size

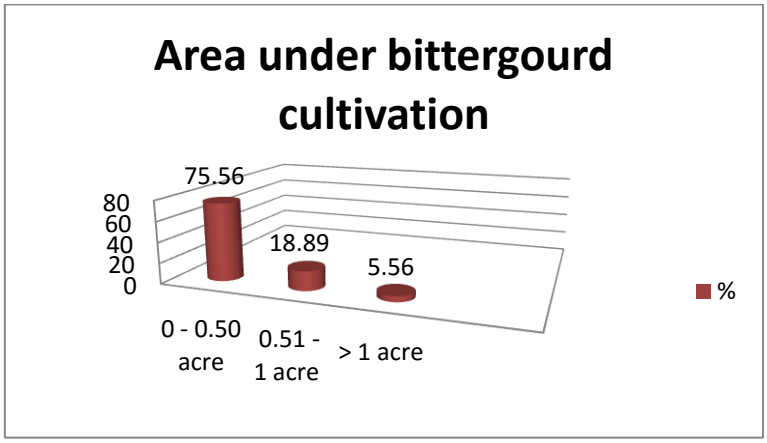


Fig. 8. Distribution of respondents based on area under bittergourd cultivation

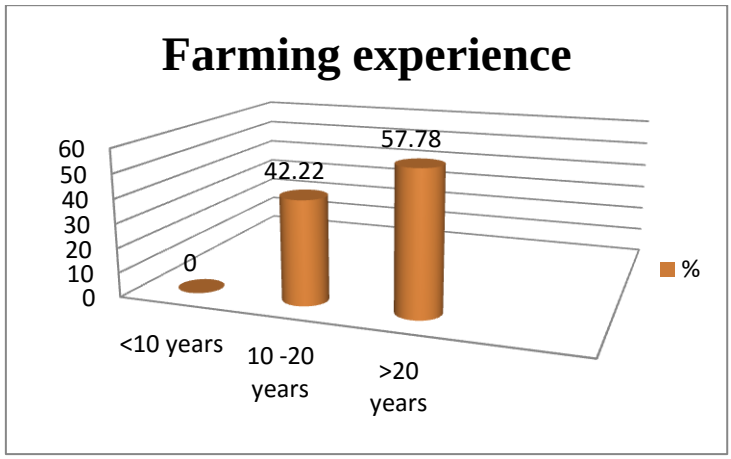


Fig. 9. Distribution of respondents based on farming experience

Table 6. Distribution of respondents based on area under bittergourd cultivation

N=90

Category (in acres)	Kalliyoor (n-30)		Manikal (n-30)		Vembayam (n-30)		Total	
	No.	%	No.	%	No.	%	No.	%
0 - 0.50	18	60.00	28	93.33	22	73.33	68	75.56
0.51- 1	10	33.33	2	6.67	5	16.67	17	18.89
> 1	2	6.67	0	0	3	10.00	5	5.55

On perusal of Table 6 it was inferred that majority of the respondents cultivated bittergourd in area less than or equal to 0.50 acres (75.56 %). Only 5.55 per cent of farmers cultivated bittergourd in more than 1 acre land and 18.89 per cent farmers' utilised area between 0.51 and 1 acre for bittergourd farming.

Panchayat wise distribution also reflected similar trend where majority of respondents utilised an area less than or equal to 0.50 acres. In Manikal Panchayat there were no farmers who cultivated bittergourd in an area of more than 1 acre. The result reflects the findings of Jayapalan (1999) were majority of the bittergourd farmers (60 %) had less area under bittergourd (< 0.60 acres).

4.1.6 Farming Experience

Farming experience was the experience of the farmer in bittergourd cultivation expressed in terms of number of years. The respondents were categorised into various groups based on farming experience and presented in Table 7.

Table 7. Distribution of bittergourd farmers based on farming experience

N=90

Category (Years)	Kalliyoor (n-30)		Manikal (n-30)		Vembayam (n-30)		Total	
	No.	%	No.	%	No.	%	No.	%
< 10	0	0.00	0	0.00	0	0.00	0	0.00
10-20	11	36.66	18	60.00	9	30.00	38	42.22
> 20	19	63.34	12	40.00	21	70.00	52	57.78

From Table 7 it was inferred that 57.78 per cent of the farmers had more than 20 years of farming experience followed by 42.22 per cent of respondents with 10-20 years of experience and no farmers with less than 10 years experience.

The Panchayat wise distribution also reflected the same as the total results with 63.34 and 70.00 per cent farmers of Kalliyoor and Vembayam Panchayats respectively having more than 20 years experience in the field of agriculture while Manikal Panchayat had more farmers (60.00%) with farming experience between 10 and 20 years and only 40.00 per cent farmers had more than 20 years farming experience.

Hence it was inferred that majority of the respondents were experienced farmers and the long experience can be attributed to the fact that majority of the farmers belongs to middle and old aged category and farming is the primary source of income to many farmers. This further indicates the absence of youth in farming. The result contradicts the findings of Jayapalan (1999) and is in confirmatory with the studies done by Jacob (2015).

4.1.7 Annual Income

This referred to the total annual earnings from the on farm and off farm activities of the farmer. This was measured in terms of lakhs of rupees per year as expressed by the bittergourd farmer respondents and presented on Table 8.

Table 8. Distribution of the respondents based on annual income

N=90

Category (in lakhs)	Kalliyoor (n-30)		Manikal (n-30)		Vembayam (n-30)		Total	
	No	%	No.	%	No.	%	No.	%
< 1	3	10.00	5	16.67	7	23.34	15	16.67
1 to 2	15	50.00	11	36.67	9	30.00	35	38.89
>2	12	40.00	14	46.66	14	46.66	40	44.44

A cursory look at Table 8 revealed that 44.44 per cent of the bittergourd farmers obtained an income of more than 2 lakh followed by 38.89 per cent with an income between 1 and 2 lakh while only 16.67 per cent farmers obtained an income less than 1 lakh.

Area wise distribution indicated that in Kalliyoor Panchayat about 50 per cent of the farmers received an income between 1 and 2 lakhs while in Manikal and Vembayam this

amounted to only 36.67 and 30.00 per cent respectively. Farmers incurring an income more than 2 lakhs was more in the case of Manikal and Vembayam Panchayat with 46.66 per cent in each of the areas while in case of Kalliyoor it was 40.00 per cent.

Hence it was inferred that majority of farmers irrespective of Panchayat assumes an income of more than 2 lakhs and this may be a reflection of the proper utilisation of the available area under cultivation and its remunerativeness.

4.1.8 Irrigation Potential

Irrigation potential referred to the extent to which irrigation water was obtainable in the holding and the extent of area irrigated by the available irrigation water. It was measured in terms of availability of irrigation water for irrigating the field and the scoring procedure is presented in Table 9.

Table 9. Distribution of respondents based on irrigation potential

N=90

Category	Kalliyoor (n-30)		Manikal (n-30)		Vembayam (n-30)		Total	
	No.	%	No.	%	No.	%	No	%
Physical Water Scarcity	1	3.33	13	43.33	13	43.33	27	30.00
Economic Water Scarcity	7	23.33	13	43.33	13	43.33	33	36.67
Little or no water scarcity	22	73.34	4	13.34	4	13.34	30	33.33

On analysis of Table 9, it was inferred that 36.67 per cent of respondents opined there exist a state of economic water scarcity followed by 33.33 per cent of respondents stated that there is little or no water scarcity and finally 30 per cent farmers stated that they confront a condition of physical water scarcity.

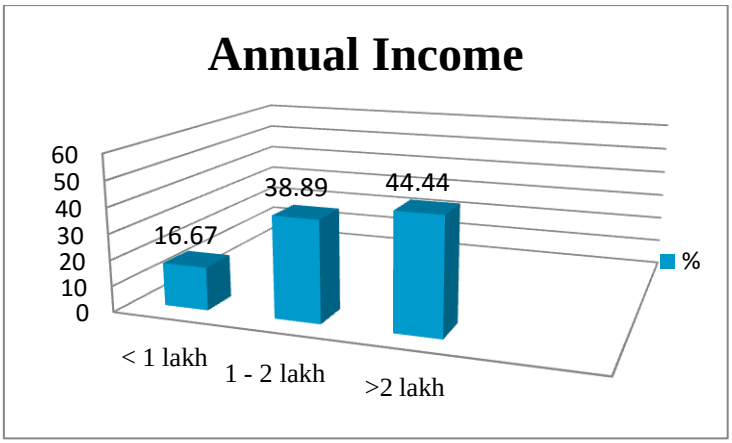


Fig. 10. Distribution of respondents based on annual income

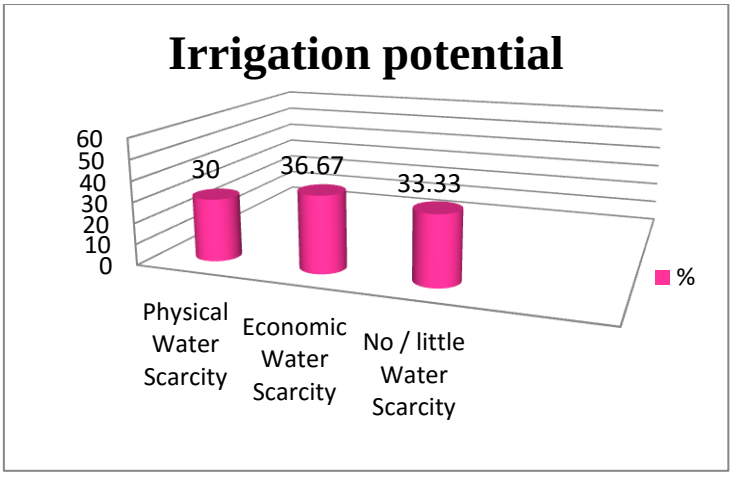


Fig. 11. Distribution of respondents based on Irrigation potential

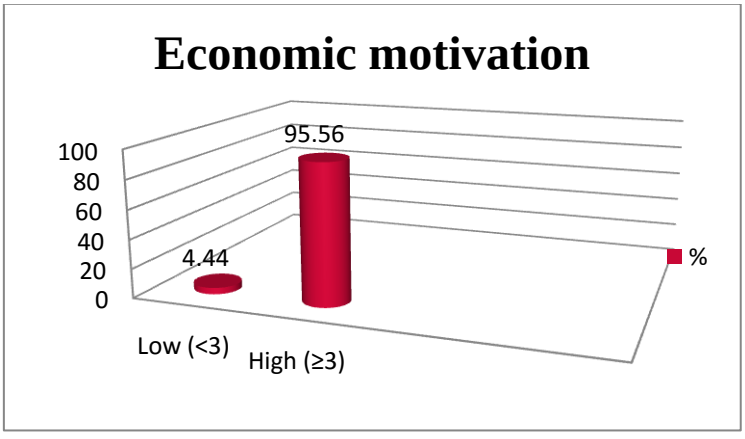


Fig. 12. Distribution of respondents based on Economic motivation

In Manikal and Vembayam Panchayat, 43.33 per cent respondents opined that they witnessed physical water scarcity as well as economic water scarcity while only 23.33 per cent and 3.33 per cent of the farmers of Kalliyoor responded that they confront with economic water scarcity and physical water scarce conditions respectively. About 73.34 per cent of the farmers of Kalliyoor stated that they do not meet with water scarce situations. This might be due to the fact that cultivation of most of the crops in this area is taken up in wet land region were there exist plenty of water for irrigation.

However the findings of the other two Panchayats highlight the importance of water conservation, as majority of the farmers (66.67 %) either confronts with economic or physical water scarcity. This finding highlights the significance of educating the farmers on effective irrigation techniques as most of them still rely on channel or basin irrigation. The results are in general conforming to the findings of Jacob (2015) and contradicts the results of Thomas (2004) in the case of Kalliyoor Panchayat. The Vellayani lake that could be a source of irrigation water could be attributed to the respondents perception of little or no water scarcity in Kalliyoor Panchayat.

4.1.9 Economic Motivation

Economic motivation was the drive of the respondent to obtain profit and the relative value placed on economic ends by the bittergourd farmers. It was one of the major factors of technology adoption. The farmers were grouped into high and low categories based on economic motivation and presented in Table 10.

Table 10. Distribution of respondents based on economic motivation

N=90

Category	Kalliyoor (n- 30)		Manikal (n- 30)		Vembayam (n- 30)		Total	
	No.	%	No.	%	No.	%	No.	%
Low (<3)	2	6.67	0	0.00	2	6.67	4	4.44
High (≥ 3)	28	93.33	30	100.00	28	93.33	86	95.56

Range: 2-6

It was inferred from Table 10 that 95.56 per cent of the total farmers had a score of more than or equal to 3 for economic motivation. Only 4.44 % of the respondents had less economic motivation which included a score of less than three. The score of economic motivation of the total respondents ranged between two and six. It indicated that there were

respondents who obtained maximum score of six but no respondents with minimum score of zero. The minimum score obtained was two.

The Panchayat wise distribution of results also reflected the total result where farmers with high economic motivation were more in number. In Manikal Panchayat all the thirty respondents had a score of more than or equal to three, while it as 93.33 per cent in Vembayam and Kalliyoor Panchayat respectively.

Hence it can be inferred that the economic motivation was high for majority of the respondents irrespective of the Panchayats in which the farmers belong. This finding is almost in conformation with the results of Patel *et al.* (2013) which reported that maximum vegetable farmer respondents had medium economic motivation. The high levels of economic motivation observed among the vast majority of respondents might be one reason for selecting bittergourd vegetable which is often considered as a remunerative crop with high demand in the market. Borthakur *et al.* (2015) also reported that farmers with high economic motivation will readily adopt improved technologies.

4.1.10 Innovativeness

Innovativeness referred to the relative earliness in adopting an innovation. The farmer respondents were categorised as high, medium and low based on innovativeness and presented in Table 11.

Table 11. Distribution of respondents based on their innovativeness

N=90

Category	Score	Kalliyoor (n- 30)		Manikal (n- 30)		Vembayam (n- 30)		Total	
		No.	%	No.	%	No.	%	No.	%
Low	1	4	13.33	11	36.66	7	23.34	22	24.45
Medium	2	18	60.00	14	46.67	17	56.66	49	54.44
High	3	8	26.67	5	16.67	6	20.00	19	21.11

It was summarised from Table 11 that 54.44 per cent of the respondents had medium level of innovativeness with a score of 2 followed by 24.45 percent with low level of innovativeness and 21.11 per cent with high level of innovativeness. Hence the innovativeness of the respondents ranged from medium to low. The result supports the findings of Jayapalan (1999) where majority of bittergourd farmers respondents were low

innovators (80 %) than high innovators (20 %) and contradicts the findings of Chandran and Joseph (2015) where majority of the coconut farmers had high innovativeness (50 %) followed by low (45.2 %) and medium innovativeness (4.8 %) in adopting irrigation interval.

Panchayat wise distribution also reflected the total result except for Kalliyoor Panchayat where farmers with high innovativeness (26.67 %) were recorded more than farmers with low innovativeness (13.33 %). Manikal Panchayat had more number of low innovative farmers with 36.66 per cent followed by Vembayam with 23.34 per cent and Kalliyoor with 13.33 per cent. Farmers with high level of innovativeness were recorded more in Kalliyoor Panchayat with 26.67 per cent followed by 20.00 per cent in Vembayam and 16.67 per cent in Manikal Panchayat. This might be due to proximity of Kalliyoor to Agriculture College, Vellayani and hence farmers are more accessible to extension activities and availability of new technologies is also more compared to other Panchayats.

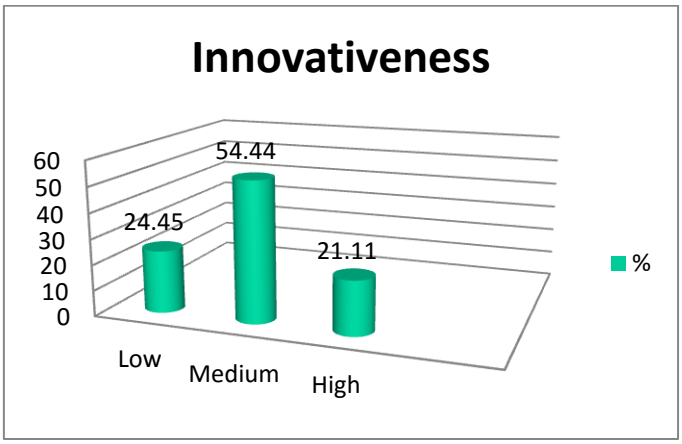


Fig. 13. Distribution of respondents based on Innovativeness

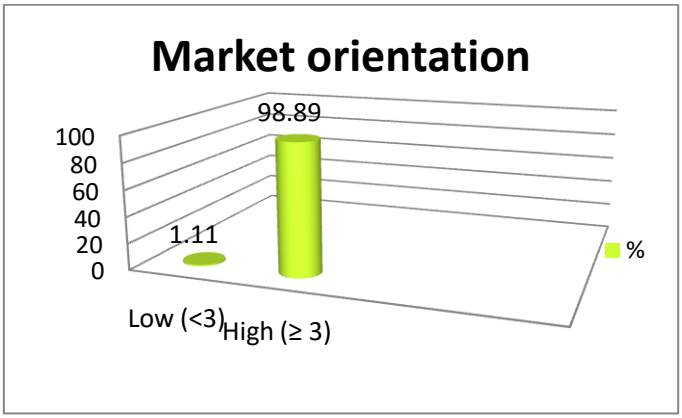


Fig. 14. Distribution of respondents based on Market orientatio

4.1.11 Market Orientation

The degree to which farmers were oriented towards marketing to obtain reasonable gains from selling the produce was operationalised as market orientation. The respondents were grouped into low and high based on market orientation and is presented in Table 12.

Table 12. Distribution of respondents based on market orientation

N= 90

Category	Kalliyoor (n- 30)		Manikal (n- 30)		Vembayam (n- 30)		Total	
	No.	%	No.	%	No.	%	No.	%
Low (<3)	0	0.00	0	0.00	1	3.33	1	1.11
High (≥3)	30	100.00	30	100.00	29	96.67	89	98.89

Range: 2-6

A perusal of Table 12 revealed that the total market orientation of the respondent sample was high with 98.89 per cent falling in the category of greater than three score *vide* table. It was found that market orientation was considerably high in all the three Panchayats with 100.00, 100.00 and 96.67 per cent of respondents respectively in Kalliyoor, Manikal and Vembayam Panchayat getting score above three. Hence it was concrete that about 98.89 per cent of the total bittergourd farmers had a higher level of market orientation. This was seemingly because of market oriented farming activity followed by the bittergourd farmers' inorder to fetch more prices for the produce. The result supports the findings of Krishnan (2013) where majority of the homegarden farmers had high market orientation (70 %) and contradicts the findings of Patel *et al.* (2013) where majority of the farmers had low market orientation (52.25 %). The score of marketing orientation of the total respondents ranged between two and six. It can be inferred that there were respondents with maximum score of six and no respondents with minimum score of zero.

Table 13: Percentage distribution of respondents based on extension contact

Category	Kalliyoor			Manikal			Vembayam			Total		
	VO	O	N	VO	O	N	VO	O	N	VO	O	N
Agricultural Officer	76.67	20.00	3.33	60.00	40.00	0.00	23.33	76.67	0.00	53.33	45.56	1.11
Scientists at KAU	6.67	90.00	3.33	6.67	80.00	13.33	0.00	53.33	46.67	4.44	74.45	21.11
Scientists at ICAR institutions	3.33	50.00	46.67	0.00	46.67	53.33	0.00	20.00	80.00	1.11	38.89	60.00
Personnel of other institutions/ commodity boards	6.67	60.00	33.33	6.67	66.67	26.66	3.33	50.00	46.67	5.56	58.89	35.55
Progressive farmers	73.33	26.67	0.00	46.67	46.67	6.66	50.00	46.67	3.33	56.67	40.00	3.33

VO – Very Often O- Often N - Never

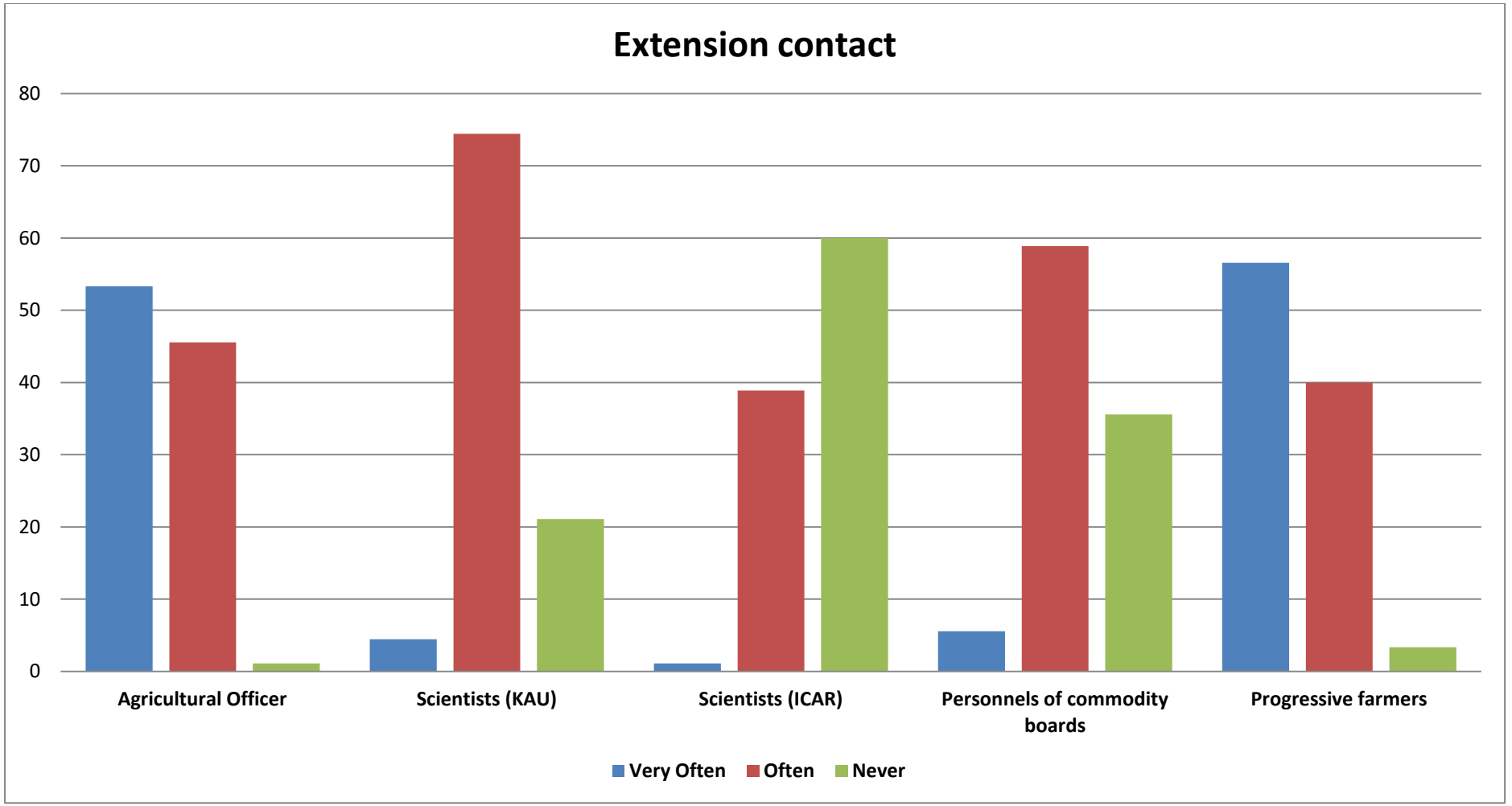


Fig. 15. Percentage distribution of respondents based on extension contact

4.1.12 Extension Orientation

Extension orientation was the extent of contact a farmer had with different extension agencies and also his participation in various extension events or programmes organised by this agencies.

It was obtained by summing up the values obtained in extension contact and extension event participation.

i. Extension Contact

On perusal of Table 13, it was inferred that 56.67 per cent of them stated that they contacted progressive farmers 'Very often', followed by Agricultural Officer (53.33 %), personnel's of various commodity boards (5.56 %), scientists at KAU (4.44 %) and finally scientists at various other ICAR institutions (1.11 %). Farmers also stated that 'often' contacts were made with scientists of KAU (74.45 %).

On checking the total results, it was analysed that 98.89 per cent of respondents had either 'very often' or 'often' contact with the Agricultural Officer, 96.67 per cent with progressive farmers and 78.89 per cent with scientists at KAU. Only 40 per cent of the farmer respondents had contact with scientists at other ICAR institutions which were the least contacted group.

From panchayat wise results it was observed that in Kalliyoor Panchayat 90.00 per cent of farmers had 'often' contact with the scientists of KAU. It might be because of the proximity of College of Agriculture. The contact of farmers with Agriculture Officer was also fairly good in Kalliyoor Panchayat with 76.67 per cent farmers having 'very often' contact with the officer.

ii. Extension Event Participation

On a cursory look at Table 14, it was inferred that about 40.00 per cent of the farmer respondents participated in meeting 'whenever conducted'. Only 1.11 per cent participated in Farmer Field Schools both 'whenever conducted' and 'sometimes' mainly because it was not conducted in any of the three Panchayats. About 76.67 and 74.44 percent of respondents participated 'sometimes' in seminar and melas respectively.

Table 14. Percentage distribution of respondents based on extension event participation

Category	Kalliyoor			Manikal			Vembayam			Total		
	WC	S	N	WC	S	N	WC	S	N	WC	S	N
Study tour	10.00	53.33	36.67	0.00	26.67	73.33	10.00	40.00	50.00	6.67	40.00	53.33
Seminar	30.00	63.33	6.67	6.67	86.67	6.67	6.67	80.00	13.33	14.44	76.67	8.89
Mela	40.00	56.67	3.33	0.00	80.00	20.00	0.00	86.67	13.33	13.33	74.44	12.22
Meeting	66.67	30.00	3.33	36.67	63.33	3.33	16.67	76.67	3.33	40.00	56.67	3.33
Farmer Field School	3.33	3.33	93.33	0.00	0.00	100.00	.00	0.00	100.00	1.11	1.11	97.78
Demonstration	3.33	66.67	30.00	3.33	63.33	33.33	6.67	50.00	43.33	4.44	60.00	35.56

WC-Whenever conducted, S-Sometimes, N-Never

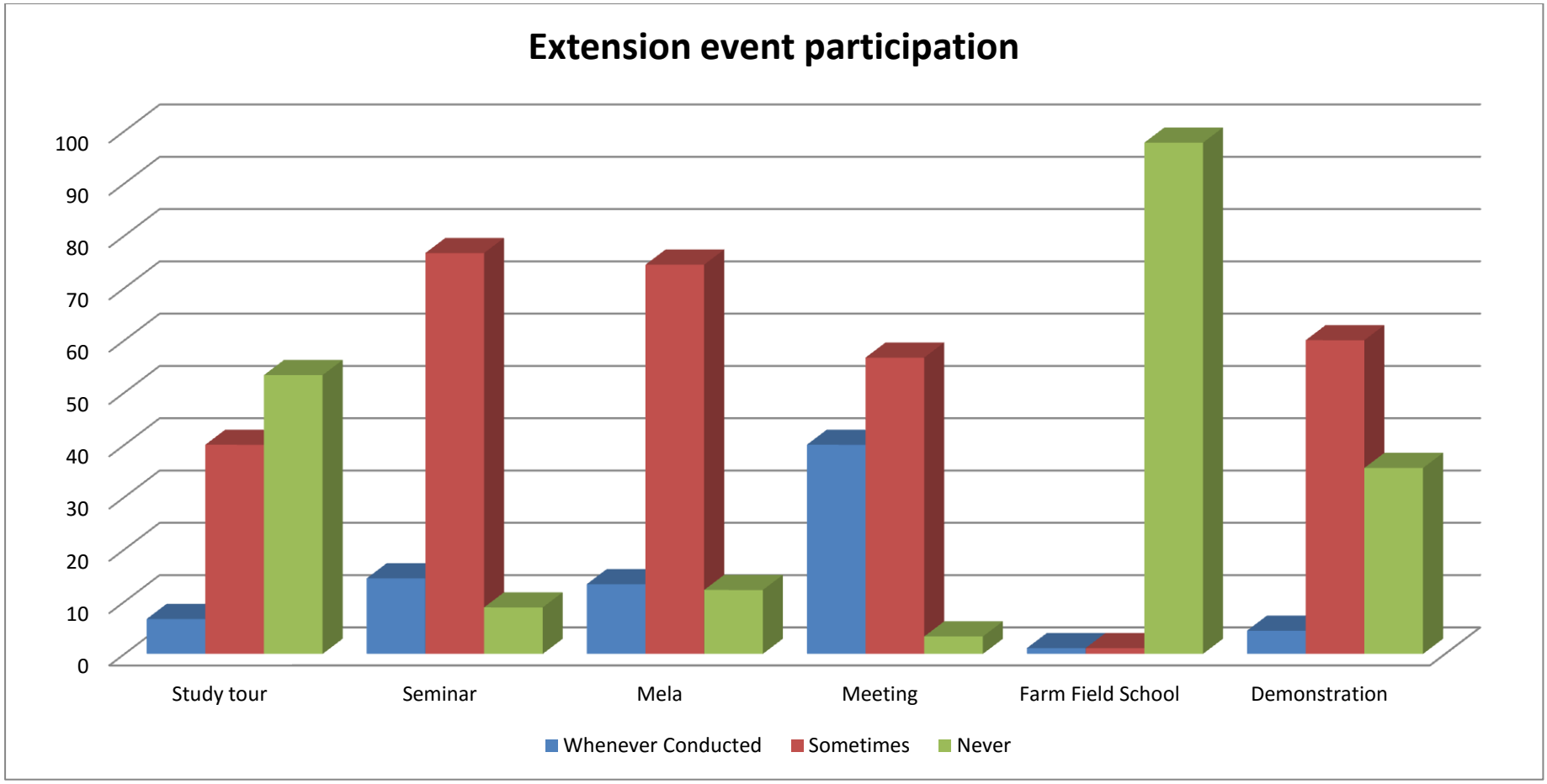


Fig.16. Percentage distribution of respondents based on extension event participation

Looking into the overall result it was summarised that meeting is the event in which about 96.67 per cent of the respondents participated either 'whenever conducted' or 'sometimes' followed by 91.11 per cent in seminar, and 87.78 per cent in melas/fairs. The least participated event was Farmer Field School were only 2.22 per cent of the farmers participated.

Extension Orientation

Table 15. Distribution of respondents based on extension orientation

N=90

Category	Class limits	Kalliyoor (n-30)		Manikal (n-30)		Vembayam (n-30)		Total	
		No	%	No	%	No	%	No	%
Low	< 9	2	6.67	7	23.33	13	43.33	22	24.44
Medium	9-14	18	60.00	17	56.67	14	46.67	49	54.44
High	> 14	10	33.33	6	20.00	3	10.00	19	21.11

Range - 4 - 25

Summarising the extension orientation of the respondents from Table 15, about 24.44 per cent farmers had low extension orientation, that is, they fall in the lower quartile range, 54.44 per cent falls in the middle quartile region while 21.11 per cent of respondents had high orientation level and they fall in the upper quartile region (Fig. 17).

The score of the respondents for extension orientation ranged from 4 to 25. The score range was considerably high with the minimum score that was obtained by a respondent as four and the maximum as 25.

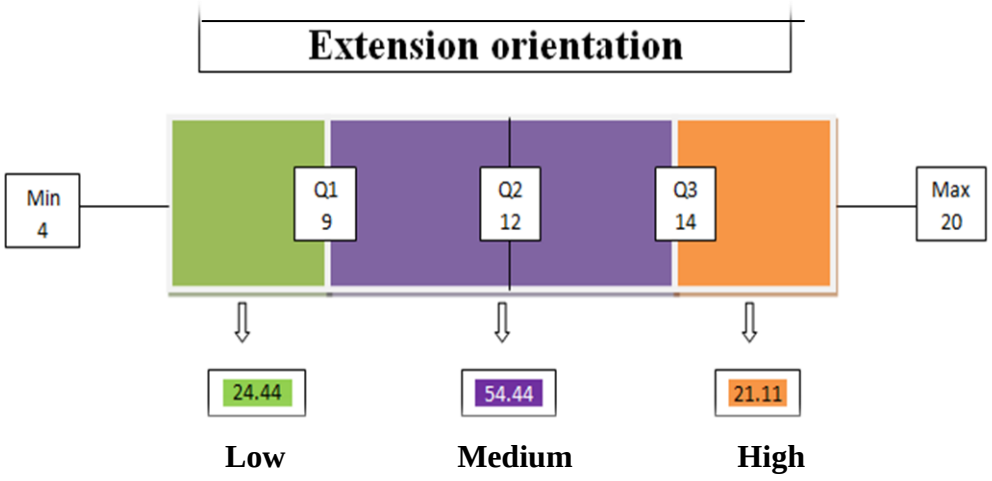


Fig. 17. Distribution of respondents based on extension orientation (Box Plot)

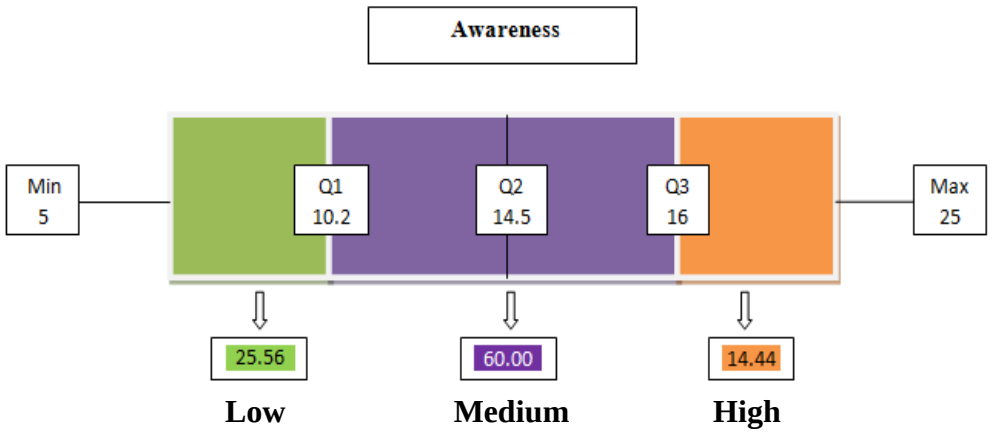


Fig.18. Distribution of respondents based on the level of awareness of recommended practices (Box plot).

The distribution of respondents based on extension orientation followed a normal distribution since more number of respondents (54.44 %) occupied the middle 50 per cent region and an almost equal number of respondents occupied the lower and upper region (24.44 % and 21.11 % respectively).

Panchayat wise distribution from Table 15. also reflected similar results except in Kalliyoor Panchayat where extension orientation ranged from medium to high. However about 33.33 per cent respondents of Kalliyoor were placed in the upper region compared to the other two Panchayats which can be attributed to the proximity of the study area to Agriculture College.

4.2 AWARENESS ABOUT RECOMMENDED PRACTICES IN BITTERGOURD CULTIVATION

Awareness indicated whether the farmers knew about the existence of a particular innovation in practice or technology.

4.2.1 Distribution of Respondents Based on their Awareness about Recommended Practices in Bittergourd Cultivation

The farmers were grouped into high, medium and low based on awareness level based on quartiles and presented on Table 16 and Fig. 18.

Table 16. Distribution of respondents based on their awareness about recommended practices

N=90

Category	Class limits	Kalliyoor (n- 30)		Manikal (n- 30)		Vembayam (n- 30)		Total	
		No.	%	No.	%	No.	%	No.	%
Low	< 10.25	0	0.00	14	46.67	9	30.00	23	25.56
Medium	10.25 – 16	30	100.00	6	20.00	18	60.00	54	60.00
High	> 16	0	0.00	10	33.33	3	10.00	13	14.44

Range: 5-25

It can be estimated from Fig.18 that 60 per cent of the respondents from the total sample fall in the mid quartile range. Majority of the respondents occupied the middle quartile range (60.00 %), and the lower and upper range was occupied by 25.56 per cent and 14.44 per cent respondents respectively (Fig.18). The score of awareness of the respondents ranged from 5 to 25. From the score range it was inferred that the highest score obtained by the respondents was 25 as against the maximum score of 32. While there were no respondents who received the minimum score of zero since five was the lowest score acquired by the respondents.

Panchayat wise distribution from Table 16 also showed similar results except for Manikal Panchayat with more number of farmers in the lower range (46.67 %). While 33.33 percent farmers occupied the upper range which is the highest when compared with the other two Panchayats. In case of Kalliyoor Panchayat 100 per cent of farmers occupied mid range. This might be because, the farmers might be 'aware' about most of the practices than was 'very aware'.

The awareness level of farmers of Kalliyoor Panchayat was fairly good than the other two Panchayats since no farmers occupied the lower range while 46.67 and 30.00 per cent of farmers in Manikal and Vembayam Panchayat respectively occupied this range.

Hence it was inferred that majority of farmers had medium to low level of awareness about recommended practices in bittergourd. So efforts have to be taken to improve the awareness level of farmers and thereby increase the percentage of farmers to fall in the upper range of awareness. Farmers are not aware of modern technologies because of weak extension services system (PARC, 2012). The need to enhance the performance of the extension unit for proper delivery was emphasized.

4.2.2 Level of Awareness about Recommended Practices by Farmers

Level of awareness was operationalised as the extent or level to which farmers were aware about the recommended practices in bittergourd cultivation.

Awareness regarding the recommended practices was found out on percentage basis of respondents and presented in Table 17.

On examining Table 17 it was analysed that 75.56 and 71.11 per cent farmers were ‘very aware’ about food bait trap and cue lure trap against fruit fly.

Practices such as weeding and raking before fertilizer application, spraying of neem based insecticide and retaining of 3 plants per pit were ‘aware’ by 77.78, 74.44 and 72.22 per cent farmers respectively.

All the respondents were aware about using fruit fly traps. Fruit fly being an important pest of bittergourd needs effective technologies for its management and the awareness level of various traps for its control shows how well the practice was disseminated through the various sources.

Overall the practices that the farmers were ‘not aware’ included seed rate of 5-6 kg/ha (77.78 %), application of carbaryl 10% DP in pit (76.67 %) On analysing Panchayat wise distribution, it was evident that in Kalliyoor panchayat, no respondents were ‘very aware’ about practices such as irrigation at 3-4 days interval, application of carbaryl 10 % DP in pit, harvesting of fruits 10 days after chemical application and seed rate of 5-6 kg/ha. About 50 percent farmers were not aware about application of *Beauveria bassiana* against epilachna beetle and other leaf and flower feeders. This finding highlights the importance of taking steps to disseminate such sustainable and safe practices for pest management to farmers. All the farmer respondents of Kalliyoor panchayat were very well aware about the traps against fruit fly.

Table 17. Percentage of respondents' awareness about recommended practices in bittergourd cultivation.

Production practices														
Items	Kalliyoor(n- 30)			Manikal(n- 30)			Vembayam(n- 30)			Total (N- 90)			Rank over class	Rank over total
	VA	A	NA	VA	A	NA	VA	A	NA	VA	A	NA		
1.	26.67	70.00	3.33	23.33	73.33	3.33	6.67	90.00	3.33	18.89	77.78	3.33	1	2.5
2.	70.00	26.67	3.33	60.00	23.33	16.67	23.33	76.67	0.00	51.11	42.22	6.67	2	5
3.	6.67	83.33	10.00	20.00	63.33	16.67	3.33	70.00	26.67	10.00	72.22	17.78	3	7
4.	33.33	46.67	20.00	10.00	53.33	36.67	3.33	60.00	36.67	15.56	53.33	31.11	4	8
5.	3.33	60.00	36.67	0.00	50.00	50.00	0.00	60.00	40.00	1.11	56.67	42.22	5	10
6.	6.67	53.33	40.00	0.00	66.67	33.33	3.33	36.67	60.00	3.33	52.22	44.44	6	11
7.	0.00	53.33	46.67	3.33	23.33	73.33	0.00	43.33	56.67	1.11	40.00	58.89	7	13
8.	0.00	40.00	60.00	0.00	33.33	66.67	0.00	33.33	66.67	0.00	35.56	64.44	8	14
9.	0.00	23.33	76.67	3.33	20.00	76.67	0.00	20.00	80.00	1.11	21.11	77.78	9	16
Plant protection practices														
10.	96.67	3.33	0.00	63.33	36.67	0.00	66.67	33.33	0.00	75.56	24.44	0.00	1	1
11	40.00	60.00	0.00	23.33	73.33	3.33	3.33	90.00	6.67	22.22	74.44	3.33	2	2.5
12.	96.67	3.33	0.00	50.00	36.67	13.33	66.67	30.00	3.33	71.11	23.33	5.56	3	4
13.	16.67	76.67	6.67	26.67	50.00	23.33	3.33	86.67	10.00	15.56	71.11	13.33	4	6
14.	10.00	70.00	20.00	20.00	46.67	33.33	0.00	50.00	50.00	10.00	55.56	34.44	5	9
15.	3.33	46.67	50.00	3.33	46.67	50.00	0.00	56.67	43.33	2.22	50.00	47.78	6	12
16.	0.00	23.33	76.67	0.00	16.67	83.33	0.00	30.00	70.00	0.00	23.33	76.67	7	15

1- Weeding and raking at the time of fertilizer application,
2 - Varieties are Priya, Priyanka and Arka Harit
3- Retain 3 plants per pit
4- Spacing is 2*2 m
5- Fertilizer application at rate 70:25:25
6- Top dressing of N fertilizer in split doses every fortnightly
7- Irrigation at 3-4 days interval and alternate days during flowering/fruiting
8- Harvesting of fruits only 10 days after chemical application
9- Seed rate is 5-6 kg/ha.
10- Food bait trap and covering fruits
11- Spraying neem based insecticide 2 %
12- Cue lure trap against fruit fly
13- Vector control of mosaic by spraying Dimethoate 0.05 %
14 – Mancozeb spraying 0.2 %
15- Application of *Beauveria bassiana* 10 % and *P.lilacinus* 5 % WP
16- Carbaryl 10 % DP in the pit before sowing

VA- Very Aware A- Aware NA- Not Aware

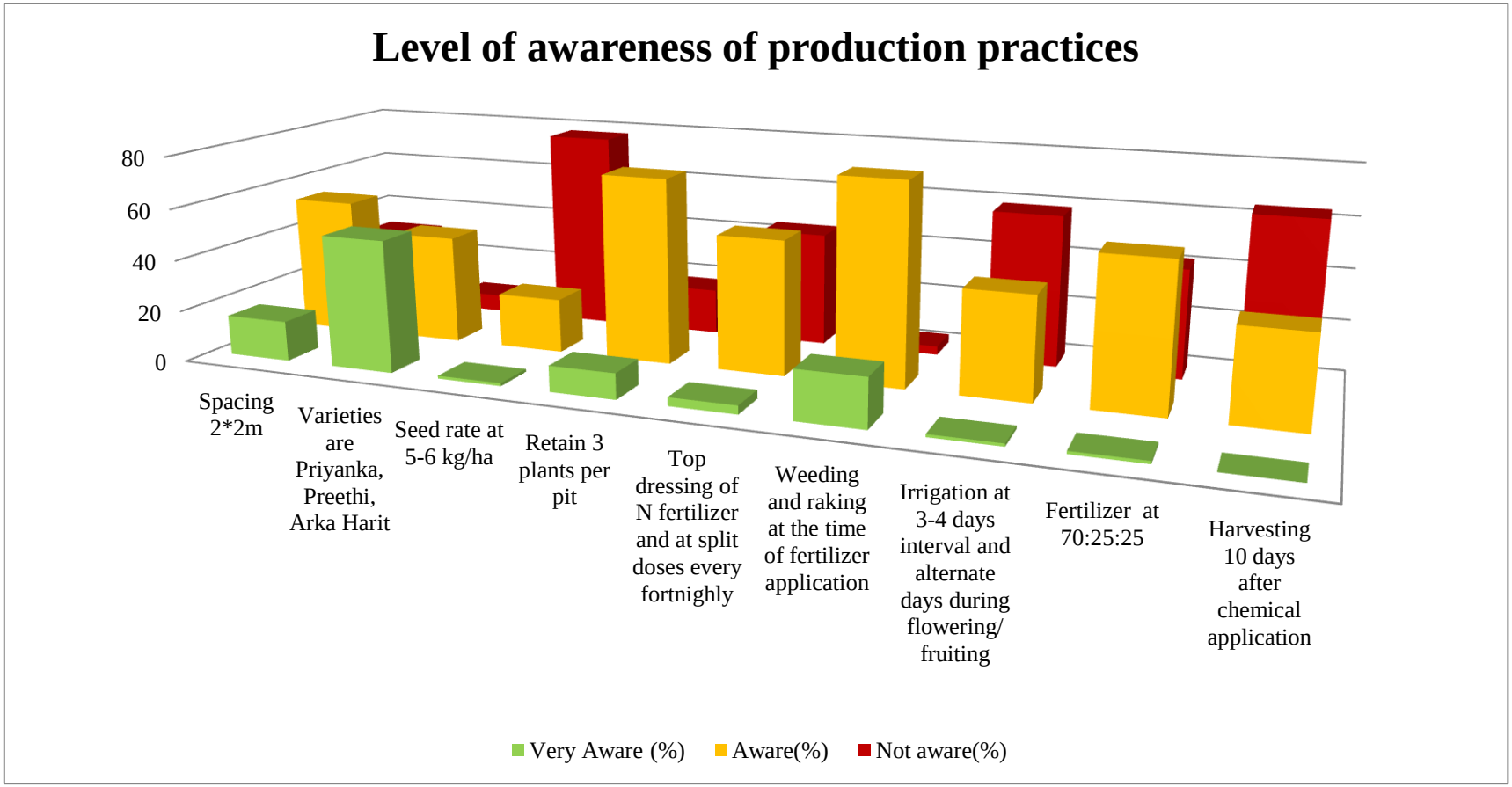


Fig. 19 Level of awareness of recommended production practices in bittergour

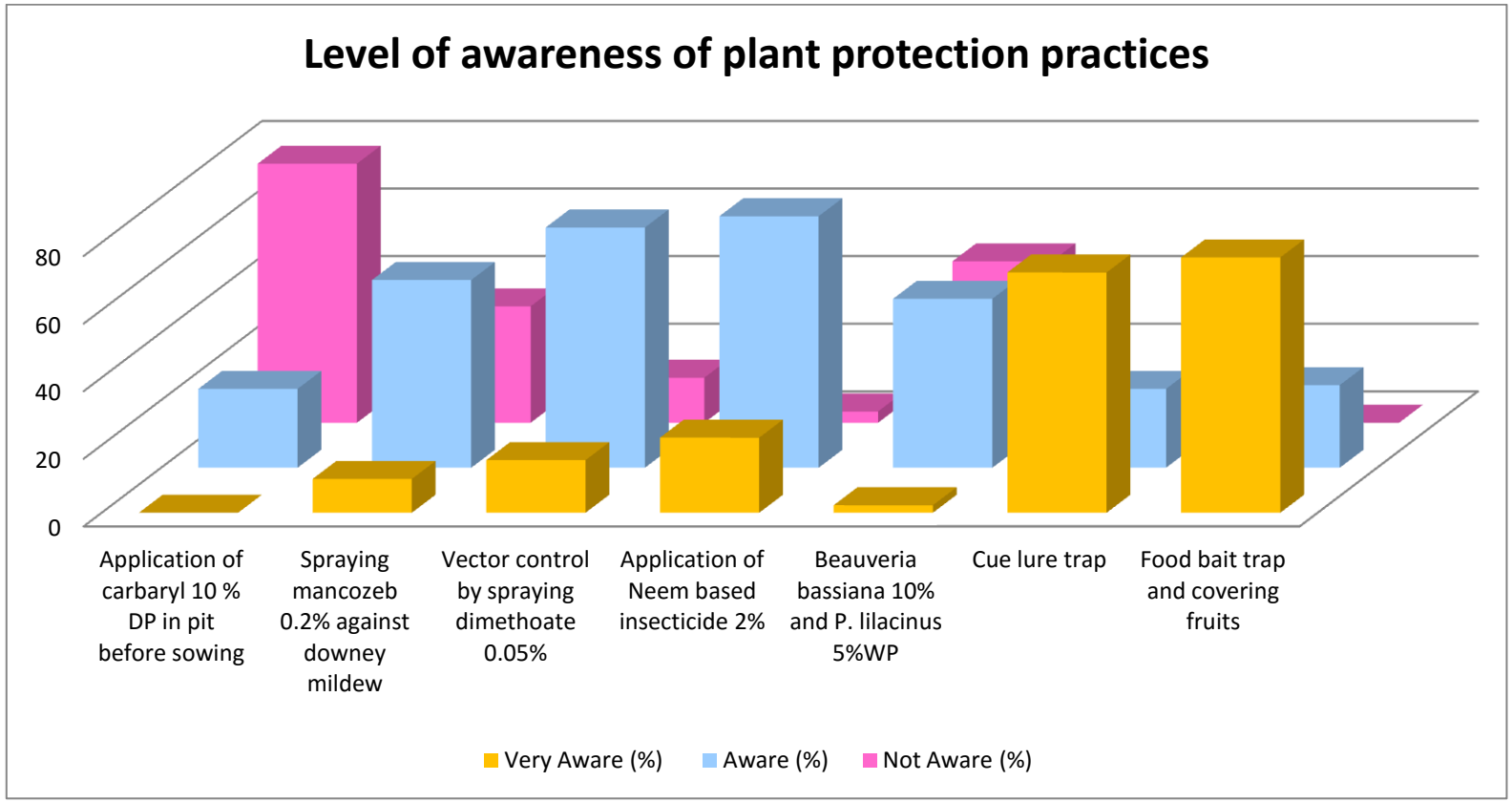


Fig. 20 Level of awareness of recommended plant protection practices in bittergourd

In Manikal panchayat, every farmer respondents were aware about fruit fly trap. In contrast to the other two Panchayats, 13.33 per cent farmers were not aware about cue lure trap. The top three practices that the farmers were 'not aware' included application of carbaryl 10 % DP in pit (83.33 %), seed rate of 5-6 kg/ha (76.67 %) and irrigation at 3-4 days interval (73.33 %). Almost 100 per cent farmers were aware about neem based insecticide against vector of mosaic. The findings of Vembayam Panchayat also reflected similar results.

Low awareness and effectiveness noticed for some technology could be improved through participatory training rendered through the extension unit of State Agricultural Department to the farmers. The need to enhance the performance of the extension unit for proper delivery was emphasized which could be achieved only by delineating the training needs of farmers carrying out bittergourd cultivation.

4.3 KNOWLEDGE OF SELECTED RECOMMENDED PRACTICES

Knowledge referred to the indepth understanding of the innovative practices by the farmer respondents. The knowledge levels of the respondents about the selected practices were found out.

4.3.1 Distribution of Respondents Based on their Knowledge of Selected Practices

The respondents were distributed based on their knowledge of selected practices into high, medium and low based on quartiles and presented in Table 18 and Fig. 21.

Table 18. Distribution of respondents based on their knowledge of selected practices

N=90

Category	Class limits	Kalliyoor (n- 30)		Manikal (n- 30)		Vembayam (n- 30)		Total	
		No.	%	No.	%	No.	%	No.	%
Low	< 9	2	6.67	10	33.33	7	23.33	19	21.11
Medium	9-12	24	80.00	13	43.33	16	53.33	53	58.89
High	> 12	4	13.33	7	23.33	7	23.33	18	20.00

Range:5-16

The knowledge level of the total respondent sample from Fig. 21 showed that 58.89 per cent respondents had a knowledge score that fell in the mid range. The per cent of farmers in the lower quartile range were 21.11 per cent while those with in the upper quartile range were 20.00 per cent. The distribution is normal with more number of respondents in the middle range (58.89 %) and an almost equal percentage of respondents in the lower and upper quartile range (21.11 % and 20.00 % respectively). The knowledge score of the respondents ranged from 5 to 16. The range was considerably high which indicated that there were respondents who received a lower score of five as well as respondents who received the maximum score of 16. The absence of respondents with zero score indicated that all the respondents had knowledge about any of the recommended practice.

A cursory look at the Panchayat wise estimation of score from Table 18 revealed that 80.00, 43.33 and 53.33 percentage of farmers of Kalliyoor, Manikal and Vembayam Panchayat respectively occupied the middle quartile range. An equal distribution of farmers in the upper and lower quartile (23.33 %) was observed in Vembayam. Though the farmers in upper range were less in Kalliyoor compared to Manikal and Vembayam most of the farmers were in the middle range with only 6.67 per cent in lower range.

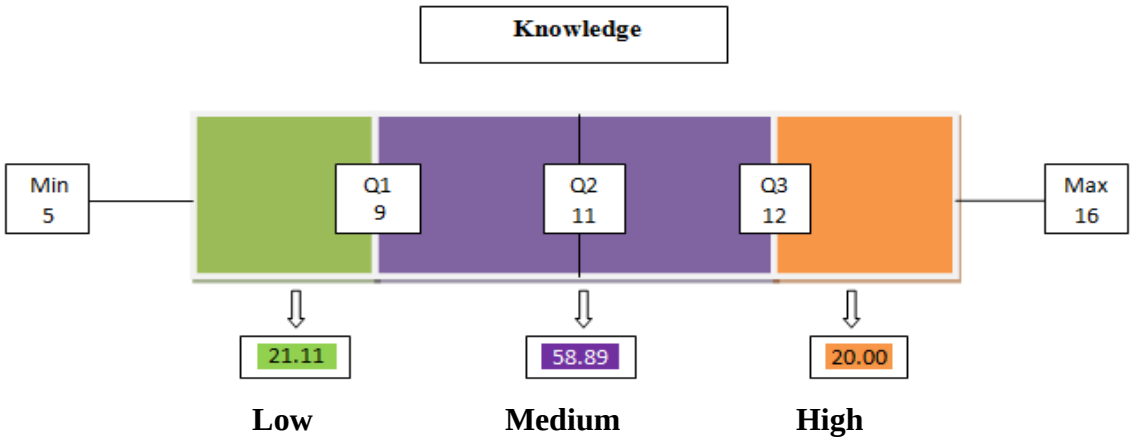


Fig.21. Distribution of respondents based on the knowledge of recommended practices (Box plot).

So it was inferred that the knowledge level of farmers was fairly good in Kalliyoor since only 6.67 per cent farmers had lower knowledge level when compared to 33.33 and 23.33 per cent in Manikal and Vembayam Panchayats respectively.

Hence from the total result it was summarised that majority of the bittergourd farmers had medium level of knowledge on scientific production practices of bittergourd. This was presumably due to the high level of literacy and education among the farmers. The results also indicate the significance of charting a strategy for knowledge development regarding recommended practices in bittergourd cultivation so that the percentage of farmers occupying the upper quartile range of knowledge distribution can be further increased.

4.3.2 Percentage of Respondents' Knowledge about Recommended Practices in Bittergourd Cultivation

The recommended practices were ranked based on the respondents' knowledge and its result is presented in Table 19. A perusal of Table 19 revealed that all the respondents had knowledge about trapping fruit fly using food baits and covering of fruits. Weeding and raking at the time of fertilizer application was the next practice known by most farmers, that is, about 95.56 per cent farmers knew about this practice. The least known practices were applying carbaryl 10% DP in pit before sowing and seed rate is 5-6 kg/ha which only 21.11 per cent of farmers respectively had knowledge about.

About 92.22 per cent farmers had knowledge about the recommended varieties. Regarding the fertilizer application, 55.55 per cent farmers had knowledge about the exact nutrient recommendation. In the recommendation of pesticides for the management of vector of mosaic, more farmers had knowledge about neem based insecticide (94.44 %) in comparison to dimethoate application (86.66 %). It might be presumably due to high awareness and interest about the benefits of sustainable and safe management practices of pest control.

4.3.3 Distribution of Recommended Practices Based on Respondents' Knowledge in Bittergourd Cultivation

The ranking of practices based on respondents' knowledge were delineated in Table 19. Further, the selected recommended practices were distributed as high, medium and low based on the knowledge of respondents of the recommended practices and presented in Appendix III.

On perusal of Appendix III, it was analysed that four practices out of the selected 16 recommended practices were highly known by the farmers which included trapping fruit fly using food baits and covering fruits, weeding and raking at the time of fertilizer application, spraying neem based insecticide 2 % and cue lure trap.

Out of the 16 practices, eight practices fall in the mid range. Four practices that were very less known to the farmers included irrigation at 3-4 days interval and alternate days during flowering and fruiting, harvesting of fruits only after 10 days of chemical application, carbaryl l0% DP in pit before sowing, and seed rate is 5-6 kg/ha. 4.4

PRODUCTION PREFERENCES, PERCEIVED USEFULNESS AND EFFECTIVENESS OF SELECTED KAU PRODUCTION TECHNOLOGIES

4.4.1 Production Preferences of Cultivating Bittergourd

Production preferences refer to the reasons or criterions due to which the farmer respondents preferred cultivating bittergourd in their field. The selected criterion from the practices were ranked in the decreasing order of preferences and presented in Table 20.

Table 19. Percentage of respondents' knowledge about recommended practices in bittergourd cultivation

Production practices				
Sl.No.	Items	No.	%	Rank
1.	Weeding and raking at the time of fertilizer application	86	95.56	2
2.	Varieties are Priya, Priyanka and Arka Harit	83	92.22	5
3.	Retain 3 plants per pit	74	82.22	7
4.	Spacing is 2*2 m	62	68.89	8
5.	Fertilizer application at rate 70:25:25	50	55.56	10
6.	Top dressing of N fertilizer and in split doses every fortnightly	49	54.44	11
7.	Irrigation at 3-4 days interval and alternate days during flowering/ fruiting	36	40.00	13
8.	Harvesting of fruits only 10 days after chemical application	32	35.56	14
9.	Seed rate is 5-6 kg/ha	19	21.11	15.5
Plant Protection practices				
10.	Food baits and covering fruits	90	100.00	1
11.	Cue lure trap	85	94.44	3.5
12.	Spraying neem based insecticide 2%	85	94.44	3.5
13.	Vector control of mosaic by spraying Dimethoate 0.05%	78	86.67	6
14.	Spraying Mancozeb 0.2 %	59	65.56	9
15.	Apply *Beauveria bassiana* 10% and *Paecilomyces lilacinus* 5% WP	47	52.22	12
16.	Carbaryl 10% DP in pit	19	21.11	15.5

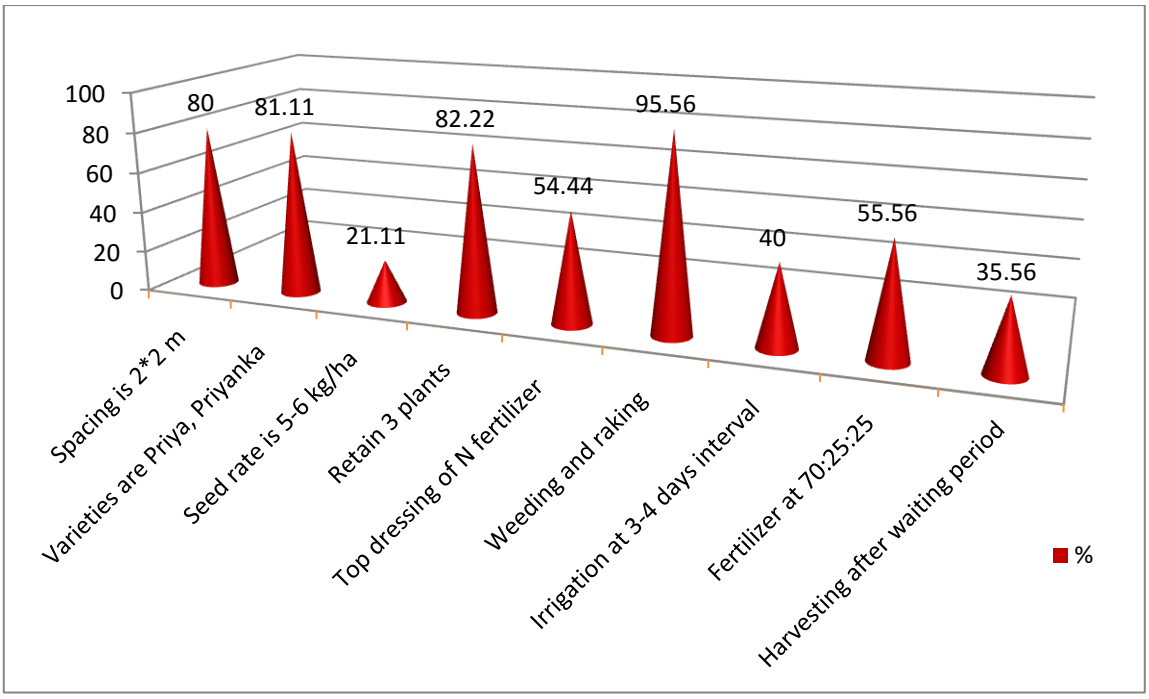


Fig. 22. Percentage of respondents' knowledge of production practices in bittergourd cultivation

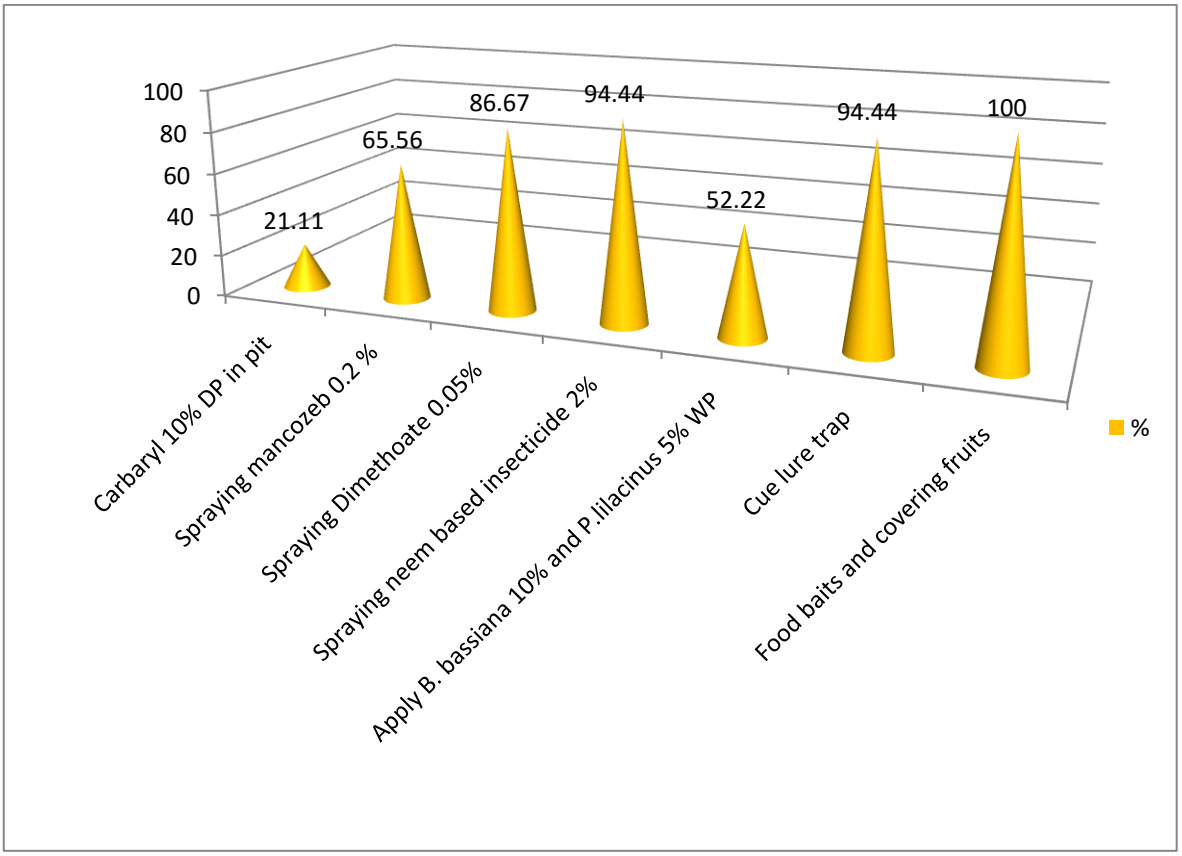


Fig. 23. Percentage of respondents' knowledge of plant protection practices in bittergourd cultivation

Table 20. Production preferences of bittergourd for selected components

Sl.No	Production criterion	Mean score	Rank
1.	Market preference	9	1
2.	Cost effectiveness	8	2.5
3.	Resource utilization	8	2.5
4.	Family needs	6	4
5.	Value addition	5	5
6.	Availability of inputs	4	6
7.	Less management	2	7.5
8.	Low cost of cultivation	2	7.5
9.	More sustainable	1	9

The preferences of bittergourd were worked out for 9 dimensions, namely, cost effectiveness, family needs, market preference, availability of inputs, value addition, less management, more sustainable, low cost of cultivation and resource utilisation.

Bittergourd was preferred by farmers for multiple reasons. Market preference was the foremost reason for preferring bittergourd cultivation.

The market for bittergourd was guaranteed and demand is also high for this vegetable. The next two important reasons were cost effectiveness and resource utilisation. Majority of farmers stated that bittergourd was one of the most remunerative crops if not affected by any adverse situations. If the preceding crop is any vegetable that was requiring pandal, then also farmers prefer to cultivate bittergourd to utilise the erected pandal. Hence resource utilisation was an important reason for preferring bittergourd. Other notable reasons were family needs and value addition.

4.4.2 Perceived Effectiveness of Selected KAU Practices

From Table 21 it was observed that 76.67 per cent of farmer respondents found the practices cure lure traps and weeding and raking at the time of fertilizer

application as ‘very effective’ followed by 72.22 per cent for recommended varieties like Priyanka, Preethi, and Arka Harit, 53.33 per cent for ‘trapping fruit fly using food baits and covering fruits’ and 51.11 per cent for the practice of retaining three plants per pit.

About 97.78 per cent respondents opined that carbaryl 10 % DP application in the pit before sowing was ‘not effective’. In total, the top eight practices that were found to be effective included weeding and raking at the time of fertilizer application, food bait trap, recommended varieties like Preethi, Priyanka and Arka Harit, cue lure trap against fruit fly, spraying neem based insecticide, retaining 3 plants in the pit, vector control by spraying dimethoate 0.05% and spacing 2*2m.

In Kalliyoor Panchayat all respondents stated that application of carbaryl 10 % DP in the pit before sowing was not effective. No farmers stated that ‘cue lure trap’ and ‘food bait trap against fruit fly was ‘not effective’ which clearly indicated that those practices were well adopted by farmers due to its effectiveness.

In Manikal no respondents opined that carbaryl application in the pit is effective. About 96.67 per cent respondents stated that the practices like irrigation at 3-4 days interval and harvesting of fruits 10 days after chemical application is ‘not effective’.

In Vembayam almost 100 per cent farmers stated that they did not find the practice of harvesting fruits 10 days after chemical application as an effective practice. Only 3.33 per cent farmer respondents each opined that recommended varieties, weeding and raking before fertilizer application and cue lure traps is ‘not effective’ which clearly showed the effectiveness of the three practices.

Table 21. Perceived effectiveness of production and plant protection practices (in percentage).

Items	Kalliyoor (n-30)			Manikal (n-30)			Vembayam (n-30)			Total (N=90)		
	VE	E	NE	VE	E	NE	VE	E	NE	VE	E	NE
1	53.33	20.00	26.67	53.33	6.67	40.00	23.33	30.00	46.67	43.33	18.89	37.78
2	90.00	6.67	3.33	46.67	3.33	16.67	80.00	16.67	3.33	72.22	8.89	7.78
3	3.33	3.33	93.33	3.33	13.33	83.33	0.00	20.00	80.00	2.22	12.22	85.56
4	53.33	36.67	10.00	60.00	26.67	13.33	40.00	30.00	30.00	51.11	31.11	17.78
5	10.00	26.67	63.33	30.00	6.67	63.33	10.00	23.33	66.67	16.67	18.89	64.44
6	93.33	6.67	0.00	93.33	6.67	0.00	43.33	53.33	3.33	76.67	22.22	1.11
7	0.00	13.33	86.67	0.00	3.33	96.67	3.33	3.33	93.33	1.11	6.67	92.22
8	13.33	13.33	73.33	3.33	16.67	80.00	16.67	6.67	76.67	11.11	12.22	76.67
9	0.00	10.00	90.00	0.00	3.33	96.67	0.00	0.00	100.00	0.00	4.44	95.56
10	0.00	0.00	100.00	0.00	0.00	100.00	0.00	6.67	93.33	0.00	2.22	97.78
11	3.33	46.67	50.00	10.00	30.00	60.00	6.67	30.00	63.33	6.67	35.56	57.78
12	23.33	50.00	26.67	13.33	16.67	70.00	13.33	70.00	16.67	16.67	45.56	37.78
13	66.67	30.00	3.33	33.33	50.00	16.67	20.00	53.33	26.67	40.00	44.44	15.56
14	0.00	16.67	83.33	0.00	3.33	96.67	10.00	26.67	63.33	3.33	15.56	81.11
15	80.00	20.00	0.00	66.67	10.00	23.33	83.33	13.33	3.33	76.67	14.44	8.89
16	63.33	36.67	0.00	53.33	40.00	6.67	43.33	50.00	6.67	53.33	42.22	4.44

1- Spacing is 2*2 m, 2 - Varieties are Priya, Priyanka and Arka Harit, 3- Seed rate is 5-6 kg/ha, 4- Retain 3 plants per pit, 5- Top dressing of N fertilizer in split doses, 6- Weeding and raking at the time of fertilizer application, 7- Irrigation at 3-4 days interval and alternate days during flowering/fruiting, 8- Fertilizer application at rate 70:25:25, 9- Harvesting of fruits only 10 days after chemical application, 10- Carbaryl 10% DP in pit, 11- Spraying mancozeb 0.2 % against downey mildew, 12- Vector control of mosaic by spraying Dimethoate 0.05 %, 13- Spraying neem based insecticide 2 %, 14 -Application of *Beauveria bassiana* 10 % and *P.lilacinus* 5 %, 15- Cue lure trap against fruit fly, 16- Food baits and covering fruits.

VE- Very Effective E- Effective NE- Not Effective

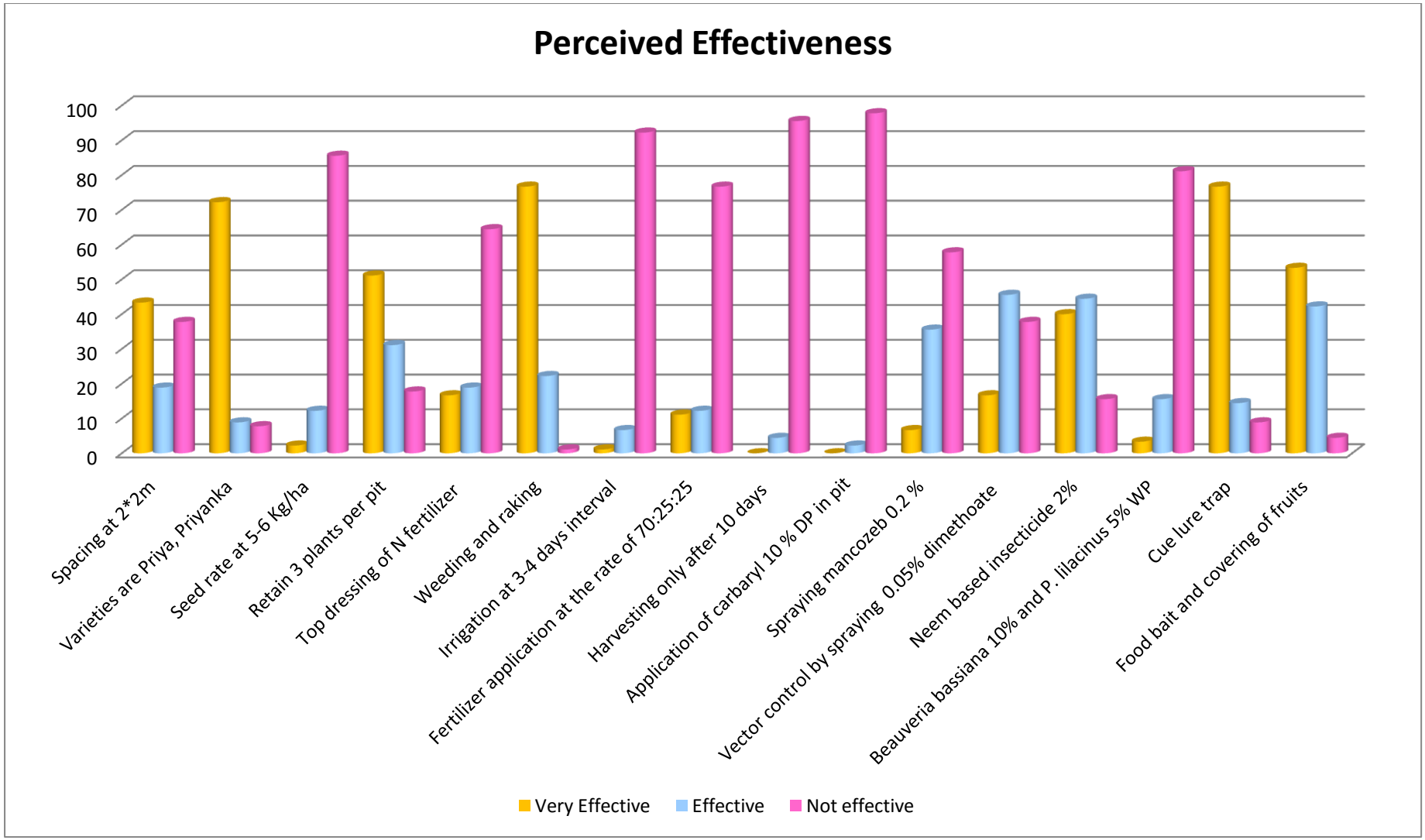


Fig. 24. Perceived Effectiveness of recommended practices in bittergourd as perceived by farmers

4.4.3 Perceived Usefulness of Selected KAU Practices

On perusal of Table 22, it was evident that the most useful practices as perceived by farmers were weeding and raking before fertilizer application (97.78 %), trapping fruit fly using food bait and covering fruits (95.56 %), cue lure traps against fruit fly (94.44 %), and recommended varieties like preethi, priyanka and arka harit (82.22 %).

On total, the practices recorded as 'not useful' by farmers were harvesting after 10 days of chemical application (90.00 %), carbaryl application 10% DP in pit (86.67 %), and seed rate 5-6 kg/ha (85.56 %). Harvesting after 10 days of chemical application according to the respondents was not an applicable practice since waiting for such long periods will hamper the marketing and thereby returns. Application of carbaryl in the pit was not found to be useful since the difficulty in the availability of this pesticide was a setback. Seed rate according to the farmers could not be appropriately followed.

Panchayat wise analysis showed that in Kalliyoor all the respondents opined that 'food bait and covering fruits against fruit fly', 'cue lure trap', 'varieties such as preethi, priyanka and arka harit', and 'weeding and raking at the time of fertilizer application' were the most useful practices since no farmers stated these practices as 'not useful'. Those practices which were recorded as 'not useful' included seed rate 5-6 kg/ha (93.33 %) and harvesting after 10 days of chemical application (86.67 %) which reflected the total result.

In Manikal Panchayat, practices like weeding and raking at the time of fertilizer application (96.67 %) and food bait and covering fruits against fruit fly (93.33 %) were the practices that were found useful to farmers. The 'not useful' and 'very useful' practices were similar to the total. The results of Vembayam Panchayat reflected the same.

Table 22.Perceived usefulness of plant production and plant protection practices (in percentage)

Items	Kalliyoor (n-30)			Manickal (n-30)			Vembayam (n-30)			Total (N=90)		
	VU	U	NU	VU	U	NU	VU	U	NU	VU	U	NU
1	53.33	20.00	26.67	56.67	3.33	40.00	23.33	33.33	43.33	44.44	18.89	36.67
2	90.00	10.00	0.00	46.67	3.33	16.67	80.00	16.67	3.33	72.22	10.00	6.67
3	3.33	3.33	93.33	3.33	13.33	83.33	0.00	20.00	80.00	2.22	12.22	85.56
4	63.33	26.67	10.00	63.33	23.33	13.33	40.00	30.00	30.00	55.56	26.67	17.78
5	10.00	30.00	10.00	26.67	10.00	63.33	10.00	23.33	66.67	15.56	21.11	46.67
6	93.33	6.67	0.00	96.67	0.00	3.33	46.67	50.00	3.33	78.89	18.89	2.22
7	3.33	23.33	73.33	0.00	16.67	83.33	3.33	16.67	80.00	2.22	18.89	78.89
8	16.67	20	63.33	6.67	10.00	83.33	13.33	3.33	83.33	12.22	11.11	76.67
9	0.00	13.33	86.67	0.00	13.33	86.67	0.00	3.33	96.67	0.00	10.00	90.00
10	0.00	16.67	83.33	0.00	10.00	90.00	0.00	13.33	86.67	0.00	13.33	86.67
11	6.67	50.00	43.33	6.67	36.67	56.67	6.67	40.00	53.33	6.67	42.22	51.11
12	23.33	53.33	23.33	10.00	36.67	53.33	13.33	73.33	13.33	15.56	54.44	30.00
13	70.00	26.67	3.33	36.67	53.33	10.00	20.00	63.33	16.67	42.22	47.78	10.00
14	46.67	0.00	53.33	0.00	20.00	80.00	10.00	50.00	40.00	18.89	23.33	57.78
15	80.00	20.00	0.00	76.67	6.67	16.67	90.00	10.00	0.00	82.22	12.22	5.56
16	63.33	36.67	0.00	40.00	53.33	6.67	43.33	50.00	6.67	48.89	46.67	4.44

1- Spacing is 2*2 m, 2 - Varieties are Priya, Priyanka and Arka Harit, 3- Seed rate is 5-6 kg/ha, 4- Retain 3 plants per pit, 5- Top dressing of N fertilizer in split doses, 6- Weeding and raking at the time of fertilizer application, 7- Irrigation at 3-4 days interval and alternate days during flowering/fruiting, 8- Fertilizer application at rate 70:25:25, 9- Harvesting of fruits only 10 days after chemical application, 10- Carbaryl 10% DP in pit, 11- Spraying mancozeb 0.2 % against downey mildew, 12- Vector control of mosaic by spraying Dimethoate 0.05 %, 13- Spraying neem based insecticide 2 %, 14 -Application of *Beauveria bassiana* 10 % and *P.lilacinus* 5 %, 15- Cue lure trap against fruit fly, 16- Food baits and covering fruits.

VU- Very Useful U- Useful NU-Not Useful

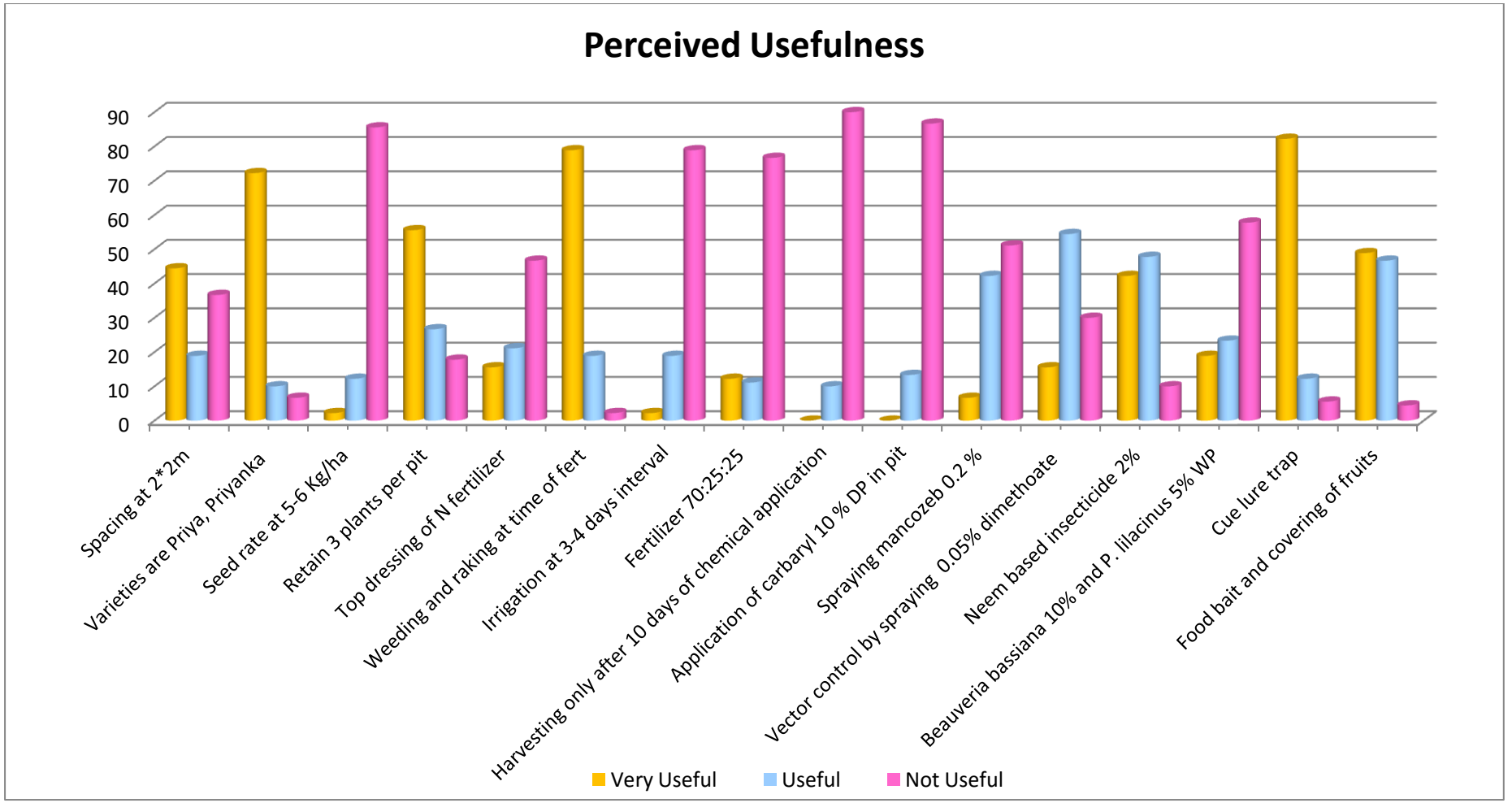


Fig. 25. Perceived Usefulness of recommended practices in bittergourd as perceived by farmers

4.5 TECHNOLOGY ASSESSMENT OF BITTERGOURD CULTIVATION

The technology assessment was made in terms of extent of adoption of selected production and plant protection practices for bittergourd cultivation, its relationship with the personal characteristics of farmers and finally technology need assessment study to delineate the needs of the farmers for improved technologies concerning bittergourd cultivation.

4.5.1 Distribution of Respondents Based on the Extent of Adoption of Recommended Practices by Bittergourd Farmers

The distribution of respondents based on the extent of adoption of recommended cultivation practices by bittergourd farmers is presented in Table 23. The respondents were categorised into high, medium and low adopters of recommended practices in bittergourd.

Table 23. Distribution of respondents based on the extent of adoption of recommended practices by bittergourd farmers

Sl. No	Category	Class limits	Total (N-90)		Kalliyoor (n-30)		Manikal (n-30)		Vembayam (n-30)	
			No	%	No.	%	No.	%	No.	%
1	High (Mean + SD)	>75.78	15	16.67	6	20.00	5	16.67	4	13.33
2	Medium (Mean ± SD)	55.50-75.78	59	65.55	21	70.00	16	53.33	22	73.34
3	Low (Mean - SD)	<55.50	16	17.78	3	10.00	9	30.00	4	13.33

Mean - 65.64 Standard Deviation - 10.14

On perusal of Table 23 it was evident that majority of farmers fell under medium category with 65.55 per cent. It was followed by low and high category with 17.78 and 16.67 per cent respectively. So it was inferred that majority of bittergourd farmer had medium to low level of adoption of recommended practices. This contradicts the findings of Jondhale *et al.* (2000) and Sai (2013). The adoption score ranged between 33.52 and 89.03 with a mean score of 65.64.

There was no respondent who completely adopted all the practice recommended by KAU in the POP for bittergourd cultivation.

In the Panchayat wise distribution, the adoption level ranged from medium (70.00 %) to high (20.00 %) in Kalliyoor Panchayat. In Manikal Panchayat the adoption ranged from medium (53.33 %) to low (30.00 %) while in Vembayam Panchayat there was an equal share of respondents with high and low adoption level (13.33%) and more than half of the respondents possessed medium adoption level (73.34 %).

4.5.2 Adopter Categorisation of Bittergourd Farmer Respondents on Level of Adoption of Recommended Practices in Bittergourd

The farmer respondents were categorised into different adopter categories as explained by Rogers (1982) namely, innovators, early adopters, early majority, late majority and laggards.

Table 24. Adopter categorisation of bittergourd farmer respondents on level of adoption of recommended practices.

Category	No.	%	Rogers standard curve (%)
Innovators	2	2.22	2.5
Early adopters	12	13.33	13.5
Early majority	23	25.56	34
Late majority	38	42.22	34
Laggards	15	16.67	16
Total	90	100	

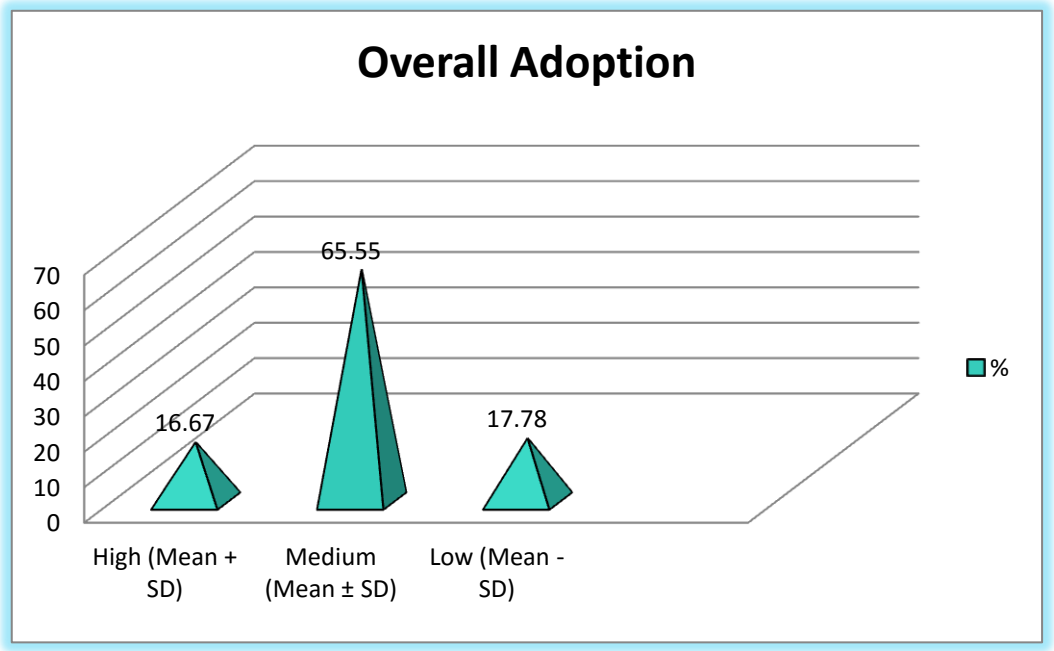


Fig.26. Distribution of respondents based on the overall adoption of recommended practices

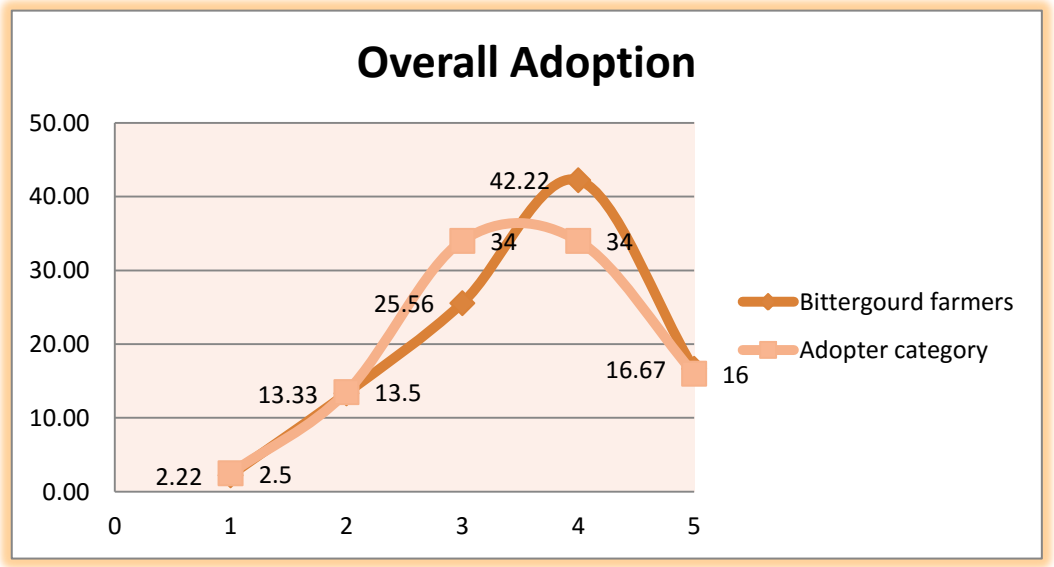


Fig. 27. Adopter categorisation of recommended practices

1 – Innovators, 2 – Early adopters, 3 – Early majority, 4- Late majority, 5- Laggards

It was revealed from Table 24 and Fig.27 that, percentage of innovators was 2.22 per cent which is in conformation with standard Rogers curve. Early adopters were 13.33 per cent which is also near to the 13.5 per cent in Rogers curve. Early majority were 25.56 per cent which was less than 34 per cent in the standard curve. Late majority were 42.22 per cent which was more than 34 per cent of Rogers curve. High percentage of respondents in late majority category and low percentage in early majority is a weak indicator of adoption. Laggards constituted 16.67 per cent which are almost in conformity with the 16 per cent laggard of standard Rogers curve.

Overall adoption can be improved by focusing on late majority and laggards through different and effective educational programmes. The finding from the adopter categorisation signifies that there is a need for effective extension mechanism along with support and encouragement so that the percentage of late majority can be further reduced which will enhance the percentage of early majority.

4.5.3 Distribution of Respondents Based on the Extent of Adoption of Recommended Production Practices by Bittergourd Farmers

The distribution of respondents based on the extent of adoption of recommended production practices by bittergourd farmers is presented in Table 25. The respondents were categorised into high, medium and low adopters of recommended protection practices in bittergourd.

Table 25. Distribution of respondents based on the extent of adoption of recommended production practices by bittergourd farmers

Sl.No	Category	Class limits	Total (N-90)		Kalliyoor (n-30)		Manikal (n-30)		Vembayam (n-30)	
			No.	%	No.	%	No.	%	No.	%
1	High (Mean + SD)	> 78.34	9	10.00	5	16.67	2	6.67	2	6.67
2	Medium (Mean ± SD)	58.74-78.34	71	78.89	23	76.66	22	73.33	26	86.66
3	Low (Mean - SD)	< 58.74	10	11.11	2	6.67	6	20.00	2	6.67

Mean- 68.54 Standard Deviation - 9.80

From Table 25, it was clear that 78.89 per cent of respondents fell in the medium adoption category followed by 11.11 per cent low adopters of recommended production practices and 10.00 per cent of respondents in the high category. Hence the adoption level of production practices ranged from medium to low. The score of extent of adoption of the recommended production practices ranged between 26.25 and 93.09 with a mean score of 68.54.

In the Panchayat wise distribution, the adoption level of production practices ranged from medium (76.66 %) to high (16.67 %) in Kalliyoor Panchayat. In Manikal Panchayat, adoption ranged from medium (73.33 %) to low (20.00 %) similar to the total results. In Vembayam Panchayat majority of the respondents belonged to medium adoption level (86.66 %) and an equal share of respondents came under high and low adoption level (6.67 %).

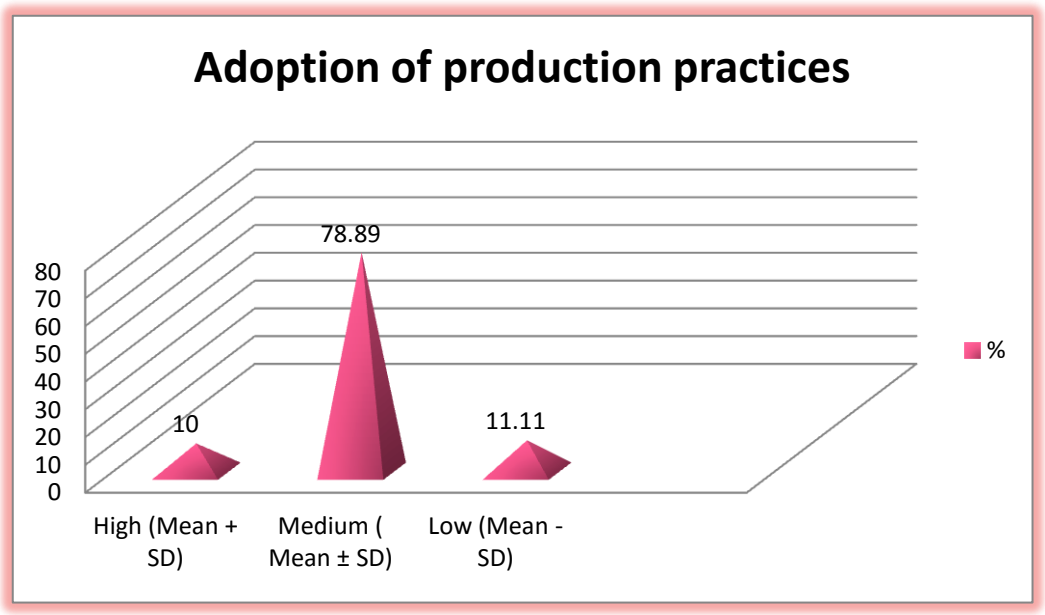


Fig.28. Distribution of respondents based on adoption of recommended production practices

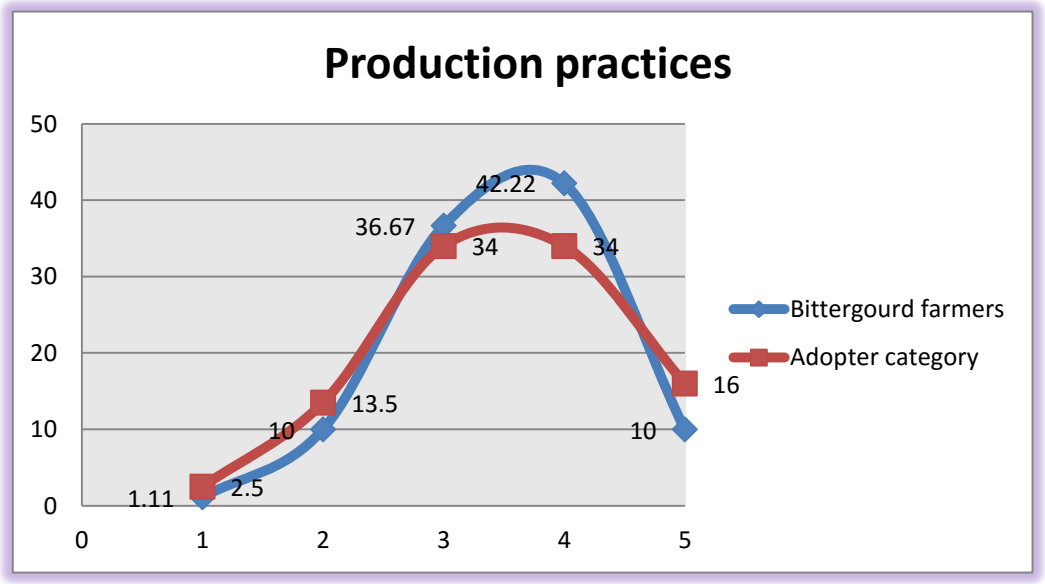


Fig.29. Adopter categorisation of recommended production practices

1 – Innovators, 2 – Early adopters, 3 – Early majority, 4- Late majority, 5- Laggards

4.5.4 Adopter Categorisation of Bittergourd Farmer Respondents on Level of Adoption of Recommended Production Practices

The farmer respondents were categorised into different adopter categories based on the adoption of plant production practices as explained by Rogers (1982) namely, innovators, early adopters, early majority, late majority and laggards.

Table 26. Adopter categorisation of bittergourd farmer respondents on level of adoption of recommended production practices.

Category	No.	%	Rogers standard curve (%)
Innovator	1	1.11	2.5
Early adopters	9	10.00	13.5
Early majority	33	36.67	34
Late majority	38	42.22	34
Laggards	9	10.00	16
Total	90	100.00	

On observing Table 26 and Fig. 29, it was inferred that percentage of innovators was 1.11 per cent as against 2.5 per cent in the standard Rogers curve. Early adopters were 10 per cent which was less than the 13.5 per cent in Rogers curve indicating less adoption of production practices in bittergourd cultivation. Early majority and late majority which were 36.67 per cent and 42.22 per cent respectively was more than the 34 per cent of Rogers curve. The presence of early majority more than the standard curve signifies average adoption. But the higher percentage belonging to late majority than the early majority signifies fairly poor adoption. Laggards constituted 10 per cent which was again less than 16 per cent of standard Rogers curve.Efforts should be focussed on developing and disseminating location specific and sustainable production practices according to the need of the farmers.

4.5.5 Distribution of Respondents Based on the Extent of Adoption of Recommended Plant Protection Practices by Bittergourd Farmers

The distribution of respondents based on the extent of adoption of recommended plant protection practices by bittergourd farmers is presented in Table 27. The respondents were categorised into high, medium and low adopters of recommended protection practices in bittergourd.

Table 27. Distribution of respondents based on the extent of adoption of recommended plant protection practices by bittergourd farmers

Sl.No	Category	Class limits	Total (N-90)		Kalliyoor (n-30)		Manickal (n-30)		Vembayam (n-30)	
			No.	%	No.	%	No.	%	No.	%
1	High (Mean + SD)	>78.04	19	21.11	5	16.67	7	23.33	7	23.33
2	Medium (Mean ± SD)	45.77-78.04	55	61.11	23	76.66	16	53.34	16	53.34
3	Low (Mean - SD)	<45.77	16	17.78	2	6.67	7	23.33	7	23.33

Mean- 61.90 Standard Deviation - 16.14

From Table 27, it was clear that 61.11 per cent of respondents fell in the medium adoption category followed by 21.11 per cent of respondents in the high category and 17.78 per cent low adopters of recommended plant protection practices. Hence, the adoption level of plant protection practices ranged from medium to high. This finding derives support from the study of Waman and Girase (2005). The score of extent of adoption of the recommended plant protection practices ranged between 28.57 and 86.67 with a mean of 61.90.

In the Panchayat wise distribution, the adoption level ranged from medium to high in Kalliyoor Panchayat. While in Manikal and Vembayam Panchayat there was an equal share of respondents with high and low adoption level (23.33 %) and more than half of the respondents possessed medium adoption level (53.34 %).

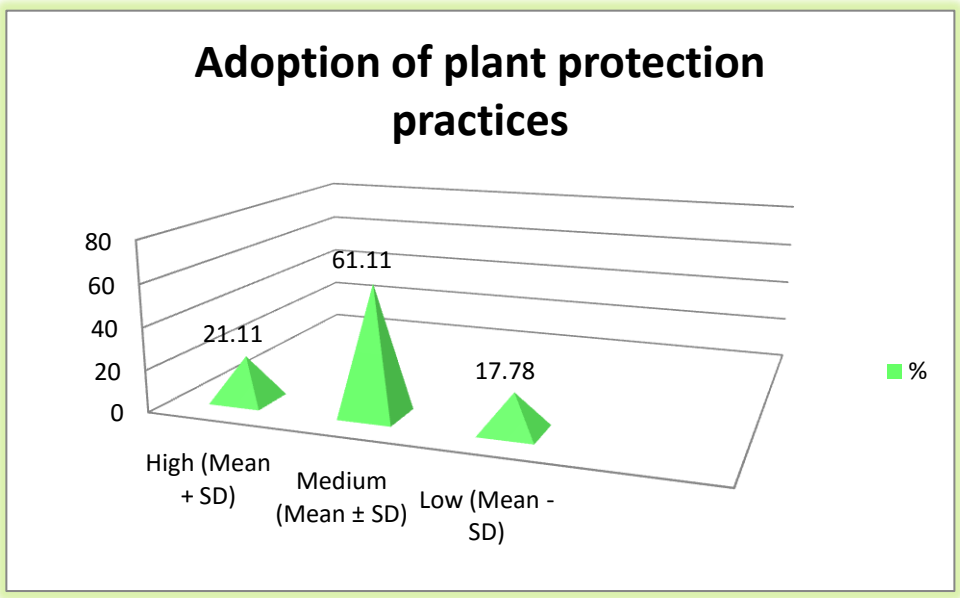


Fig.30. Distribution of respondents based on adoption of recommended plant protection practices

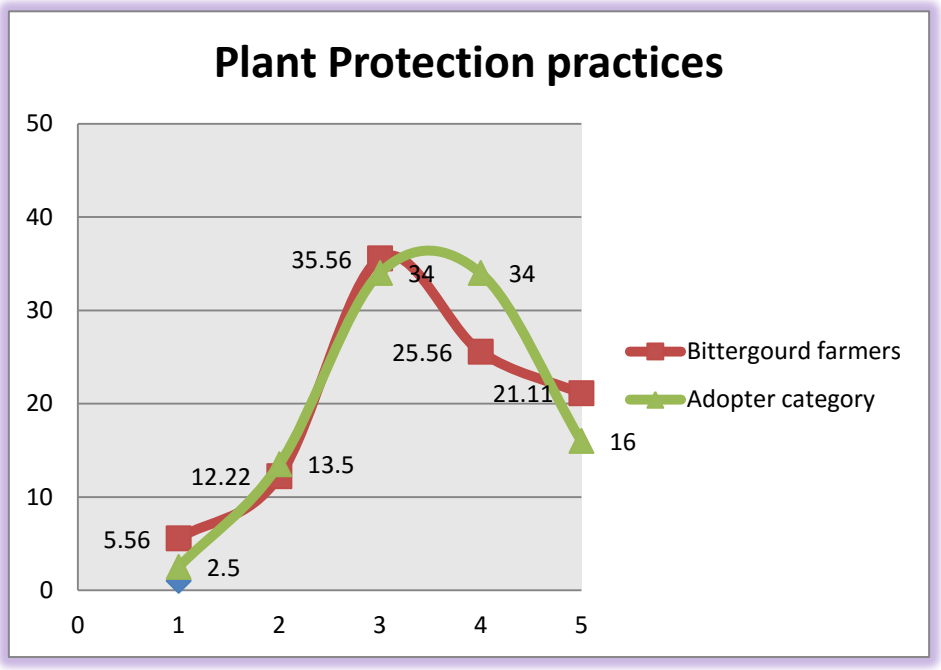


Fig.31. Adopter categorisation of recommended plant protection practices

1 – Innovators, 2 – Early adopters, 3 – Early majority, 4- Late majority, 5- Laggards

4.5.6 Adopter Categorisation of Bittergourd Farmer Respondents on Level of Adoption of Recommended Plant Protection Practices

The farmer respondents were categorised into different adopter categories based on the adoption of plant protection practices as explained by Rogers (1982) namely, innovators, early adopters, early majority, late majority and laggards.

Table 28. Adopter categorisation of bittergourd farmer respondents on level of adoption of recommended plant protection practices.

Category	No.	%	Rogers standard curve (%)
Innovator	5	5.56	2.5
Early adopters	11	12.22	13.5
Early majority	32	35.56	34
Late majority	23	25.56	34
Laggards	19	21.11	16
Total	90	100.00	

It was revealed from Table 28 and Fig. 31 that, respondents belonging to innovator category were 5.56 per cent which was higher than the normal Rogers curve. Early adopter per cent of 12.22 per cent was almost on par with the normal curve. The early majority was higher than the normal Rogers curve. Late majority which was 25.56 per cent was lesser than the standard per cent of 34 in Rogers curve. All this are indicating a fairly good level of adoption of protection practices by farmers. However table designates that laggards were 21.11 per cent which was greater compared to the normal value of 16 per cent.

The higher percentage of innovators and early adopters than in the case of production practices signifies better adoption of plant protection practices. Farmers are more conscious of yield and hence would deliberately plan and

implement extension advisory with special reference to protection of the crop produce. This could be the reason for the fairly better level of extent of adoption of plant protection practices in comparison to production practices.

Also the higher percentage of laggards reveals the dubious nature of few farmers when it comes to protection practices. Farmers are reluctant to try protection practices owing to multiple reasons like the effectiveness, sustainability, cost and returns of the technologies.

Therefore extension efforts should focus on effective transferring of those protection practices that the laggard category of farmers are reluctant to adopt after identifying the reasons so that their percentage can be lowered to a great extent and hence thereby increase the adoption level.

4.5.7 Adoption of the Recommended Practices by the Respondents in Percentage

The percentage of adoption of the recommended production and protection practices were found out and presented in Table 29 and Table 30 respectively.

Table 29. Adoption of the recommended production practices by the respondents in percentage

N=90

Sl. No	Production practices	Kalliyoor (n-30)		Manikal (n-30)		Vembayam (n-30)		Total	
		No.	%	No.	%	No.	%	No.	%
1.	Weeding and raking at fertilizer application	30	100.00	28	93.33	27	90.00	85	94.44
2.	Varieties are Priyanka, Preethi	28	93.33	25	83.33	28	93.33	81	90.00
3.	Retain 3 plants per pit	24	80.00	25	83.33	20	66.67	69	76.67
4.	Spacing is 2*2m	19	63.33	18	60.00	17	56.67	54	60.00
5.	Top dressing with N fertilizer	12	40.00	12	40.00	10	33.33	34	37.78
6.	Fertilizer recommendation	8	26.67	3	10.00	7	23.33	18	20.00
7.	Seed rate 5-6 kg/ha	2	6.67	5	16.67	4	13.33	11	12.22
8.	Irrigation at 3-4 days interval and alternative days	2	6.67	1	3.33	2	6.67	5	5.56
9.	Harvesting after 10 days of chemical application	1	3.33	0	0.00	0	0.00	1	1.11

On perusal of Table 29 it was inferred that 94.44 per cent of farmers adopted weeding and raking at the time of fertilizer application, 90 per cent of farmers adopted recommended varieties like Preethi, Priyanka, Priya and Arka Harit followed by the practice of retaining 3 plants per pit (76.67 %), spacing 2*2m (60.00 %), top dressing with N fertilizer at 3-4 split doses (37.78 %), fertilizer recommendation (20.00 %), seed rate (12.22 %), irrigation at 3-4 days interval (5.56 %) and harvesting after 10 days of chemical application (1.11 %).

In the Panchayat wise distribution, the practice that was adopted by most of the farmers was weeding and raking at the time of fertilizer with 100.00, 93.33 and 90.00 per cent respectively in Kalliyoor, Manikal and Vembayam Panchayats respectively since this practice was perceived be very effective to the farmers. The least adopted practice was harvesting after 10 days of chemical application which only 3.33 per cent of the respondents of Kalliyoor Panchayat and no farmers of the other two Panchayats adopted. This might be because of the fact that the farmers did not perceive this practice as useful for them unlike to the consumers of bittergourd. Such a practice of waiting for long days to harvest will hamper the marketing of the produce according to the farmers.

Table 30. Adoption of the recommended plant protection practices by the respondents in percentage

N=90

Sl.No	Plant Protection practices	Kalliyoor (n-30)		Manikal (n-30)		Vembayam (n-30)		Total	
		No.	%	No.	%	No.	%	No.	%
1.	Food bait trap and covering fruits	29	96.67	28	93.33	27	90.00	84	93.33
2.	Neem based insecticide 2%	27	90.00	28	93.33	24	80.00	79	87.78
3.	Cue lure trap	27	90.00	24	80.00	27	90.00	78	86.67
4.	Vector control by dimethoate 0.05%	22	73.33	13	43.33	25	83.33	60	66.67
5.	Spraying mancozeb 0.2 %	13	43.33	11	36.67	11	36.67	35	38.89
6.	*Beauveria bassiana* 10 % and *P.lilacinus* 5 %	6	20.00	4	13.33	11	36.67	21	23.33
7.	Carbaryl 10 % DP in pit	0	0.00	0	0.00	1	3.33	1	1.11

In the case of plant protection practice, 93.33 per cent of farmers adopted the practice of using food bait trap and covering fruits against fruit fly. This might be due to the eco friendly nature of the practice. The least adopted practice

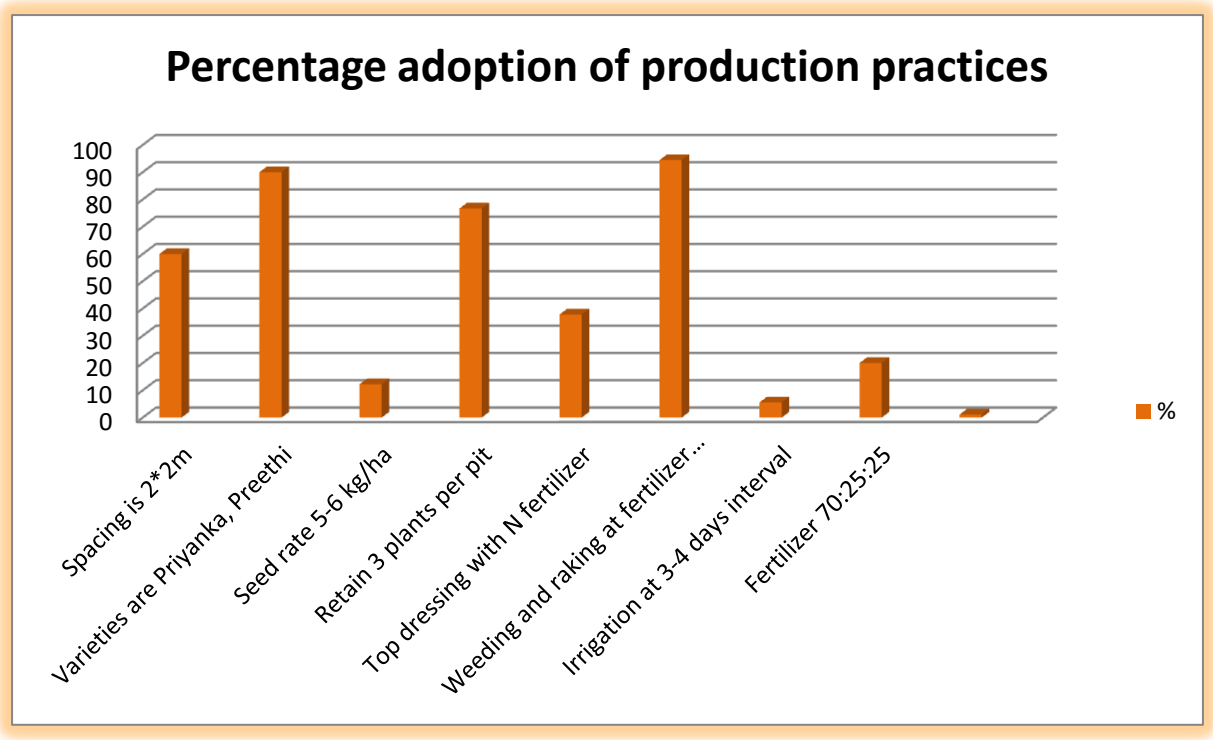


Fig.32. Percentage of respondents adopting the recommended production practices in bittergourd cultivation

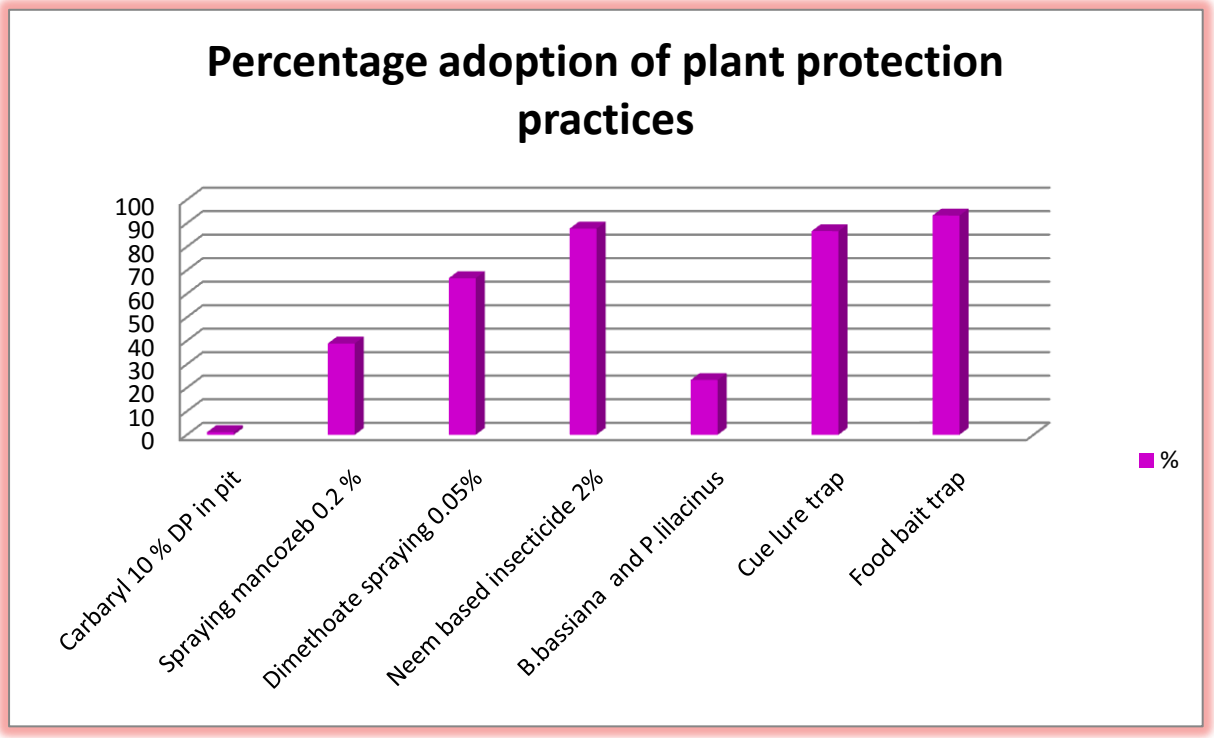


Fig.33. Percentage of respondents adopting the recommended plant protection practices in bittergourd cultivation

was application of carbaryl 10 % DP in the pit before sowing against fruit fly (1.11 %). This might be due to the non availability of carbaryl insecticide to farmers.

In Kalliyoor Panchayat, food bait and covering fruits was the most adopted plant protection practice (96.67 %). In Manikal Panchayat, neem based insecticide 2 % application and food bait trap against fruit fly were the most adopted practices (93.33 %). While in Vembayam Panchayat, the most adopted practices included the traps against fruit fly like food bait trap and cue lure traps.

4.5.8 Adoption of Recommended Varieties by Bittergourd Farmers

Adoption of the recommended varieties by the respondents were found out and presented in Table 31.

Table 31. Percentage of respondents adopting the recommended varieties

N=90

Varieties	Kalliyoor (n-30)		Manickal (n-30)		Vembayam (n-30)		Total	
	No.	%	No.	%	No.	%	No.	%
Preethi	19	63.33	25	83.33	20	66.67	64	71.11
Priyanka	9	30.00	0	0.00	8	26.67	17	18.89
Others	2	6.67	5	16.67	2	6.67	9	10.00
Priya	0	0.00	0	0.00	0	0.00	0	0.00

Perusal of Table 31 showed that the most adopted variety by the bittergourd farmers was Preethi where 71.11 per cent of the farmers adopted it, followed by Priyanka (18.89 %) and other varieties (10.00 %) which included hybrids obtained from retail seed outlets. Preethi was preferred by majority owing to its accessibility and market preference. The adoption of other varieties like Priyanka and Priya were less mainly due to its non availability according to the farmers.

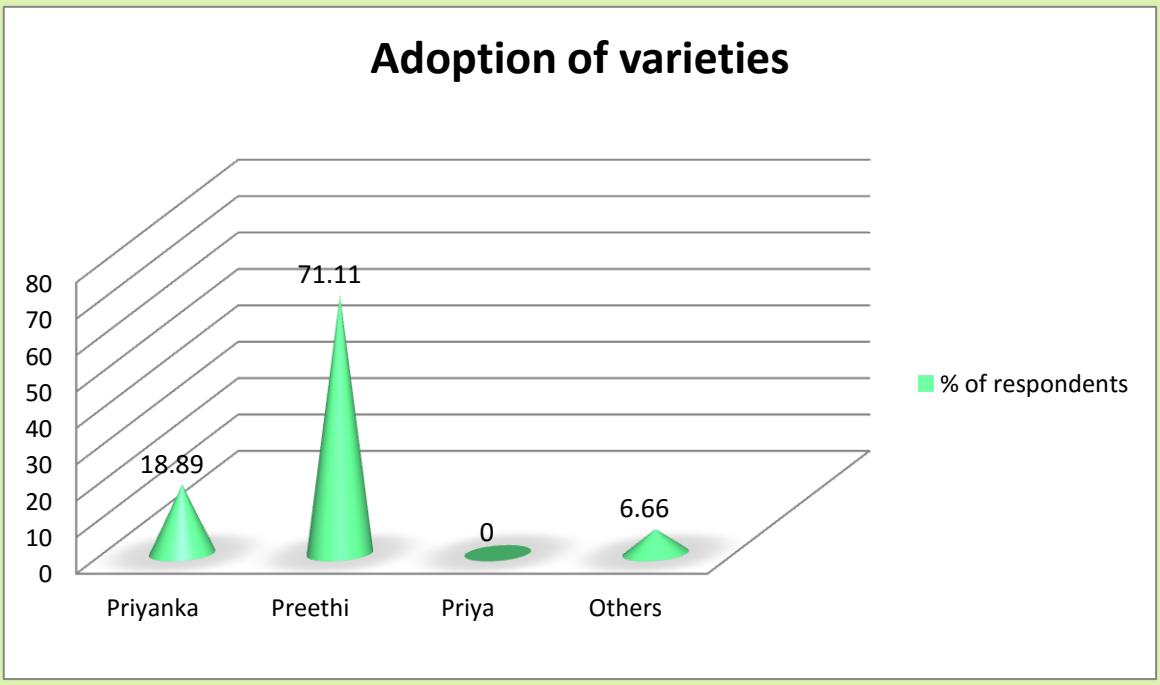


Fig.34. Percentage of respondents adopting the recommended varieties

4.5.9 Distribution of Recommended Practices based on Adoption

The adoption of recommended practices by the farmer respondents were delineated and presented in Table 29 and Table 30. Further**,** the selected recommended practices in bittergourd cultivation were distributed into high, medium and low based on their adoption by farmer respondents and presented in Appendix IV.

Out of the 16 recommended practices, five practices were highly adopted by the farmers, seven practices were medium adopted and the least adopted practices were four (Appendix IV). This signifies the effective extension services rendered through College of Agriculture and Kerala Agricultural University for the fairly good adoption of 12 out of 16 recommended practices in bittergourd cultivation.

4.5.10 Relation between the Extent of Adoption of Farmers' Practices with the Selected Characteristics of the Respondents.

The influence of the independent variables on the extent of adoption was found out using simple correlation analysis and presented in Table 32. The detailed table of correlation analysis is presented in Appendix V.

Table 32. Correlation between extent of adoption of recommended practices by bittergourd farmers and the selected independent variables

Variable	Independent variable	Correlation coefficient
X_1	Age	-0.058
X_2	Education	0.225*
X_3	Occupation	-0.064
X_4	Farm size	0.744**
X_5	Area under bittergourd cultivation	-0.090
X_6	Farming experience	0.214*
X_7	Annual income	0.729**
X_8	Irrigation potential	0.509**
X_9	Extension orientation	0.609**
X_{10}	Innovativeness	0.834**
X_{11}	Market orientation	0.883**
X_{12}	Economic motivation	0.227*
X_{13}	Extent of awareness	0.664**
X_{14}	Knowledge	0.679**

** - Significant at 1 % level * - Significant at 5 % level

It was evident from Table 32 that age, occupation and area under bittergourd cultivation possessed no significant relation with the extent of adoption. Education, farming experience and economic motivation was significant at 5 per cent level of significance while all the other variables were significant at 1 per cent level of significance.

Age was negative and not associated with the extent of adoption. This implied that the older the farmer, the lesser the adoption of crop technologies. This might be because of the assertion that older farmers' exhibit risk-averse attitude towards new technologies and their long experience with farming could influence the adoption of the crop technologies as compared to the younger farmers. But the variable was not significant enough to explain any relation with the extent of adoption. This result is similar to the studies done by Wetengere (2009), Singh *et al*. (2010) and Amponsah (2013).

The education level of farmers measured by the number of formal years of schooling influenced the adoption decisions of farmers in regards to the recommended practices. The relation between education level and adoption decision of farmers was positive and significant. This implied that farmers with higher levels of education are inclined more to adopt recommended scientific practices and newly developed technologies than those with lower education since farmers with higher level of education can come to know the existence and importance of a technology from different sources.This observation reflects the findings of the works of Ghosh *et al.* (2004) and Singha *et al.* (2012) which show that farmers with formal education are more inclined to adopt recent technology and practices.

Occupation was negative and not significantly related to adoption. The negative sign implied that when off farm work is done along with farming, adoption of recommended practices increases. This might be because of the economic security and support offered by the off farm work and hence such farmers can easily bear the risks of the new technology by virtue of the income provided by the other job. But the variable was not significant enough to explain any relation with the extent of adoption. The finding contradicts the results of the study done by Raghu *et al.* (2014), Kara *et al*. (2008) and reflects the results of the work done by Singh *et al.* (2010).

Area under bittergourd cultivation was negative and not significantly influencing extent of adoption. The result reflects the findings of Jayapalan (1999).

The table revealed that annual income of the respondents had significant and positive relationship with adoption of recommended practices. Since majority of the farmers in the study area were economically sound (> 2 lakh /annum) they might not have faced any setback in procuring the recommended inputs and practices which favoured adoption of technology in their farming situations. Thus, technology adoption by the farmers was significantly influenced by

farmers' annual income generated from different sources. This result agrees to the findings of the studies by Singha *et al.* (2012), Sai (2013) and Chanu *et al.* (2014).

Farm size had positive and significant relationship with respect to technology adoption of recommended practices in bittergourd. This finding is in line with the findings of Wetenegere (2009), Kallas *et al*. (2010) and Raghu *et al.* (2014) and contradicts the findings of Singh *et al.* (2010). This finding would probably stem from the assertion that farmers have the possibility to exploit some part of their land for the new and risky technology, which further diminishes the unknown risk of the new practice or technology.

The next factor influencing adoption was the farming experience of the bittergourd farmers. It was significantly and positively influencing adoption of improved practices. It can be accessed from the study that the adopters were more experienced than their counterparts. This result corresponds to the results of study done by Läpple (2010) and Ramesh *et al*. (2010).

Results of this study indicated that irrigation potential was another most significant factor influencing adoption of recommended practices in bittergourd. This finding might have developed from the assertion that expanded and improved irrigation facilities will facilitate the adoption of improved practices. Notably, the aim of increasing the adoption level can be enhanced by promoting and disseminating technologies related to irrigation.

Economic motivation was another factor that was significantly and positively influencing adoption of practices. As the motivation to obtain net profits from investment increased, adoption level of farmers also increased. This finding is in line with the study of Roy (2007), Singha *et al.* (2011) and Borthakur *et al.* (2015).

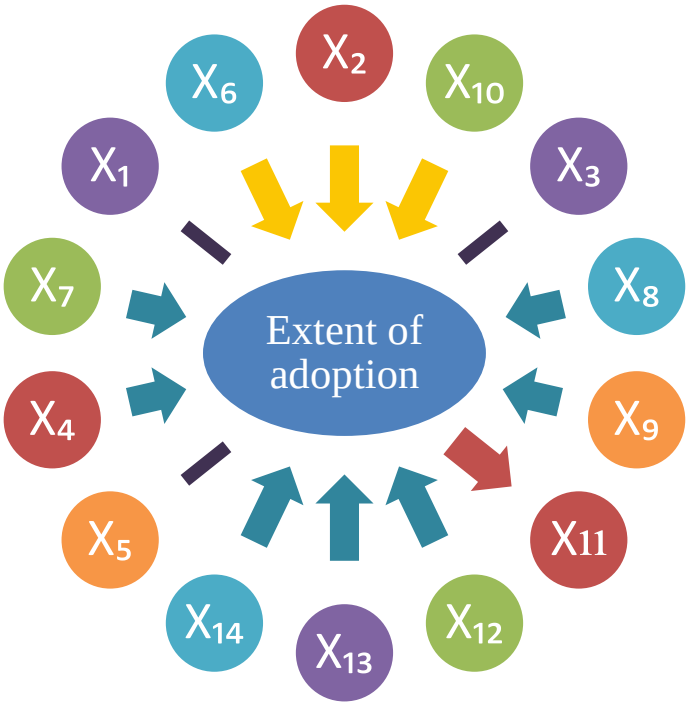
It could be observed from Table 32 that, innovativeness of the farmers resulted in higher technology adoption by farmers as it is evident from the positive and significant relationship at 1 % level of probability. More the innovativeness of farmers more will be the chance of adoption of improved practices since there might be a positive attitude towards confronting risks. Higher economic motivation and education level of the farmers in the study area might presumably be a reason for the increased innovativeness. This result is supported by the findings of Sai (2013).

Extension orientation was found to be positively and significantly correlated with the extent of adoption. More extension contact of the respondents could make them expose to different information and field visits regarding improved farming practices which helped to reinforce their knowledge and skills to enhance the accuracy of implementation of the technology packages.

Market orientation was found to be significantly and positively influencing adoption of recommended practices. These results tend to portray the assumption that farmers who are inclined more to marketing their farm produce tend to adopt scientific produces more easily with the view to obtain better profit from marketing their produce. This finding is not in line with the findings of Patel *et al.* (2013).

Level of awareness about new technologies significantly and positively affected farmers' choices of adoption. Acquisition of information about a new technology or practice makes it more available to farmers. Information further diminishes the vagueness about a technology's performance which may influence an individual's decision.

Knowledge and extent of adoption was also positively and significantly correlated. As the knowledge level of farmers increased, the adoption of practices also increased. This finding highlights the importance of extension systems role in improving the knowledge level of farmers which in turn will



Significant at 1 % level

Significant at 5 % level

Non Significant

X_1 - Age

X_2 - Education

X_3 – Occupation

X_4 – Farm size

X_5 - Area under bittergourd cultivation

X_6 - Farming Experience

X_7 - Annual Income

X_8 - Irrigation Potential

X_9 - Extension Orientation

X_{10} - Economic Motivation

X_{11} – Innovativeness

X_{12} - Market Orientation

X_{13} - Level of awareness

X_{14} – Knowledge

Fig. 35. Empirical model of relationship between dependent and independent variable.

influence the decision to adopt practices developed from various institutions. This finding is in line with the findings of Singh *et al.* (2010) and Sai (2013).

4.5.11 Technology Needs Assessment for the Production Practices as Perceived by Bittergourd Farmers.

Technology needs as perceived by the farmers vary with respect to speckled reasons. Though various institutions have developed and disseminated technologies, its acceptance and adoption by the farming community is varied owing due to diverse reasons. Hence the needs for individual farmers are wide rangingly different. Technology needs as perceived by the farmers is relevant in this respect and is presented in Table 33.

Table 33. Technology needs assessment for the production practices in bittergourd

Sl.No	Practice	Kalliyoor	Manikal	Vembayam	Total	Rank
1.	Value addition	30	28	30	88	1
2.	Nutrient management	81	66	74	221	2
3.	Vector control	95	90	97	283	3
4.	Downey mildew management	104	99	98	301	4
5.	Irrigation	102	100	100	302	5
6.	Spacing	104	100	108	312	6
7.	Epilachna beetle management	110	116	100	326	7
8.	Variety	118	100	120	338	8
9.	Organic manure application	114	110	115	339	9
10.	Harvesting	150	100	100	350	10
11.	Fruit fly management	120	120	119	359	11

From Table 33, it was clear that maximum technology needs was reported for value addition (88) followed by nutrient management (221),

vector control of mosaic (283), downey mildew management (301), and irrigation (302). Most of the farmers reported that they are not encouraged for value addition of the harvested fruits though the returns that they are obtaining are

meagre. Many fruits according to them get ripened soon owing to the high temperature and hence not unsuitable to the market.

Better technology needs for nutrient management was also assessed from the responses. Many respondents stated the non applicability of nutrient rates as recommended. So there is a need for location specific and sustainable recommendation of fertilizer and organic manure. The technology need was also comparatively high for vector control. Mosaic disease was reported as a serious problem in bittergourd cultivation and the availability of recommended practices like spraying dimethoate 0.05 per cent was not much effective or sustainable according to majority of respondents. Hence majority of farmers stated the need for a sustainable and effective management of mosaic control. This might also presumably due to the less awareness about the management practices that were recommended by KAU. The same holds true for the technology need for downey control.

Hence it was inferred from the technology need assessment that majority of the farmers favour low cost, sustainable and effective technologies. In case of nutrition, farmers needed an ideal mix of organic and location specific nutrient management.

4.6 CONSTRAINTS EXPERIENCED BY BITTERGOURD FARMERS AND SUGGESTION FOR REFINEMENT AS PERCEIVED BY THE FARMERS.

Bittergourd farmers face a number of limitations in the cultivation of bittergourd. Constraints experienced by the bittergourd farmers were identified, ranked and presented as a list. The constraint with the highest score got the highest rank. The constraints were grouped into crop management and economic constraints and presented in Table 34.

Table 34. Constraints experienced by the bittergourd farmers

Sl.No	Constraints	Score	Rank over class	Rank over total
I.	Crop management constraints			
1	Incidence of pests and diseases	360	1	1
2	Flooding due to heavy rainfall	354	2	2
3	Scarce water resources	320	3	3
4	Extremity in weather	319	4	4
5	Labour scarcity	219	5	8
6	Lack of knowledge on management practices	217	6	9
7	Inadequate capital	215	7	10
8	Poor transportation	143	8	13
9	Uneven production	119	9	15
10	Lack of extension service	115	10	16
11	Interrupted power supply	106	11	17
II.	Economic constraints			
1	High cost of inputs	318	1	5
2	Less profit	289	2	6
3	High labour charge	252	3	7
4	Poor economic status	207	4	11
5	Non availability of credit	144	5	12
6	Price fluctuation	142	6	14

A brief observation of Table 34 revealed that, among the crop management constraints, incidence of pests and diseases ranked first followed by flooding due to heavy rainfall, scarce water resources, extremity in weather conditions leading to worsening of other problems like pest and diseases etc. Other major constraints as perceived by bittergourd farmers included labour scarcity, lack of knowledge on management practices, inadequate capital, poor transportation, uneven production, lack of extension service, and interrupted power supply in the decreasing order of importance. Among the economic

constraints, high cost of inputs, less profit owing to varied reasons and high labour charge top the list. Other constraints were poor economic status, non availability of credit and price fluctuation.

4.7 REASONS FOR NON ADOPTION OF RECOMMENDED KAU PRACTICES IN THE CULTIVATION OF BITTERGOURD

Non adoption of practices suggested and recommended by various institutions can be attributed to multifaceted reasons. Various general reasons were delineated after discussion with the sample respondents and a list was prepared which was administered to the respondents for scoring. The reasons were ranked from 10 to 1 with the highest score for the most important reason. Mean of the score was found out for each reason and ranked from highest to lowest. The reasons were ranked based on the mean score. High mean score means it was the most important reason for non adoption of KAU practices. The major reasons for non adoption of recommended practices are presented in Table 35.

Table 35. Reasons for non adoption of KAU practices in the cultivation of bittergourd

Sl.No	Reasons for non adoption	Mean Score	Rank
1	Lack of awareness	10	1
2	Not applicable	9	2.5
3	More cost	9	2.5
4	Not accessible / available	7	4
5	Not sustainable practices	6	5
6	Not effective	5	6
7	Prejudiced	4	7
8	Time consuming	3	8
9	Lack of support from extension agents.	2	9
10	Not useful	1	10

The reasons for non adoption of recommended practices are reported in Table 35. Lack of awareness was ranked as the main reason for non adoption. The perception of a farmer about a technology can be affected by the farmers' awareness and the farmer awareness can significantly influence the adoption of new technology (Oladele and Fawole, 2007; Mathialagan and Senthilkumar, 2012).

Non applicability as the second most important reason for non adoption was attributed to the fact that the farmers perceive certain practices as not practical in the field. This applied to practices like seed rate, recommended irrigation interval, fertilizer recommendation due to its complexity nature. The next major reason reported was high cost of the material inputs which was applicable in the case of chemicals for weed, pest and disease management, cue lure trap and fertilizer.

Non accessibility as the fourth major reason was reported mainly in the case of chemical pesticides and entemopathogenic fungus (*Beauveria bassiana* and *Paecilomyces lilacinus*). The fifth reason attributed to non adoption was 'not sustainable' since the farmers perceived a practice as harmful to him and the environment like in the case of chemical management of pests and diseases. This was followed by the reason 'non effective' practices since the results produced by the application of certain practices were not effective when tried over a small scale.

Prejudice, that is, the farmers forming an opinion based on the experience of other farmers regarding the practice was also attributed as a reason of non adoption. Time consumption of practices and lack of support from extension agents especially personals of agriculture department were also reported by farmers which occupies the eighth and ninth position respectively.

4.8 SUGGESTIONS FOR REFINEMENT

The major strategies for refinement of the available recommendations as perceived by farmers and screened after discussing with subject matter specialists were presented in Table 36.

Table 36. Suggestions for refinement

Sl.No	Suggestion	%
1	Follow up and support by extension agents on the adoption of recommended practices	94.44
2	Farmer participatory development and framing of technologies or practices.	93.33
3	Participatory training between the extension unit and the farmers.	93.33
4	Revisiting traditional farmer practices and developing an integrated mix of scientific and farmer practices.	92.22
5	Inclusion of accessible and low cost technologies	77.78
6	Inclusion of soil and water conservation practices for sustainable natural resource management	72.22
7	Ensure the availability of technologies to the farmers by setting up input centers near to the farm	72.22
8	Promotion of value addition technologies	72.22

A cursory look at Table 36 indicated that majority of the respondents (94.44 %) perceived 'Follow up and support by extension agents on the adoption of recommended practices' as the major strategy for refinement followed by 'Farmer participatory development and framing of technologies or practices' (93.33 %); 'Participatory training between the extension unit and the farmers' (93.33 %); 'Revisiting traditional farmer practices and developing an integrated mix of scientific and farmer practices' (92.22 %); 'Inclusion of accessible and low cost technologies' (77.78 %). Strategies suggested by 72.22 per cent of the farmers were 'Inclusion of accessible and low cost technologies'; 'Ensure the

availability of technologies to the farmers by setting up input centers near to the farm' and 'Promotion of value addition technologies'.

Hence in general, in addition to development of need based technologies efforts are to be taken to improve the knowledge level of the farmers regarding the recommended practices which will in return influence the adoption of such improved practices. Systematic gathering and utilisation of traditional farmer practices after scientific rationalisation will also make bittergourd cultivation a sustainable one with more returns to the farmers. On taking account of the nutritional benefits of bittergourd it is also necessary to promote value addition of bittergourd to ensure adequate returns to the farmers during glut period.

Plate 1. Survey of the farmer respondents

Plate 2. Survey of the farmer respondents

Plate 3. Farmers Fields

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SUMMARY

CHAPTER V

SUMMARY

Bittergourd which is a primitive vegetable crop is widely cultivated in Kerala. Its demand is high in the market owing to its nutritional and therapeutic factors. Large number of farmers cultivates this crop especially during the peak season of Onam. Enhancing the production of bittergourd through the application of modern crop technologies and practices is relevant in improving the income of farmers thereby to attract other farmers into the cultivation and to reduce the dependence of pesticide laden vegetables on nearby states. The POP technologies are some of the technologies or practices that have been developed and introduced by KAU with the aim of improving the production of farmers. This study was carried out to examine the elements that influenced the adoption decisions of POP technologies among bittergourd farmers in three selected Panchayats of Thiruvananthapuram district. It largely will contribute to the present knowledge on the socioeconomic factors that influence farmers in their adoption decisions of bittergourd practices as well. Hence the present study was undertaken with the following objectives:

i. To analyse the social and personal characteristics of bittergourd farmers.

ii. To assess the level of adoption of selected KAU production technologies of bittergourd.

iii. To establish the relationship of social and personal characteristics of bittergourd farmers with the extent of adoption of production practices.

iv. To identify the constraints experienced as perceived by bittergourd farmers and suggestions for refinement.

The study was conducted during the year 2015 in Thiruvananthapuram district covering a sample of 90 farmers in three Panchayats, namely, Kalliyoor, Manikal and Vembayam, which were purposively selected on the basis of area of cultivation. Level of adoption of different production and plant protection practices of bittergourd included in the POP was selected as the dependent variable and the independent variables were age, education, occupation, farm size, area under bittergourd cultivation, farming experience, annual income, irrigation potential, economic motivation, innovativeness, market orientation, extension orientation, awareness and knowledge.

The data were collected from the field through personal interview using a well structured and pre tested interview schedule. Focus Group Discussion was also conducted to get information regarding constraints experienced and suggestions for refinement. Using the data, results were generated after apposite statistical analysis.

Socio- personal analysis of the farmers helps in identifying the major factors influencing adoption of improved practices. Technology needs assessment helps in identifying the major criterions for preferring bittergourd, identifying the major needs of the farmers and adoption level of various practices which further serve as valuable data for future research works.

The salient findings of the study were

1. Majority of the farmers belonged to middle aged category (46.67%).
2. Seventy per cent of the farmers had high school education, followed by 17.78 per cent acquiring middle school, 6.66 per cent primary education and 5.56 per cent with collegiate education. There were no farmers who were illiterate.
3. Majority of the farmers took agriculture as the sole job (84.44%) whereas 15.56 per cent farmers took other jobs along with agriculture.

4. Majority of the bittergourd farmers were either small or marginal farmers, that is, with farm size of 1-2 acre (51.12%) or less than one acre (34.44%).
5. Majority of the respondents cultivated bittergourd in area less than or equal to 0.50 (75.56 %). Only 5.55 per cent of farmers cultivated bittergourd in more than 1 acre land and 18.89 per cent farmers utilised area between 0.51 and 1 acre for bittergourd farming.
6. Majority of the farmers were experienced in farming. About 57.78 per cent of the farmers had more than 20 years of farming experience followed by 42.22 per cent of respondents with 10-20 years of experience and no farmers with less than 10 years experience.
7. Majority of the farmer respondents (44.44 %) were having an annual income of more than 2 lakhs, 38.89 per cent of farmers with an annual income of 1-2 lakhs and 16.67 per cent with less than 1 lakh.
8. About 36.67 per cent of respondents opined that there exists a state of economic water scarcity followed by 33.33 per cent of respondents stating that there is little or no water scarcity and finally 30 per cent farmers stated that they confront a condition physical water scarcity.
9. Economic motivation was high for majority of the respondents (95.56 %).
10. Medium innovative farmers were 54.44 per cent followed by 24.44 percent with low innovativeness and 21.11 per cent with high innovativeness.
11. Market orientation of the respondent sample was high with 98.89 per cent falling in the category of greater than three score vide table.
12. Progressive farmers were the most contacted extension agent where, 56.67 per cent of the respondents stated that they contacted them ‘very often’ followed by agricultural officer (53.33 %), personnels of other institutions / various commodity boards (5.56 %), scientists at

KAU (4.44 %) and finally scientists at various other ICAR institutions (1.11 %). Farmers also stated that most 'often' contacts were made with scientists at KAU.

13. Meeting was the event in which about 96.67 per cent of the respondents participated followed by 91.11 per cent in seminar, and 87.78 per cent in melas / fairs. The least participated event was Farm Field School were only 2.22 per cent of the farmers participate.
14. About 21.11 per cent farmers had high extension orientation, that is, they fell in the upper quartile range. 54.44 percent fell in the middle quartile region while 24.44 per cent of respondents had low orientation level and they fell in the lower quartile region
15. Sixty per cent of the respondents had medium awareness level, 25.56 per cent farmers with low awareness level and 14.44 per cent farmers with high awareness.
16. All the respondents were aware about using fruit fly traps. Fruit fly being an important pest of bittergourd needs effective technologies for its management and the awareness level of various traps for its control shows how well the practice was disseminated through the various sources.
17. Majority of the bittergourd farmers had medium level of knowledge (58.89 %) on scientific production practices of bittergourd. This was presumably due to the high level of literacy and education among the farmers. This was followed by 21.11 per cent with low knowledge level and 20.00 per cent in the upper range.
18. All the respondents had knowledge about trapping fruit fly using food baits and covering of fruits. Weeding and raking at the time of fertilizer application was the next practice known by most farmers, that is, about 95.55 per cent farmers knew about this practice. The least known practices were applying carbaryl 10 % DP in pit before sowing and seed rate is 5-6 kg/ha which only 21.11 per cent of farmers had knowledge about.

19. Four practices out of the selected 16 recommended practices were highly known by the farmers which included trapping fruit fly using food baits and covering fruits, weeding and raking at the time of fertilizer application, spraying neem based insecticide 2 % and cue lure trap.
20. Four practices that are very less known to the farmers were irrigation at 3-4 days interval and alternate days during flowering and fruiting, harvesting of fruits only after 10 days of chemical application, carbaryl l0 % DP in pit before sowing, and seed rate is 5-6 kg/ha.
21. Market preference was the foremost reason for preferring bittergourd cultivation. The market for bittergourd was guaranteed and demand is also high for this vegetable. The next two important reasons were cost effectiveness and resource utilisation.
22. Majority of bittergourd farmers had medium (65.55 %) to low level of adoption (17.78 %) of recommended practices.
23. Adoption level of production practices ranged from medium (78.89 %) to low (11.11 %).
24. In the case of plant protection practices adoption ranged from medium (61.11 %) to high (21.11 %).
25. Most adopted variety by the bittergourd farmers was Preethi where 71.11 per cent of the farmers adopted it, followed by Priyanka (18.89 %) and other varieties (10.00 %) which included hybrids obtained from retail seed outlets.
26. Out of the 16 recommended practices, five practices were highly adopted by the farmers, seven practices were medium adopted and four practices were the least adopted. The most adopted practices included: Recommended varieties, weeding and raking at the time of fertilizer application, neem based insecticide application against vector of mosaic, cue lure trap against fruit fly, and food bait trap and covering fruits against fruit fly.

27. Age, occupation and area under bittergourd cultivation possessed no significant relation with the extent of adoption. Education, farming experience and economic motivation was significant at 5 per cent level of significance while all the other variables were significant at 1 per cent level of significance.
28. Technology assessment revealed that maximum technology needs was reported for value addition (88) followed by nutrient management (221), vector control of mosaic (283), downey mildew management (301), and Irrigation (302). Most of the farmers reported that they are not encouraged for value addition of the harvested fruits though the returns that they are obtaining are meagre.
29. Constraints analysis revealed that the three important constraints confronted by farmers were incidence of pests and diseases, flooding due to heavy rainfall and scarce water resources.
30. The three major reasons for non adoption of practices as perceived by the farmers were: Lack of awareness about improved practices, non applicability of the practices in the field and high cost of the material inputs
31. The three prime strategies as perceived by the farmers included the need for follow up and support by extension agents on the adoption of recommended practices; farmer participatory development and framing of technologies or practices; participatory training between the extension unit and the farmers.

Suggestions for future research

1. Repetition of the same study in other districts as well.
2. Thrust should be given for developing and disseminating value addition technologies.
3. Field level demonstrations of effectiveness of entemopathogenic fungus.
4. Research studies on rationalized ITK practices in bittergourd and developing an integrated mix of farmers and scientific practices for recommendation.

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APPENDICES

APPENDIX I
Famers profile analysis

KERALA AGRICULTURAL UNIVERSITY
College of Agriculture, Vellayani
Thiruvananthapuram- 695522

Dr. Allan Thomas
Chairman,Advisorycommittee
t_allan@rediffmail.com

Department of Ag.Extension
Date: 31-07-2015

Sir/Madam,

Mrs. Noobiya Basheer (Ad. No. 2014-11-121), one of my post graduate Scholar in the Department of Agricultural Extension, College of Agriculture, Vellayani is undertaking a research study entitled "Technology utilization of KAU practices of bittergourd in Thiruvananthapuram district" as part of her research work. Variables supposed to have close association with the study have been identified after extensive review of the available literature and discussion with Extension Scientist's and other Experts,

Considering your vast experience and knowledge on the subject, I request you to kindly spare some of your valuable time for examining the questionnaire critically as a judge to rate the relevancy of the variables. Kindly return the list duly filled at the earliest in the self addressed stamped envelope enclosed with this letter.

Thanking you.

Yours sincerely

(Allan Thomas)

OBJECTIVES OF THE STUDY

1. To analyse the social and personal characteristics of bittergourd farmers.
2. To assess the level of adoption of selected KAU production technologies of bittergourd.
3. To establish the relationship of social and personal characteristics of bittergourd farmers with the extent of adoption of production practices.
4. To identify the constraints experienced as perceived by bittergourd farmers and suggestions for refinement.

You may please rate the statement with a tick mark in the appropriate column against the statement with special reference to its importance to the objectives of the study

Sl.No	Item	Most R	More R	R	Less R	Least R
1	**Age** Operationally defined as the chronological completed years of the bittergourd farmers at the time of investigation.					
2.	**Education** Operationally defined as the number of formal schooling obtained by the farmers.					
3.	**Family Size** Operationally defined as the number of members in the family of bittergourd farmers.					
4.	**Farm size** Operationally defined as the total farm area in hectare owned by the farmer.					
5.	**Farming Experience** Operationalised as the experience of the farmers in bittergourd cultivation expressed in terms of number of years.					
6.	**Occupation** Refers to whether agriculture was the respondent's chief occupation or not.					
7	**Gender** Refers to whether the respondent is male or female and the difference in adoption.					
8.	**Availabilty of Labour**					

	Refers to the manpower available to carry out farming activities.					
9.	**Market access** Operationalised as the means or opportunity to get the inputs as well to sell the outputs.					
10.	**Annual Income** Operationally defined as the total on farm and off farm earnings of the farmers and the family members in a year.					
11.	**Scientific orientation** Degree to which a farmer is oriented to the use of scientific methods in decision making in farming.					
12.	**Management orientation** Management orientation has been conceptualised as the degree to which a farmer is oriented towards scientific farm management practices in bittergourd cultivation.					
13.	**Information source utilisation** Refers to individual's contact with various sources of information.					
14.	**Farmers wealth** It is the classification of the farmers as rich, medium and poor based on land area, income, house type, entertainment means, equipment, other activities and food consumption.					
15	**Area under bittergourd cultivation** Operationalised as the area under bittergourd cultivation by the farmer measured in acres.					
16.	**Extension orientation** Refers to the extent of contact a farmer had with different extension agencies/other sources and also his participation in various extension activities or programmes like meetings, seminars etc. organised.					
17.	**Extent of commercialisation** Refers to the degree of					

	commercialisation of the farm that may be likely to contribute positively to technology use to attain high level of productivity in order to earn maximum income.					
18.	**Innovativeness** Refers to the degree to which an individual is relatively earlier in adopting new ideas than other members of the social system.					
19.	**Accessibility** Refers to the ability to access the technology by the respondents because technology availability alone may not influence adoption.					
20.	**Economic motivation** Operationalised as the drive of the respondent to obtain profit and the relative value placed on economic ends so that it influences further adoption or its sustenance.					
21.	**Tenure** Refers to the land ownership of the farmer respondents that is available for agriculture with special reference to bittergourd cultivation.					
22.	**Awareness** Awareness of a need is generally perceived as a first step in the adoption process. It's a state of knowledge that something exists, or understanding of a situation or subject at the present time based on information or experience					
23.	**Elasticity of farm household income** Refers to the extent of on farm and off farm incomes ability to increase the probability of adopting bittergourd production practices.					
24.	**Knowledge about recommended practices** Refers to the extent of information possessed by the respondents on recommended practices.					

25.	**Network analysis** It refers to the study of how the social structure of relationships around a person, group, or organisation affects beliefs or behaviours.					
26.	**Credit orientation** Refers to the favourable and positive attitude of bittergourd growers towards obtaining credit from institutional sources with special reference to its availability and accessibility in bittergourd cultivation.					
27.	**Cosmopoliteness** It is operationalised as the tendency of the farmers to be in contact with the outside world.					
28.	**Irrigation potential** Refers to the extent to which the water is available for irrigating the crop.					
29.	**Social participation** Operationally defined as the degree of involvement and participation of farmers in various formal and informal organisations either as member or as office bearers.					
30.	**Risk perception-** Farmers subjective judgement on the factors that are influencing farming activity. It includes Price fluctuation risk and Yield fluctuation risk					
31.	**Risk orientation**- Degree to which the respondent is oriented towards facing a risk in the process of bittergourd cultivation.					
32.	**Spread effect- It is** likelihood that the new practices introduced among the initial activity target population would be diffused among other groups.					
33	**Socio-cultural feasibility-** The compatibility of the activity with the socio cultural environment in					

	which the innovation or technology in bittergourd is to be introduced.					
34	**Social impact-** distribution of benefits and burdens among different groups, both within the initial activity population and beyond involved directly or indirectly with bittergourd cultivation..					
35	**Any others: (Please specify)**					

R- Relevant

APPENDIX II

The variables with their mean relevancy score

Sl.No	Independent variables	Mean relevancy score
1.	Age	**4.26**
2.	Education	**4.37**
3.	Family size	3.00
4.	Farm size	**4.22**
5.	Farming experience	**4.56**
6.	Occupation	**4.19**
7.	Gender	3.59
8.	Labour availability	4.01
9.	Market access	4.02
10.	Annual income	**4.04**
11.	Scientific orientation	3.91
12.	Market orientation	**4.56**
13.	Information source utilization	4.01
14.	Farmers wealth	3.30
15.	Area under bittergourd	3.89
16.	Extension orientation	**4.48**
17.	Extent of commercialization	3.15
18.	Innovativeness	**4.67**
19.	Accessibility	4.01
20.	Economic motivation	**4.52**
21.	Tenure	3.48
22.	Level of awareness	**4.19**
23.	Elasticity of farm household income	3.30
24.	Knowledge	**4.52**
25.	Network analysis	3.67
26.	Credit orientation	3.93
27.	Cosmpoliteness	3.85
28.	Irrigation potential	**4.26**
29.	Social participation	3.89
30.	Risk perception	3.91
31.	Risk orientation	4.00
32.	Spread effect	3.74
33.	Socio cultural feasibility	3.74
34.	Social Impact	3.59
	Mean	**4.03**

APPENDIX III

Distribution of recommended practices in bittergourd cultivation based on their knowledge by respondents

Category	Practices
High (>83.5)	1. Trapping fruit fly using food baits and covering fruits
	2. Weeding and raking at the time of fertilizer application
	3. Spraying neem based insecticide 2%
	4. Cue lure traps
Medium (44.25-83.5)	1. Varieties are Preethi, Priyanka and Arka Harit
	2. Vector control of mosaic by spraying dimethoate 0.05 %
	3. Retain 3 plants per pit
	4. Spacing is 2*2m
	5. Spraying Mancozeb 0.2%
	6. Fertilizer application 70:25:25
	7. Top dressing of N fertilizer at split doses fortnightly
	8. Apply *Beauveria bassiana* 10% and *Paecilomyces lilacinus* 5% WP.
Low (<44.25)	1. Irrigation at 3-4 days interval and alternate days during flowering and fruiting.
	2. Harvesting of fruits only 10days of chemical application.
	3. Carbaryl l0% DP in pit before sowing
	4.Seed rate is 5-6 kg/ha

APPENDIX IV

Distribution of recommended practices based on adoption

Category	Score limits	Practices
High	> 85.67	1. Varieties are Priyanka, Preethi and Arka Harit
		2. Weeding and raking at time of fertilizer application
		3. Neem based insecticide 2 % to control vector
		4. Cue lure trap
		5. Food bait trap and covering fruits against fruit fly
Medium	13.78-85.67	1. Spacing is 2*2m
		2. Retain 3 plants
		3. Top dressing of N fertilizer at split doses everyfortnightly
		4. Fertilizer recommendation at 70:25:25
		5. Spraying mancozeb 0.2%
		6.Vector control by spraying dimethoate 0.05
		7. *Beauveria bassiana* 10 % WP and *Paecilomyces lilacinus* 5 % WP
Low	< 13.78	1.Seed rate is 5-6 Kg/ha
		2.Irrigation at 3-4 days interval or at alternative days during flowering/ fruiting
		3.Harvesting of fruits after 10 days of chemical application
		4.Carbaryl application 10 % DP in the pit before sowing

APPENDIX V

Correlation between the extent of adoption of recommended practices and the selected characteristics of the respondents

Variables	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	**Y**
X_1	1														
X_2	0.03	1													
X_3	0.17	-0.10	1												
X_4	0.01	0.09	0.03	1											
X_5	0.09	-0.20	-0.23	0.20	1										
X_6	0.01	-0.30	-0.13	0.1	0.16	1									
X_7	0.00	0.19	-0.01	0.6	-0.05	0.11	1								
X_8	0.08	0.10	0.06	0.4	0.16	0.01	0.35	1							
X_9	-0.11	0.06	0.06	0.6	0.06	0.15	0.49	0.62	1						
X_{10}	-0.08	0.20	0.23	0.2	-0.09	-0.06	0.30	0.19	0.33	1					
X_{11}	-0.11	0.19	-0.12	0.7	0.16	0.23	0.55	0.40	0.50	0.17	1				
X_{12}	0.00	0.17	0.05	0.7	0.11	0.14	0.72	0.49	0.56	0.27	0.70	1			
X_{13}	-0.16	-0.03	0.10	0.5	0.09	0.23	0.62	0.57	0.74	0.41	0.54	0.65	1		
X_{14}	-0.17	-0.04	0.01	0.5	0.16	0.23	0.51	0.63	0.76	0.30	0.59	0.60	0.87	1	
Y	-0.06	0.22*	-0.06	0.74**	- 0.09	0.21*	0.72**	0.51**	0.61**	0.23*	0.83**	0.88**	0.68**	0.66**	1

X_1 - Age, X_2 - Education, X_3 – Occupation, X_4 – Farm size, X_5 - Area under bittergourd cultivation, X_6 - Farming Experience, X_7 - Annual Income, X_8 - Irrigation Potential, X_9 - Extension Orientation, X_{10} - Economic Motivation, X_{11} – Innovativeness, X_{12} - Market Orientation, X_{13} - Knowledge, X_{14} – Level of Awareness, Y– Extent of Adoption

* - Significant at 5% level

**- Significant at 1% level

APPENDIX VI

Interview Schedule

1. Name:

Address:

2. Family structure and characteristics:

Name of member	Sex	Age	Relationship with head	Education	Occupation		Income	
					Primary	Secondary	Daily	Monthly

3. Farm Size

Farmstead (cents)

Particulars	**Wet land**	**Garden land**
Total area cultivated		
Land put to non agricultural uses		
Fallow land		
Net sown area		
Area sown more than once		
Gross cropped area		

4. Area under bittergourd cultivation:

5. Tenancy status: Owned / Tenant

6. Land status

A. Type of land

a) Wet land :

b) Garden land :

c) Hilly land :

d) Undulating :

B. Topography :

C. Type of Soil :

7. Experience in farming (in year):

8. Annual income

a) From agriculture:

b) Other means :

9. IRRIGATION POTENTIAL

a) Whether bittergourd is (Irrigated/ Rain fed/Combination)

b) What is the perception of farmer on availability of water (Physical water scarcity/ Economic water scarcity/ Little or no water scarcity)

c) Source of irrigation water (Wells/ Tube wells/ Canals/ Ponds/ River/ Tap/ Others)

d) Capacity or period for which irrigation water is available……

e) Area irrigated…….

f) Do you pay for the water used? (Y/N) If yes, Amount incurred for irrigation purpose (Rs/Month) Amount incurred for home use (Rs/ Month)

g) Do you adopt any water harvesting method/sustainable water management practices in your homegarden? Yes/ No. If yes, what is the method practised? How efficient it is? (Very efficient/ Moderately efficient/ less efficient).

10. EXTENSION ORIENTATION

A) Extension contact

Sl.No	Items	Often	Frequently	Never
a)	AO's/AA's of agricultural dept.			
b)	Scientists of Kerala Agricultural University			
c)	Scientists of ICAR institutes			
d)	Personnel of other institutes/ Commodity boards, etc.			
e)	Friends, neighbours and well wishers			
f)	Progressive farmers			
g)	Others			

B) Extension participation

Sl.No	Items	Whenever conducted	Sometimes	Never
1.	Study tours			
2.	Seminars			
3.	Melas / Fairs			
4.	Meetings			
5.	Farm field schools			
6.	Demonstrations			
7.	Others			

11. ECONOMIC MOTIVATION

Are you agreeing or disagreeing with the following statement given below

Sl.No	Statements	Agree	Disagree
1.	A farmer should do farming for more production and profit.		
2.	A farmer becomes successful when he makes more profit.		
3.	Any innovative idea which brings in more profit should be adopted.		
4.	Cash crops should be preferred by a farmer who aims at profit making than preferring food crops.		
5.	Without financial support from the farmer head, his children will find it difficult to move ahead.		
6.	A farmer should earn for living but should never connect finance with life's important matters.		

12. INNOVATIVENESS

When do you adopt a new technology or idea in farming?

a) As soon as it is brought to my knowledge
b) After I have seen other farmers tried successfully in their farm.
c) I prefer to wait and take my own time.

13. MARKET ACCESS

The distance to the nearest major market (In km):

14. EXTENT OF KNOWLEDGE, AWARENESS AND LEVEL OF ADOPTION OF SCIENTIFIC PRODUCTION PRACTICES

Sl. No	Items	Extent of Knowledge		Awareness			Level of Adoption					Perceived Effectiveness and Usefullness		
		Y	**N**	**VA**	**A**	**NA**	**AA**	**CA**	**PA**	**NA**	**Remarks**	**VE/VU**	**E/U**	**NE/NU**
1.	Spacing is 2*2m													
2.	Varieties are Preethi, Priyanka, Priya and Arka Harit													
3.	Seed rate is 5-6 kg/ha													
4.	Retain 3 plants per pit.													
5.	Top dressing of N fertilizer in split doses at fortnightly interval.													
6.	Weeding and raking at the time of fertilizer application.													
7.	Irrigation at 3-4 days													

	interval and alternate days during flowering/fruiting													
8.	Carbaryl 10% DP in pit before sowing.													
9.	Spraying 0.2% mancozeb against downey mildew													
10.	Vector control of mosaic by spraying dimethoate 0.05%													
11.	Harvesting of fruits only 10 days of chemical application													
	ORGANIC PLANT PROTECTION PRACTICES													

12.	Spraying neem based insecticide 2% to control vector of mosaic													
13.	Apply Beauveria bassiana 10% and Paecilomyces lilacinus 5% WP against epilachna beetle and leaf and flower feeders													
14.	Cue lure traps against fruit fly													
15.	Trapping fruit fly using food baits and covering fruits.													

Y- Yes, N- No; VA- Very much Aware, A- Aware, NA- Not Aware; AA- Actual Adoption, CA- Complete Adoption, PA- Partial Adoption, NA- Non Adoption; VE/VU- Very Effective/ Very Useful; E/U- Effective/Useful, NE/NU- Not effective/Not Useful

15. PERCEIVED USEFULLNESS

SL.No	Items	Reasons				
		More yield	Less cost	More sustainable	Accessible	Other reasons
1.	Spacing is 2*2m					
2.	Varieties are Preethi, Priyanka, Priya and Arka Harit					
3.	Seed rate is 5-6 kg/ha					
4.	Retain 3 plants per pit.					
5.	Top dressing of N fertilizer in split doses at fortnightly interval.					
6	Weeding and raking at the time of fertilizer application.					
7.	Irrigation at 3-4 days interval and alternate days during flowering/fruiting					
8.	Carbaryl 10% DP in pit before sowing.					

9.	Spraying 0.2% mancozeb against downey mildew					
10.	Vector control of mosaic by spraying dimethoate 0.05%					
11.	Harvesting of fruits only 10 days of chemical application					
	ORGANIC PLANT PROTECTION PRACTICES					
12.	Spraying neem based insecticide 2% to control vector of mosaic					
13.	Apply Beauveria bassiana 10% and Paecilomyces lilacinus 5% WP against epilachna beetle and leaf and flower feeders					
14.	Cue lure traps against fruit fly					
15.	Trapping fruit fly using food					

	baits and covering fruits.					

16. TECHNOLOGY NEEDS ASSESSMENT

Sl.No	Items	Technology not available	Tech. available but not applicable	Tech. available but not sustainable	Technology available, applicable and sustainable
	PRODUCTION				
1.	Varieties				
2.	Spacing				
3.	Nutritional requirements				
4.	Irrigation				
5.	Organic manure application				
6.	Harvesting				
	PROTECTION				
1.	Fruit fly				
2.	Epilachna beetle				
3.	Downey mildew				
4.	Vector control				
	VALUE ADDITION AND POST HARVEST TECHNOLOGY				
1.	Drying				
2.	Pickling				
3.	Others				

17. ITK/FARMERS' PRACTICES

Sl.no	ITK/Farmers' practice	Effectiveness		
		E	NE	VE

18. MARKET ORIENTATION

Sl.No	Statements	Response	
1.	Market is not useful to a farmer	A	DA
2.	A farmer can get good price by eliminating the middle man		
3.	One should sell his produce to the nearest market irrespective of price		
4.	One should purchase his inputs from shops where his friends or relatives purchase		
5.	One should grow those crops which have more market demand		
6.	Co-operatives can help a farmer to get better price for his produce		

A- Agree DA- Disagree

19. CONSTRAINT ANALYSIS

Sl.No	Constraints	MI	I	L I.	Li	Perceived solutions
1.	Incidence of pest and diseases					
2.	Labour scarcity					
3.	Inadequate capital					
4.	Scarce water resources					
5.	Lack of knowledge on management practices					
6.	Poor transportation					
7.	Uneven production					
8.	Lack of extension service					
9.	Interrupted power supply					
1.	Flooding due to heavy rainfall					
2.	High cost of inputs					
3.	High labour charge					
4.	Price fluctuation of produce					
5.	Less profit					
6.	Poor economic status					
7.	Non availability of credit					

MI- Most Important I- Important LI- Less Important Li- Least Important

ABSTRACT

TECHNOLOGY UTILISATION OF BITTERGOURD IN THIRUVANANTHAPURAM DISTRICT

by

NOOBIYA BASHEER

(2014-11-121)

ABSTRACT

Of the thesis submitted in partial fulfillment of

the requirement for the degree of

Master of Science in Agriculture

Faculty of Agriculture

Kerala Agricultural University, Thrissur

DEPARTMENT OF AGRICULTURAL EXTENSION

COLLEGE OF AGRICULTURE

VELLAYANI, THIRUVANANTHAPURAM – 695 522

KERALA, INDIA

2016

ABSTRACT

The study entitled 'Technology utilisation of bittergourd in Thiruvananthapuram district' conducted in Thiruvananthapuram involved 90 bittergourd farmers, with 30 each from Kalliyoor, Manickal and Vembayam Panchayats, during the period, 2015-2016. The study was done to determine the levels of adoption of varieties cum the selected KAU production technologies, factors associated with the adoption of the agricultural technologies, its relation with level of adoption and constraints experienced by the bittergourd growing farmers with suggestions for refinement.

Twelve independent variables, namely, age, education, occupation, farm size, area under bittergourd cultivation, annual income, farming experience, irrigation potential, extension orientation, innovativeness, market orientation and economic motivation were selected through judges rating. Along with the selected variables, two additional variables like extent of awareness and knowledge were also included purposively. The level of adoption was the dependent variable. Sixteen recommended practices in bittergourd were selected consulting the subject matter specialists.

Knowledge level was high for 20.00 per cent of farmers, medium for 58.89 per cent of farmers and low for 21.11 per cent of farmers.

Perceived effectiveness was high for practices like cue lure trap and weeding and raking at the time of fertilizer application where 76.67 per cent of farmers reported it as 'very effective'. Eighty two percent of the farmers reported that cue lure trap was 'very useful' followed by 78 per cent for weeding and raking at the time of fertilizer application.

Technology assessment revealed that 65.55 per cent of farmers belonged to medium category of adoption, followed by 17.78 per cent with low adoption level and 16.67 per cent with high adoption level. In the case of recommended varieties,

adoption was higher for the variety Preethi (71.11 %) followed by Priyanka (18.89 %).

Farmer respondents were categorized to different adopter categories as explained by Rogers (1982). According to the findings major portion of farmer respondents were late majority (42.22 %) followed by early majority (25.56 %) and about 2.22 per cent of the farmers were innovators.

The main factors of influences on technology adoption of recommended practices were farm size, extension orientation, annual income, market orientation, irrigation potential, innovativeness, knowledge and awareness at 1% significance followed by education, economic motivation and farming experience at 5% significance.

Technology needs assessment as perceived by bittergourd farmers revealed that maximum need was observed for value addition technologies. The major reason for non adoption as perceived by the non adopters was ‘lack of awareness’. The major constraint experienced by the farmers was incidence of pests and diseases.

The primary suggestion for refinement was follow up and support by extension agents on adoption of recommended practices.

സംഗ്രഹം

"തിരുവനന്തപുരം ജില്ലയിലെ പാവൽ കൃഷി മേഖലയിലെ കർഷകരുടെ സാങ്കേതിക വിദ്യ വിനിയോഗം" എന്ന പഠനം 2015-16 കാലയളവിൽ തിരുവനന്തപുരം ജില്ലയിലെ കല്ലിയൂർ, മാണിക്കൽ, വെമ്പായം എന്നീ ഗ്രാമ പഞ്ചായത്തുകളിലെ 90 കർഷകരിൽ നടത്തുകയു□ ായി. കേരള കാർഷിക സർവ്വകലാശാലയുടെ പാവൽ ഇനങ്ങളുടേയും കൃഷിമുറകളുടേയും സ്വീകാര്യത, ഇതിനെ സ്വാധീനിക്കുന്ന പ്രധാന കാരണങ്ങൾ, സാങ്കേതിക വിദ്യയുടെ ഉപയോഗപ്പെടുത്തലിന്റെ അഭാവം, കർഷകർ നേരിടുന്ന പ്രശ്നങ്ങൾ എന്നിവയാണ് പ്രധാനമായും ഈ പഠനത്തിൽ നിന്നും സ്വീകരിച്ച വിവരങ്ങൾ.

പഠന പ്രക്രിയയിൽ സ്വതന്ത്ര വേരിയബിലുകളായി തെരെഞ്ഞെടുത്തിരിക്കുന്നത് വയസ്സ്, വിദ്യാഭ്യാസം, ജോലി, ആകെ കൃഷിയിടത്തിന്റെ വിസ്തീർണ്ണം, പാവൽ കൃഷിയിടത്തിന്റെ വിസ്തീർണ്ണം, വാർഷിക വരുമാനം, കൃഷി പരിചയം, ജലസേചന സാധ്യതകൾ, വിജ്ഞാന വ്യാപന വിന്യാസം, നൂതന ആശയ സ്വീകാര്യത, വിപണന വിന്യാസവും സാമ്പത്തിക പ്രേരണ എന്നീ 12 ഇനങ്ങളെയാണ് ജഡ്ജസ് റേറ്റിംഗ് മുഖാന്തിരം തെരെഞ്ഞെടുത്തിട്ടുള്ളത്. കൂടാതെ ജ്ഞാനം, അവബോധം എന്നീ അധിക സ്വതന്ത്ര വേരിയബിലുകളും ഇതോടൊപ്പം ഉൾപ്പെടുത്തിയിരിക്കുന്നു. കൂടാതെ ആശ്രിത വേരിയബിലുകളായി "കൃഷിമുറകളുടെ സ്വീകാര്യത" എന്ന വേരിയബിലിനേയും ആണ് ഉൾപ്പെടുത്തിയിരിക്കുന്നത്.

കൃഷിമുറകളിൽ കർഷകർക്കുള്ള "ജ്ഞാനം", 20 ശതമാനത്തോളം പേരിൽ വളരെ കൂടുതലും 58-89 ശതമാനം പേരിൽ ശരാശരി അളവിലും 21.11 ശതമാനം കർഷകരിൽ വളരെ കുറവും എന്ന രീതിയിൽ ആണ് കാണപ്പെട്ടത്.

കൃഷിയിടങ്ങളിൽ കർഷകർക്ക് വളരെ ഫലപ്രദമായി കാണപ്പെട്ട മാർഗ്ഗങ്ങളായിരുന്നു കായീച്ചക്ക് എതിരെയുള്ള കെണിയും (ക്യൂ ലൂടർ ട്രാപ്പ്), വളപ്രയോഗത്തിന് മുമ്പുള്ള കളപറിക്കലും, മണ്ണ് ഇളക്കലും.

കാർഷിക സർവ്വകലാശാല തയ്യാറാക്കിയ കൃഷിമുറകളിലെ സാങ്കേതിക വിദ്യയുടെ സ്വീകാര്യത പരിശോധിച്ചതിൽ 65.5% കർഷകരിൽ കൃഷിമുറ സ്വീകരിക്കുന്നതിൽ ശരാശരി നിലവാരം പുലർത്തുകയും 17.78% പേർ തീരെ താഴ്ന്ന രീതിയിലും, 16.67% കർഷകരിൽ ഉയർന്ന നിലയിൽ സാങ്കേതിക വിദ്യ

സ്വീകരിക്കുന്നവരുമായാണ് കാണാൻ കഴിയുന്നത്. പാവൽ ഇനങ്ങളിൽ 71.11% പേർ ഉപയോഗിച്ചിരുന്നത് "പ്രീതി" ഇനത്തിൽപ്പെട്ട വിത്തും 18.89% പേർ "പ്രിയങ്ക" ഇനത്തിൽപ്പെട്ട വിത്തുമാണ്.

കർഷകർ നൂതന സാങ്കേതിക വിദ്യകളും, കൃഷിമുറകളേയും എത്രവേഗം സ്വീകരിക്കുന്നു ് എന്നത് റോജർസിന്റെ നിർവചനവുമായി ബന്ധപ്പെടുത്തി പറയുമ്പോൾ, 42.22 ശതമാനത്തോളം വരുന്ന ഭൂരിഭാഗം കർഷകരും ലേറ്റ് മജോറിറ്റി 25.56% പേർ ഏർളി മെജോറിറ്റി, 2.22% പേർ ഇന്നവേറ്റർ എന്ന രീതിയിലുമാണ് കാണാൻ കഴിഞ്ഞത്.

കൃഷിമുറകളിൽ സാങ്കേതിക വിദ്യയുടെ സ്വീകാര്യതയും, ഉപയോഗവും പഠനത്തിനായി തെരഞ്ഞെടുത്ത വെരിയബിളുകളായ കൃഷി സ്ഥലത്തിന്റെ വിസ്തീർണ്ണം, വിജ്ഞാന-വ്യാപന വിന്യാസം, വാർഷിക വരുമാനം, വിപണന വിന്യാസം, ജലസേചന സാധ്യതകൾ, നൂതന ആശയ സ്വീകാര്യത, ജ്ഞാനവും, അവബോധവും എന്നിവ വളരെ നല്ല സ്വീകാര്യതയിലും (1%) വിദ്യാഭ്യാസം, സാമ്പത്തിക പ്രേരണ, കൃഷി പരിചയം എന്നിവ (5%) കൃഷിയുമായി ബന്ധപ്പെട്ട് സ്വീകാര്യ ഉള്ളതായും കാണാൻ കഴിഞ്ഞു.

കൃഷിയിടങ്ങളിൽ സാങ്കേതിക വിദ്യയുടെ ആവശ്യം വിലയിരുത്തുന്നതിന്റെ ഭാഗമായി ക ത്താൻ കഴിഞ്ഞത്, മൂല്യവർദ്ധിത സാങ്കേതിക വിദ്യകൾ വളരെ കൂടുതൽ ആവശ്യമാണ് എന്നുള്ളതാണ്.

കൃഷിമുറകൾ സ്വീകരിക്കാത്തതിന്റെ പ്രധാന കാരണങ്ങളായി ക ത്താൻ കഴിഞ്ഞത് ഈ മേഖലയിലെ അവബോധമില്ലായ്മയും, രോഗകീടാക്രമവുമാണ് .

ഈ പഠനവുമായി ബന്ധപ്പെട്ട് കൃഷിമുറകളുടെ സ്വീകാര്യതക്ക് വേ ി പ്രാഥമിക നിർദ്ദേശങ്ങളുമായി വയ്ക്കാനുള്ളത്. വിജ്ഞാന വ്യാപന വിപുലീകരണവും, കൃഷിക്കാവശ്യമായ തുടർ സഹായ പ്രവർത്തനങ്ങൾ ഊർജ്ജിതപ്പെടുത്തുക എന്നുള്ളതുമാണ്.