TECHNOLOGY NEED ASSESSMENT ON HORIZONTAL AND VERTICAL DIVERSIFICATIONS FOR THE ECONOMICALLY DOMINANT CROPS IN HOMEGARDENS

by

IBY SEBASTIAN

(2013-11-200)

THESIS

Submitted in partial fulfillment of the

requirements for the degree of

MASTER OF SCIENCE IN AGRICULTURE

Faculty of Agriculture

Kerala Agricultural University

DEPARTMENT OF AGRICULTURAL EXTENSION

COLLEGE OF AGRICULTURE

VELLAYANI, THIRUVANANTHAPURAM- 695 522

KERALA, INDIA

2015

TECHNOLOGY NEED ASSESSMENT ON HORIZONTAL AND VERTICAL DIVERSIFICATIONS FOR THE ECONOMICALLY DOMINANT CROPS IN HOMEGARDENS

by

IBY SEBASTIAN

(2013-11-200)

ABSTRACT

of the thesis submitted in the partial fulfillment of the

requirements for the degree of

MASTER OF SCIENCE IN AGRICULTURE

Faculty of Agriculture

Kerala Agricultural University

DEPARTMENT OF AGRICULTURAL EXTENSION
COLLEGE OF AGRICULTURE
VELLAYANI, THIRUVANANTHAPURAM - 695 522
KERALA, INDIA

2015

DECLARATION

I, hereby declare that this thesis entitled **"TECHNOLOGY NEED ASSESSMENT ON HORIZONTAL AND VERTICAL DIVERSIFICATIONS FOR THE ECONOMICALLY DOMINANT CROPS IN HOMEGARDENS**" 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 of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Vellayani **Iby Sebastian**

Date : **(2013-11-200)**

CERTIFICATE

Certified that this thesis entitled **"TECHNOLOGY NEED ASSESSMENT ON HORIZONTAL AND VERTICAL DIVERSIFICATIONS FOR THE ECONOMICALLY DOMINANT CROPS IN HOMEGARDENS**" is a record of bonafide research work done independently by Miss. Iby Sebastian (2013-11-200) under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

Vellayani

Date:

Dr. R. Prakash
Professor and Head
Department of Ag. Extension
College of Agriculture, Vellayani,
Thiruvanathapuram- 695 522

CERTIFICATE

We, the undersigned members of the advisory committee of Ms. Iby Sebastian (2013-11-200), a candidate for the degree of **Master of Science in Agriculture** with major in Agricultural Extension agree that this thesis entitled **"TECHNOLOGY NEED ASSESSMENT ON HORIZONTAL AND VERTICAL DIVERSIFICATIONS FOR THE ECONOMICALLY DOMINANT CROPS IN HOMEGARDENS"** may be submitted by Ms. Iby Sebastian in partial fulfillment of the requirement for the degree.

Dr. R. Prakash
(Chairman , Advisory Committee)
Professor and Head
Department of Agrl. Extension
College of Agriculture,Vellayani,

Dr. Vijayaraghava Kumar
(Member, Advisory Committee)
Professor and Head
Department of Agrl. Statistics
College of Agriculture, Vellayani

Dr. Allan Thomas
(Member, Advisory Committee)
Assistant Professor (Sr. Scale)
Department of Agrl. Extension
College of Agriculture,
Vellayani.

Dr. N. Kishore Kumar
(Member, Advisory Committee)
Professor
Department of Agrl. Extension
College of Agriculture, Vellay

EXTERNAL EXAMINER
(Name and Address)

Acknowledgement

First and Foremost, I give thanks to God almighty for His protection, guidance and provision of wisdom and strength during my entire education. True to His word, he has indeed brought me to a successful end.

I feel immense pleasure to express my profound and heartfelt thankfulness to Dr. R. Prakash Professor and Head ,Department of Agricultural Extension and Chairperson of the advisory committee & Dr. Allan Thomas, Assistant Professor, Department of Agricultural Extension and member of the Advisory Committee for their guidance, suggestions, constant encouragement, support, unfailing patience and above all the kind of understanding throughout the course of this research work and preparation of the thesis.

I wish to express my sincere gratitude to Dr. N. Kishore Kumar Professor, Department of Agricultural Extension and member of advisory committee, for the help rendered for the smooth conduct of research work, co-operation and critical evaluation of thesis.

I am grateful to Dr. Vijayaraghava Kumar, Professor and Head , Department of Agrl. Statistics and member of advisory committee for his valuable suggestions, timely support and critical evaluation during the course of this work.

I am thankful to Dr. B Seema, Professor, Department of Agrl Extension for her valuable suggestion, encouragement and co-operation rendered throughout the study.

I express my sincere thanks to Dr. Anil Kumar, Professor, Department of Agrl. Extension for his entire well wishes help and support.

I express my sincere thanks to Dr. V.B Padmanabhan, professor Department of Agrl. Extension for his entire well wishes help and support.

I express my sincere thanks to Dr. A.K Sherief, Professor, Department of Agrl. Extension for his entire well wishes help and support.

My heartful thanks to Dr. G. S. Sreedaya, Assistant Professor, Department of Agrl. Extension, for her friendly approach, creative suggestions and constant encouragement rendered to me during the course of my study and research work.

I greatly acknowledge the advice rendered by Dr. Jose Joseph, Professor and head Department of Agricultural Extension, college of Agriculture, Vellanikkara to carry out the work .

I express my sincere thanks to Jacob John sir for his entire well wishes help and support.

I wish to express my heartfelt thanks to Dean, College of Agriculture, Vellayani for providing me all the necessary facilities from the University during the whole course of study.

I also extent my acknowledgement to Kamarudeen Sir, Radhakrisnan chettan, Ashwathy chechy, Nadeshan chettan and to all non-teaching staffs of the Department of Agricultural extension for the help rendered to me during the course of study.

I wish to express my heartfelt thanks to all teaching and non-teaching staffs of Department of Agrl. Statistics, College of Agriculture, Vellayani for providing me all the necessary facilities during the whole course of study.

I wish to express my heartfelt thanks to all teaching and non-teaching staffs of Department of Agrl. Economics, College of Agriculture, Vellayani for providing me all the necessary facilities during the whole course of study.

I wish to place my heartful thanks to Sujitha and Reeba for their valuable help, cooperation and support during my research work.

I joyfully recollect the friendly help and contributions which I got from my heart-bound friends Sachu, Sukanya, Anju, Aishwarya, Shilpa, Priyanka and Vyshakhi for their help, good company, positive criticism and moral support throughout my P.G. programme without their help it would have been impossible to complete my research work.

My grateful thanks to my seniors Chinchu, Shelly , Ravi ,Anupama, Rahul, Sreejith chettan and others for their blissful presence and assistance and also my juniors Namitha, Vishnu , Suma, Dhanya, Binsa, Noobiya, Anju, Thasneem , Ishrath, Neethu chandran for their wishes and help rendered at each and every stage of my P.G.programme.

My loving and wholehearted thanks to my batchmates Arya, Litty, Revathy ,Akshay. Anila, Ashwathy, Ardhra, and others for their help and support throughout my P.G. programme.

I am most indebted for my papa and mamma , for their affection, prayers, constant encouragement, moral support and blessings that have enabled me to

finish this work, without which I would not have completed this research. I wish to express my sincere gratitude to Jomon and Litty chechy for their encouragement, blessings and support during my studies. I take this opportunity to acknowledge them for all the inspiring words, unconditional love, care and support they offered to me.

Once more I humbly bow my head before that Almighty for the numberless blessings that He showered upon my life.

Iby Sebastian

CONTENTS

LIST OF TABLES

11	Distribution of homegarden respondents based on mass media contribution	
12	Distribution of homegarden respondents based on mass media contribution (frequency)	
13	Distribution of homegarden respondents based on mass media contribution (usefulness)	
14	Distribution of homegarden respondents based on evaluative perception with special reference to the sustainability aspects of horizontal and vertical diversification	
15	Dominance profile of homegarden	
16	Extent of horizontal diversification of economically dominant crops in homegardens	
17	Extent of vertical diversification for the economically dominant crops in the homegardens	
18	Vertical diversification based on number of levels practiced by each of the homegarden respondents	
19	Knowledge on horizontal diversification and vertical of the homegarden	
20	Relationship of independent variables with knowledge on horizontal and vertical diversification of the homegarden respondents.	
21	Diversification preferences of the homegarden	
22	Technology needs (gaps) as perceived by the homegarden farmers in the process of horizontal diversification	
23	Technology needs/gaps as perceived by the homegarden farmers in the process of vertical diversification	
24	Technology needs assessment on vertical diversification of homegardens	
25	Constraints in horizontal diversification and vertical diversification of the homegarden respondent	

LIST OF FIGURES

17.	Extent of vertical diversification for the economically dominant crops in the homegardens	
18.	Knowledge on horizontal diversification of the homegarden	
19.	Knowledge on vertical diversification of the homegarden	
20.	Technology needs (gaps) as perceived by the homegarden farmers in the process of horizontal diversification	
21.	Technology needs (gaps) as perceived by the homegarden farmers in the process of vertical diversification	

LIST OF PLATES

LIST OF ABBREVIATIONS AND SYMBOLS USED

%	Per cent
@	At the rate of
AEU	Agro ecological unit
et al.	And other co workers
Fig.	Figure
g	Gram
HG	Homegarden
i.e.	That is
KAU	Kerala Agricultural university
Kg	Kilo gram
KSLUB	Kerala state land use board
MAS	Mobile advisory service
MILMA	Kerala Co-operative Milk Marketing Federation
No.	Number
r_h	Correlation coefficient for horizontal diversification
r_v	Correlation coefficient for vertical diversification
Sl	Serial
viz.	Namely

INTRODUCTION

1. INTRODUCTION

Homegardens are dynamic entity in agriculture and they play a vital role in supporting households in many diverse ways such as provision of food, fuel, wood, building materials, cooking utensils, fodder for livestock, and cash income among others. Homegarden agroforestry is believed to be more diverse and provide multiple services for household than other monocropping system and this is due to the combination of crops, trees and livestock. Homegarden with trees are one of agroforestry practices known to be ecologically sustainable and diversifies livelihood of local community. Homegarden is commonly defined as; land use system involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and invariably livestock within the compounds of individual houses, the whole tree-crop, and animal unit is being intensively managed by family labour (Kumar and Nair 2004).

Homegardens, one of the oldest forms of managed land-use systems, are considered to be the richest in species diversity per unit area. Several landraces and cultivars, and rare and endangered species have been preserved in the homegardens (Leiva *et al.,*2002; Kumar and Nair, 2004). They are regarded as a source of income diversification and also play a crucial cultural and social role in rural communities. They may be seen as a buffer to household resources providing additional food, and in some cases cash income (FAO, 2004). Homegardens are agro-ecosystems located close to the area that serves as a permanent or temporary residence. Homegardens are common in most tropical countries and they have evolved over centuries, thanks to the adaptive abilities of farmers in responding to changing rural and livelihood conditions (Kumar and Nair, 2004). Homegardens have a long history of adapting diverse plants and small livestock to meet a range of household needs and conditions, mixing traditional and new technologies. Intensively managed, gardens can be highly productive all year round. Homegarden is the most direct means of supplying families

with most of the non-staple foods they need year round. Homegardens are ancient forms of agriculture, and with the current issues of growing population, scarce resources and food crisis, gardens can provide many people with improved livelihoods. Population growth, commercialization of farm products and the use of modern inputs have resulted in increased importance and attention been given to more intensive land use practices such as homegardens. Economists and even households themselves sometimes find it hard to describe and value all of the benefits from diverse gardens. Planners, researchers, community development and extension officers often lack the information to identify situations where homegardens can achieve sustainability in terms of technology, socio-psychologically and economically.

High population growth rates, increasing land fragmentation and continuous mono cropping have resulted in low farm productivity and food insecurity. Due to land fragmentation agricultural area got decreased. In addition to the reduced land sizes, soil fertility also reduces as a result of continuous market oriented mono-cropping on the same piece of land. This situation has led farmers to adopt a more complex, and more intensive use of their lands in a bit to increase productivity, diversify income sources and also ensure sustainability in agriculture (Abebe, 2005). To make homegardens more remunerative, diversification is the best choice. Diversification can better tolerate the ups and downs in the market value of farm products. It will ensure economic stability for farming families in the country.

Crop intensification and diversification through the use of modern technologies, especially seeds, fertilizer, irrigation, mechanization of agricultural production, post-harvest processing, storage, marketing and development of new technologies by research are available plans.

The term ‘diversification’ has been derived from the word ‘diverge’ which means to move or extent in the direction different from a common point (Jha *et al,*. 2000).

Agricultural diversification can be described in terms of the shift from the regional dominance of one crop towards the production of a large number of crops and its market orientation to meet the increasing demand of those crops. Crop diversification can be a useful means to increase crop output under different situations. Crop diversification can be approached in two ways, horizontal and vertical diversification. It takes into account the economic returns from different value added crops. It also implies the effective use of environmental as well as human resources to grow a mix of crops with complementary marketing opportunities, and it entails shifting of resources from low value crops to high value crops. Horizontal diversification means expanding the types of crops being grown. It means the addition of more crops to the existing cropping system. Vertical diversification of food crops may be defined as the expansion of post harvest activities including sorting, grading, processing, packing, storage and transport (Hedley, 1987). The expansion of processing and transformation industries seems to be the most important factor in generating income and employment in rural areas. Vertical crop diversification will reflect the extent and stage of industrialization of the crop. Therefore, the present study was taken up with the following objectives:

I. To determine the technology needs of horizontal and vertical diversifications for the economically dominant crops in the homegardens
II. To identify the diversification preferences and knowledge level on both horizontal and vertical diversifications within each homegardens
III. To delineate constraints experienced by farmers in the process of these diversifications in the homegardens

1.1 SCOPE AND IMPORTANCE OF THE STUDY

Crop diversification can better tolerate the ups and downs in the market value of farm products and may ensure economic stability for farming families of the country. Due to globalization, crop diversification in agriculture is also a means to increase the total crop productivity in terms of quality, monetary and quantity value under specific, diverse agro ecological situations all over the world. Horizontal diversification, the primary approach to crop diversification is used in production agriculture. In this approach, diversification normally takes place through crop intensification which means adding new high-value crops to existing cropping systems as a way of improving the overall productivity of a particular farm or a region's farming economy as a whole. Vertical diversification approach in which value is added to the products by farmers through various methods such as processing, regional branding, packaging, merchandising, or other efforts to enhance the product. Adding value to agricultural production contributes to the economic and environmental sustainability of both farm and community. Adding value to an agricultural product offers homegarden farmers the opportunity to receive a bigger share of the consumer’s food rupee. Value-added products can open new markets, create recognition and appreciation for the farm, and extend the marketing season. Value-added products can dramatically increase a homegarden farmer’s income. Value-added agriculture is very important to any local economic development strategy.

1.2 LIMITATIONS OF THE STUDY

As the study is part of Masters Research the area of study was confined to Thiruvanathapuram district. Only 20 homegardens were selected from each agro ecological units hence generalization of the results may not be appropriate. All the data were collected by personal interview with the respondents. Most of the responses

were from the respondents recall memory and not based on written records. However, due care was taken to ensure high reliability of the data.

1.3 PRESENTATION OF THE THESIS

The entire Master's thesis is presented as five chapters: The first chapter 'introduction' explains the importance of the topic, objectives, scope and limitation of the study. Second chapter, 'review of literature' deals with review of relevant literature in line with the objectives of the study. Third chapter 'research 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' discusses the results of the study to draw specific inferences and the final chapter 'summary' briefly summarizes the work done and salient findings, explains the implications based on the results of the study and also suggests future areas of research.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

A proper framework for the research study is based on ideas generated through different information sources. Review of literature is a comprehensive way of collecting information pertaining to research studies. Hence various sources were thoroughly reviewed which was directly or indirectly related to topic of research. Different reviews satisfying the objectives of the study is described under the following heads.

2.1 Personal and social characteristics of homegarden farmers

2.2 Horizontal and vertical diversifications in homegardens

2.3 Knowledge level of homegarden farmers on horizontal and vertical diversification and diversification preferences in the homegardens

2.4 Technology needs (gaps) with special reference to vertical diversification

2.5 Constraints and suggestion as perceived by homegarden farmers with special reference to vertical diversification

2.1 PERSONAL AND SOCIAL CHARACTERISTICS OF HOMEGARDEN FARMERS

Understanding the behavioural dynamics of respondents will enable proper maneuvering of research data so as to generate useful information for the study. The review of literature on the personal and social characteristics of homegarden farmers are presented under given subheads.

2.1.1 Age

Age was operationally defined as the number of years completed by the respondent at the time of investigation.

Manjusha (1999) reported that there is non- significant relationship between age and extent of adoption of recommended practices by the farmers in bittergourd cultivation.

Thomas (2000) reported that age had positive and significant relationship with the knowledge of farmers.

Jayawardhana (2007) reported that the majority of coconut based homestead farmers (84%) belonged to the old age category

According to Voeks (2007) homegarden species knowledge also increases with landowner age, in both men and women.

According to Muchara (2009), the household's age is a highly important aspect because it shows whether the household benefit from the experience of the older people or has to base its decisions on the risk taking attitude of younger farmers.

Hanjabam (2013) reported that majority of the precision farmers (80%) belonged to old age category and majority of the conventional farmers belong to middle age category (63.33%). Only 10 per cent are young precision farmers.

Rahul (2013) reported that more than half of the sampled specialized homegarden farmers were in middle aged category whereas the old and young category were comparatively less with 43.33 and 3.33 per cent respectively.

2.1.2 Education

Education is operationalised as the extent of non-formal or formal learning possessed by the homegarden respondent.

Manju (1997) found a positive and highly significant relationship between educational status and knowledge.

Sherief (1998) reported that the knowledge of homestead respondents was positively and significantly related to educational status.

Sasankan (2004) stated that nearly half of the cassava farmers (49%) had education upto secondary level. There were negligible per cent (< 2%) of illiterate farmers.

Jaganathan (2004) reported that education status of the farmers had positive and significant relationship about knowledge and adoption of organic farming practices and majority of the respondents (52%) had secondary level education.

According to Muchara (2009) the people who have higher educational level are able to interpret information better.

Hanjabam (2013) found that in precision farming, 100% farmers were literate and also more than 50 per cent of the farmers had attended high school.

Rahul (2013) reported that the educational status of the homegarden farmers projects that all farmers were under the literate category of which more than 80 per cent of the farmers were having the educational qualification ranging from high school to collegiate level.

2.1.3 Family Size

Family size refers to the number of members of either sex living in a household / family dependent on the head of the family

Verma and Rao (1969) reported that family requirement has a direct relationship to garden size. So, size of family is important in influencing garden size.

Rahul (2013) reported that more than three fourth of the homegarden farmers (66.67 %) were having the family size with 3-4 members.

2.1.4 Occupation

Occupation was operationalised as the professional status for a farmer respondent possessing at the time of interview with an aim to know whether agriculture was the respondents chief occupation.

Rathinasabapathi (1978) reported non-significant relationship of occupation with extent of adoption of integrated pest management practices in cotton.

Rahul (2013) reported that nearly 60 per cent of the homegarden farmers depended on agriculture as their primary source of income and 23.33 per cent engaged in private sources of income in conjunction with agriculture and 16.67 per cent were government employees.

2.1.5 Effective Homegarden Area

Effective Homegarden Area was operationalised as the effective homegarden area measured in acres.

Jha and Shaktawat (1972) found that size of holding was not significantly related to adoption of farmers in their study.

Lok (1998) found that in urban homegarden were smaller than rural gardens, nevertheless, the available space reduction incremented management intensity and species density, which were promoted in urban systems.

Surendran (2000) reported that large farm size resulted in more returns from farming which was conductive for higher group participation.

Das and Das (2005) reported that with increase in holding size, more variations in species composition were encountered. In larger homegardens, the land is demarcated into more micro zones or management zones and larger areas allotted to arecanut cultivation. Also, well-defined, dense zones were encountered in many

such homegardens. In the smaller land holdings, the homegardens are not well demarcated into numerous zones and are usually composed of several species mixed together.

Esakkimuthu (2012) reported, with respect to area under cultivation of banana, majority (70%) of the respondents were having the area of below 60 cents.

2.1.6 Social Participation

Govind (1984) reported that social participation of farm women had significant and negative association with extent of involvement in farm activities.

Sindhu (2002) reported that the old farmers are likely to loose interest in active participation within and outside the social system.

Sasankan (2004) found that majority of the cassava farmers had medium level of social participation in credible institutions and organization and extension contacts.

Lad and Wattamwar (2009) found out that 48 per cent of the tele-viewers had medium social participation.

2.1.7 Market Orientation

Samantha (1977) defined market orientation as 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.

Sajeevachandran (1989) reported that there was a positive and significant relationship between market orientation and adoption of scientific practices in pepper.

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

Torquebiau and Penot (2006) reported that homegardens are productive throughout the entire year and evade making purchases for products.

Sreedaya (2000) reported that farmers were aware of the different market trends and marketing channels through their credit market farmers, field staff, market information center and above all frequent meetings at the field centre. She also reported that 56 per cent of the farmers had low level of market perception followed by medium (30%) and high level (14%).

Fayas (2003) stated that 89 per cent of the vegetable growers had high level of market orientation.

Jaganathan (2004) found that 55 per cent of the respondents had medium level of market orientation and respondent's awareness and attitude towards the organic farming practices had a positive and significant relationship with market orientation.

Rowe (2009) found that nearly half of the food consumed at home and one-third of the food sold in the market came from homegardens.

Saikia and Khan (2012) reported that, homegardeners maintained their gardens for meeting the household requirements of fruits, timber, vegetable, ornamentals, and fuelwood; market oriented production was of secondary importance.

Rahul (2013) reported that the market orientation of the total homegarden respondent sample was high with 70 per cent falling in the category of greater than three score. It was found that market orientation was considerably low in Thrissur district with about 40 per cent of respondents getting the score below three.

2.1.8 Risk Orientation

Santhasheela (1999) observed that one fifth of the tomato growers had low level of risk orientation followed by 46.67 and 33.33 percent who had medium and high levels of risk orientation respectively.

Majjusha (2000) observed that equal percentage of the cowpea growers had high and low risk orientation.

Sreedaya (2000) reported that majority of the vegetable growers (66%) had low risk orientation followed by equal percentage of respondents (17%) with medium and high risk orientation.

Fayas (2003) reported that 90 per cent of the vegetable farmers had medium level of risk orientation.

Suthan (2003) concluded that 58.67 per cent of the vegetable growers had high risk orientation.

2.1.9 Annual Homegarden Income

Das (1988) reported that in the case of multi-storied cropping under irrigation in coconut garden the benefit: cost ratio was 1.76 and the internal rate of return higher than 20 per cent and the net present value worth Rs. 32700/-. He also opined that different varieties of cereals, pulses, oil seeds, tubers and rhizomatous crops were relatively more compatible and remunerative intercrops than the other annuals in coconut garden in Kerala.

Rajendran (1992) reported that the income from crops formed the major source of income of the farm households and it formed about 82 percent of the gross income of the families.

Lok and Méndez (1998) reported that homegardens play a very important role in supplying products cultivated in their own land offering important economic and subsistence income.

Talukder *et al.,* (2000) reported that additional income from homegarden will more likely benefit the family and/or contribute to a more balanced diet.

Alam & Masum (2005) found out that annual income from the homegarden biodiversity was also found to correlate with household size.

Howard (2006) reported that homegardens are important to families because they provide income and sustenance throughout the year from the diversity of crops contained within them which are harvested at different times.

Miller *et al*., (2006) reported that homegardens generate monetary contribution that can be significant. Animals play a very important role and sometimes generate greater income gain than vegetable products.

Rowe (2009) reported that homegardens are very important especially for women-headed families in terms of meeting their everyday food consumption needs and generating income.

CIMMYT (2009) reported that wealthier farmers may be the first to try a new technology, especially if it involves purchased inputs. Many farmers who do not adopt may complain of a lack of cash or credit as the principal factor limiting their adoption.

Esakkimuthu (2012) found that majority (76.6%) of the respondents had annual income between Rs.50,001-1,00,000 and over twenty one per cent of the respondents had it upto Rs 50,000 and only one farmer was having income above Rs.1,00,000 (high category).

Rahul (2013) reported that about 67 per cent of the sampled homegarden respondents had an annual homegarden income less than the total average income (Rs. 2,84,000) followed by about 33.33 per cent respondents with an income higher than the total average income.

2.1.10 Mass Media Contribution

Sharma (2001) reported that the majority of farm women (69%) with semi-modern lifestyle has medium mass media exposure.

Ahire and Shinoy (2005) in their study regarding the utilization of communication channels by mango growers of Andhra Pradesh observed that newspaper, TV and farm magazines as the most utilized mass media sources.

Sengupta (2008) stated the most of farmers are extremely vulnerable to misinformation about crop prospects due to the lack of mass media exposure.

Chavan *et al.,*(2010) had reported that mass media exposure had significant correlation with the perceived effectiveness of agricultural programmes

2.1.11 Evaluative perception of homegarden farmers in relation to sustainability of the horizontal and vertical diversification of the homegarden respondents

Pinton (1985) reported that social sustainability of homegardens is attributed to diverse factors related with subsistence. Aspects such as nutritional security, satisfaction of energy necessities, economic security and the form in which these can allow population level and appropriate socioeconomic maintenance have been used as indicators of sustainability.

Fernandez and Nair (1986) also reported that the presence of multi-layered structure of homegarden is an indicator of ecological function through environmental protection and efficient use of resource (like sunlight).

Jambulingam and Fernandez (1986) reported that the woody perennials in homegarden with other agricultural crops are better able to cope with poor growing conditions and thereby increasing integration on farmlands, which represented a strategy to minimize the risk of crop failure.

Soemarwoto (1986) opined that while it is relatively easy to increase yield and income, there are difficult problems in achieving long term sustainability of the homegardens.

Salam *et al*., (1991) homegardens are capable to maintain soil health and to ensure environment safety.

Kumar and Nair (2004) reported that a commonly perceived indicator of homegardens socioeconomic sustainability is the fact that homegardens typically contribute towards nutritional security, energy needs and income generation even under conditions of high population densities.

Peyre *et al.,* (2006) concluded that the concept of socio-economic sustainability should not only be related to the homegardens' function in the present livelihood conditions, but also to their ability to adjust to socio-economic changes.

Tynsong and Tiwari (2010) reported that multilayered vegetation structure prevents soil erosion, provides habitat to soil micro-organisms and promote a favorable microclimate for the household.

Bagson and Beyuo (2012) reported that, the socioeconomic sustainability in a homegarden refers to the effective use of the indigenous knowledge system to continuously enhance output per unit area.

Rahul (2013) reported that the more than three fourth (83.33%) of the sampled respondents fell in the high category of evaluative perception.

2.2 HORIZONTAL AND VERTICAL DIVERSIFICATION IN HOMEGARDENS

2.2.1. Definitions of homegardens

Ninez (1984) pointed that household garden is a small-scale production system supplying plant and animal consumption and utilitarian items either not obtainable, affordable, or readily available through retail markets, field cultivation, hunting, gathering, fishing, and wage earning. Household gardens tend to be located close to dwelling for security, convenience, and special care. They occupy land marginal to field production and labour marginal to major household economic activities. Featuring ecologically adapted and complementary species, household gardens are marked by low capital input and simple technology.

According to Soemarwoto and Christianity (1985), homegardens are defined as a land surrounding houses in which the structure resembles that of a forest, combining the natural aspects of a forest with solutions to the socioeconomic and cultural needs of the people.

Hoogerbrugge and Fresco (1993) described homegarden as a small-scale 'supplementary' food production system, which use 'marginal land and marginal labour' in production.

Dilrukshi *et al.,* (1996) described homegardens as a mixed cropping system that encompasses vegetables, fruits, plantation crops, spices, herbs, ornamental and medicinal plants as well as livestock that can serve as a supplementary source of food and income.

Kumar and Nair (2004) referred homegarden as a well-defined, multi-storied and multi-use area near the family dwelling that serves as a small-scale supplementary food production system maintained by the household members, and one that encompasses a diverse array of plant and animal species that mimics the natural eco-system.

Das and Das (2005) pointed out that homegardens are the closest mimics of natural forests in their structure and usually have 3–4 vertical canopy layers. Besides the vertical structure, homegardens also have distinct horizontal structure which together help in the efficient utilization of water, light and space, and support diverse wildlife species besides meeting various social and basic needs of families.

Krishna (2006) referred homegarden as a well-defined, multi-storied and multi-use area near the family dwelling that serves as a small-scale supplementary food production system maintained by the household members, and one that encompasses a diverse array of plant and animal species that mimics the natural eco-system.

Abdoellah *et al.,* (2006) referred homegardens as centuries-old components of the rural ecosystem and, especially in rural areas, are usually cultivated with a mixture of annual and perennial plants that can be harvested on a daily or seasonal basis.

Altieri (2008) reported homegardens are small plots either in the backyard or located close to the habitation. They are fertilized with household wastes and are rich in plant species diversity, usually maintaining 30 to 100 species. This practice provides diversification of crop species and is of economic importance because of its food and nutritional (balanced diet) and medicinal value to the household. The farmer obtains food products, firewood, medicinal plants, spices and ornamentals, and some cash income all year round.

Galhena (2013) reported that home gardens can be described as a mixed cropping system that encompasses vegetables, fruits, plantation crops, spices, herbs, ornamental and medicinal plants as well as livestock that can serve as a supplementary source of food and income.

Although several authors have tried to describe the term ‘homegarden,’ none is perhaps universally accepted as ‘the definition’; but it is well understood that the concept refers to ‘intimate, multi-story combinations of various trees and crops, sometimes in association with domestic animals, around homesteads.

2.2.2 Agricultural Diversification

Timmer (1990) identified three reasons for policy makers to pay more attention to agricultural diversification: (i) when output prices are highly unstable, diverse and flexible agriculture provide more stable farm incomes; (ii) better living standards can, in turn, reduce rural-to-urban migration; (iii) in the long run, a diversified cropping pattern is more ecologically sustainable than intensive cultivation of a single crop. Agricultural diversification may alleviate poverty directly or indirectly, as it may not only increase and stabilize farmers’ incomes, but also foster rural economic growth, increase value adding, create employment, improve nutrition, reduce import demand and increase exports.

Petit and Barghouti (1992) opined that crop diversification takes into account the economic returns from different value-added crops. It also implies the effective use of environmental as well as human resources to grow a mix of crops with complementary marketing opportunities, and it entails shifting of resources from low value crops to high value crops. There are two approaches to crop diversification in agriculture. Horizontal diversification is the primary approach to crop diversification used in production agriculture. In this approach, diversification normally takes place through crop intensification which means adding new high-value crops to existing cropping systems as a way of improving the overall productivity of a particular farm or a region's farming economy as a whole. Vertical diversification approach in which, value is added to the products by farmers through various methods such as processing, regional branding, packaging, merchandising, or other efforts to enhance the product. Opportunities for crop diversification normally vary depending upon the

risk, opportunity and the feasibility of proposed changes within a socio-economic and agro-economic context.

Tabora (1992) refers that the key drivers of diversification that are identified are : (1) Food Security (2) Employment generation through creation of off-farm and non-farm investment opportunities within the capabilities of the resource-poor farmers (3) Changes in crop patterns and farming systems (4) More effective use of land and water resources (5) Market access initiatives replacing risk aversion with risk acceptance (6) Changing consumer demands irrespective of the nature of habitation and standards of living due to spread-effect of health consciousness caused by the visual media and non discriminatory demand for quality goods, and (7) The role of urbanization in fast developing countries like India.

Karma *et al*., (1992) identified several non-price policies that may influence agricultural diversification:

• Macroeconomic policies including fiscal, monetary and trade policies. These policies affect agricultural diversification because they affect inter-sectoral and inter-regional movement of resources, growth and composition of agricultural production and trade in agricultural products.

• Investment policies for infrastructure such as roads, transportation, communication and information facilities. The implementation of these policies will reduce marketing costs, boost farm income and therefore encourage agricultural diversification.

• Agro-industry and export promotion policies. These policies will foster the demand for various agricultural products and therefore encourage agricultural diversification.

• Agricultural technology development policy. This policy is important because no agricultural diversification programme can succeed without appropriate agricultural technologies that enhance productivity.

Dorsey (1999) states that crop diversification presents distinct advantages and disadvantages as a livelihood strategy.

+ Having many different crops increases resilience to pests, diseases, weeds and aberrant weather.

– While risks from these factors are spread out over a number of crops, the risks are not completely eliminated.

+ The availability of different crops for food can increase household food security and nutrition.

– Depending on crop choices, food security could take precedent over crops for sale and thus reduce available income.

+ Producing a variety of different crops insulates farmers from markets. Even if the sale price of one crop drops, the farmer has other crops that can sell at favorable prices.

– The counterpoint is that the returns to the use of a farmer's land and labour are variable.

+ Growing diverse crops on farm plots mitigates the environmental impact of mono-cropping.

– A farmer must have or be able to quickly obtain the knowhow to grow and manage different crops well.

The term 'diversification' has been derived from the word 'diverge' which means to move or extend in the direction different from a common point (Jha *et al.,* 2000).

Ellis (2000) states additional non-price policies to support agricultural diversification include: (i) improvement of the agricultural extension programme both on farm and off farm (post harvest, processing and marketing) for alternative crops other than rice; (ii) strengthening farmer institutions and encouraging partnerships between farmers and private companies to overcome the marketing constraints of alternative crops; (iii) improving the market structures of alternative commodities;

(iv) improving the availability of credit and farmers' accessibility to credit, especially for non-rice production; (v) community self-help promoting farm diversification; and (vi) developing marketing infrastructure for alternative commodities.

Agricultural diversification can be described in terms of the shift from the regional dominance of one crop towards the production of a large number of crops to meet the increasing demand of those crops. The process of diversification can be classified into horizontal and vertical diversification (Start, 2001).

Diversification can be used as a tool to augment farm income generate employment, alleviate poverty and conservation resources (Ryan and Spencer, 2001).

Chemonics (2002) states that the activity a farmer should diversify, it depends on a lot of factors. It is important to be aware of conditions that limit choices. For example, in case the markets are far away and infrastructural accessibility is bad, diversification in fruits may not be very profitable. Characteristics of the terrain, like steep slopes, availability of water, altitude and climate, and bad infrastructure access, already exclude certain diversification options. It is important to exploit the strengths of existing farming systems before attempting to introduce radical changes.

Joshi *et al*., (2003) pointed that diversification can also involve "a shift of resources from one crop (or livestock) to a larger mix of crops and livestock, keeping in view the varying nature of risks and expected returns from each crop/livestock activity, and adjusting in such a way that it leads to optimum portfolio of income".

Anonymous (2003) identified factors encouraging farmers to diversify crops on irrigated land as (i) stability and level of income (ii) availability of technology (iii) availability of human labour and mechanical power (particularly tractors) (iv) access to capital and (v) optimization of land utilization.

Crop diversification can be a useful means to increase crop output under different situations. Crop diversification can be approached in two ways. The main form and the commonly understood concept is the addition of more crops to the

existing cropping system, which could be referred to as horizontal diversification. For instance, cultivation of field crops in rice fields or growing various types of other crops in uplands have been defined as crop diversification (Pingali, 2005).

Oxfam (2005) reported that crop diversification can be a useful means to increase crop output under different situations. Diversification means that farmers create a diverse income portfolio that best matches their individual situation.

Agriculture diversification can, play a vital role in diversifying and commercializing agriculture, adding value to agricultural produce, generate employment, enhance income of farmers, and create surplus for export of processed products. Crop diversification is intended to give a wider choice in the production of a variety of crops in a given area so as to expand production related activities on various crops and also to lessen risk. Crop diversification in India is generally viewed as a shift from traditionally grown less remunerative crops to more remunerative crops. The crop diversification also takes place due to governmental policies and thrust on some crops over a given time. Agriculture diversification in favour of more competitive and high value commodities is considered an important strategy to overcome many of these emerging challenges (Kumar, 2014)**.**

2.2.2 Concept of horizontal and vertical diversification in homegardens

In spite of the very small average size of the management units, homegardens are characterized by high species diversity and usually 3-4 vertical canopy strata, which result in intimate plant associations. The layered canopy configurations and combination of compatible species are the most conspicuous characteristics of all homegardens. Contrary to the appearance of random arrangement, the gardens are usually carefully structured systems with every component having a specific place and function. The Japanese homegarden (*pekarangan)* is a clean and carefully tended system surrounding the house, where plants of different heights and architectural types, though not planted in an orderly manner, optimally occupy the available space

both horizontally and vertically (Wiersum, 1982; Soemarwoto and Soemarwoto, 1984).

Hedley (1987) states that vertical diversification of food crops may be defined as the expansion of post-harvest activities including sorting, grading, processing, packing, storage and transport. The expansion of processing and transformation industries seems to be the most important factor in generating income and employment in rural areas. Agricultural diversification can also reduce the instability of rural income, foster rural economic growth and eventually alleviate poverty through employment creation and increased value addition.

Homestead farms with a multitude of crops presenting a multi-tier canopy configuration ensure a high level of exploitation of environmental resources. Top-most canopy is occupied by coconuts, the second layer by arecanut, pepper, jack, tamarind and mango, the third layer is occupied by banana, tapioca and fruit plants and the lowermost layer of canopy consists of tuber crops, vegetables and guinea grass. The boundaries are live-fenced with glyricidia (Salam and Sreekumar, 1990; Aravind *et al*, 2004).

Petit and Barghouti (1992) reported that there are two ways of crop diversification. The main form and the commonly understood concept is the addition of more crops to the existing cropping system, which could be referred to as horizontal diversification. For instance, cultivation of field crops in rice fields or growing various types of other crops in uplands have been defined as crop diversification. However, this type of crop diversification means the broadening of the base of the system, simply by adding more crops to the existing cropping system utilizing techniques such as multiple cropping techniques coupled with other efficient management practices. The other type of crop diversification is vertical crop diversification, in which various other downstream activities are undertaken. This could be illustrated by using any crop species, which could be refined to

manufactured products, such as fruits, which are canned or manufactured into juices or syrups as the case may be. Vertical crop diversification will reflect the extent and stage of industrialization of the crop. It has to be noted that crop diversification takes into account the economic returns from different crops. This is very different to the concept of multiple cropping in which the cropping in a given piece of land in a given period is taken into account.

Karma *et al*., (1992) identified several potential benefits of horizontal and vertical agricultural diversification:

1. Increasing quantity and quality of foods and raw materials, providing more income for farmers, improved nutrition and reduced imports
2. Better use of natural resources
3. Vertical diversification increases local value-added and creates employment
4. The increasing income and diversified sources of foods will reduce the demand
5. Processed products, resulting from vertical diversification will increase exports and increase foreign exchange earnings.

Shehana *et al*., (1992) pointed out that spice components grown in a polyculture that consisted of distinct canopy stratification, helped to reduce soil temperature inside the microclimate which in turn helped to reduce soil evaporation rate. The litter and crop residues were often left to get accumulated in soil and this was helpful to reduce soil evaporation rate.

Wickaramasinghe (1995) analysed the spatial structure of traditional homegardens (not affected by modern intervention) in selected villages of Kandy. He reported that there was a large variation in the spatial arrangement of species. These were primarily linked with priority needs, potential uses and availability of space.

Sharma (1996) pointed out that there was a long standing tradition of practicing coconut based system in Kerala. An important aspect was the presence of more plant cover on the plantation floor, which increased the fixation of nutrients that

is cycled within the soil plant system. The vegetative cover maintained reduced soil erosion risks, biotic diversity of species composition, age distribution, trophic levels and so on was sustained above the level at which the activities of pests and diseases become an ecological and economic constraint. Previous experience have shown that large scale plantations restore forest coverage and achieve objective of sustainability, increased production which benefit the farmers as well as rural poor.

Haque (1996) refers horizontal diversification as that form of diversification wherein farmers diversify their agricultural activities in order to either stabilize or increase their income or both. It can either take the form of shift from subsistence farming to commercial farming or the shift from low value food crops to high value crops. Vertical Diversification refers to the farmers access to non-farm income, *i.e.,* the income from non agricultural sources

According to Jha (1996) on the farm level, horizontal and vertical diversification can be very advantageous. However, the success of a diversification strategy depends heavily on how the diversification strategy is implemented. Potentially, there are many benefits. First, it enables the farmers to spread the resource requirements (e.g. labour, capital) more evenly over the agricultural season. Second, it provides some protection against price and production risks, as low returns from one crop may be compensated by a return from another activity. For successful risk spreading, it is important to diversify in activities with a low covariate risk between the different income streams. Third, it gives the farmers some flexibility for exploiting potential improved market opportunities and enables them to adjust more quickly to changed market conditions. However, all these advantages of horizontal and vertical diversification might be reduced in reality, because of the loss in average profits incurred by not specialising in the most profitable activity. Advantages of economies of scale from specialisation are usually compromised when farmers diversify their income portfolio.

Marsh and Fernandez (1998) reported that there are many indirect contributions that exist due to diversification, which lessen market variations because the gardens are productive throughout the entire year and evade making purchases for products found in the garden. They balance the necessity for gain and subsistence as well as creating connections in the community because of the products that are gifted or traded.

Dorsey (1999) refers one type of crop diversification means the broadening of the base of the system, simply by adding more crops to the existing cropping system utilizing techniques such as multiple cropping techniques coupled with other efficient management practices. The other type of crop diversification is vertical crop diversification, in which various other downstream activities are undertaken. This could be illustrated by using any crop species, which could be refined to manufactured products, such as fruits, which are canned or manufactured into juices or syrups as the case may be. Vertical crop diversification will reflect the extent and stage of industrialization of the crop. It has to be noted that crop diversification takes into account the economic returns from different crops.

According to Yao (2004) to increase vertical diversification, it may be appropriate for the government to provide incentives in the form of risk sharing and tax relief so that the private sector is willing to invest in processing and post-harvest activities.

Thomas (2004) opined that the effect of the distance from home to the edge of the homegarden was identified as a factor contributing to the zonation of homegarden which implied that the match between the variations in priorities of the home and the spatial arrangements of homegardens is strong both socially and economically.

The utilization of village bamboos, a keystone resource selected by the small-holder farmers for its socio-economic and ecological importance, needs to be strengthened for diversification of products through value addition (NMBA, 2004).

This would provide opportunities for development of small scale rural industries and create off-farm employment and marketing opportunities (Kumar and Nair 2004).

Zaman *et al*., (2010) in his study showed that, to get fruits, fuel wood, timber and various agricultural products as well as to bring back equilibrium in the ecosystem, establishment of multi-layered cropping systems in the homesteads are inevitable.

Devi and Das (2010) in their study recorded ten horizontal zones in the homegardens, although these were not systematically arranged. These microzones included bamboo groves, spice zone (e.g*., Allium odorum*), cattle sheds, courtyards in front of the house, out-house, ponds used for fishery and for planting *Neptunia prostrata* and *Ipomea aquatica*, residential zone, vegetable growing area, boundary zone, and the sacred zone.

Cafenica (2013) reported that there exists a low adoption level for agricultural and economic diversification alternatives. They explain this phenomenon with (1) the fact that there exists little financial and technical knowledge, and (2) that there exist cultural barriers, that are related to the farmers "way of thinking and seeing the things"

Galhena (2013) opined that home gardens are mainly intended to grow and produce food items for family consumption, but they can be diversified to produce outputs that have multiple uses including indigenous medicines and home remedies for certain illnesses, alternative fuel source, manure, building material, and animal feed.

2.3 KNOWLEDGE LEVEL OF FARMERS ON HORIZONTAL AND VERTICAL DIVERSIFICATION AND DIVERSIFICATION PREFERENCES IN THE HOMEGARDENS

English and English (1958) defined knowledge as the body of understood information possessed by an individual by a culture.

Rogers and Shoemaker (1971) opined that knowledge of innovation could create motivation for their adoption.

According to Boster (1985), species knowledge and management practices are part of physical and cultural capital that is transmitted between women and their descendents.

Soemarwoto *et al.*, (1985) suggests that people are not completely conscious of the knowledge rooted in their management practices; the processes of change involved in market or urbanization can provoke pressures and alterations in this knowledge.

Meerabhai *et al.,* (1991) reported that coconut based farming system is commonly practiced in the homestead agriculture especially in coastal and mid-land Kerala. The by products of coconut *viz.,* petiole, frond, stipules, spadix (bunch stalk and spathe), husk and shell are mainly used as energy source (by burning) for rural cooking and these meet the fuel requirement of the farm family to a greater extent.

Thampan (1996) reported that the scope and advantage for mixed farming in coconut garden involving cultivation of shade tolerant fodder crops in the interspaces of coconut and integrating animal enterprises and recycling the by products

Sairam (1997) reported that, in the coastal areas, coconut is grown intervened by patches of cocoa, tobacco and paddy. Coconut is mostly intercropped with black pepper, cocoa, cinnamon, clove and coffee. It was observed that when coconut is

intercropped, the production of nut per palm increases. Besides, mixed farming provides coconut farmers with a higher return per hectare than monoculture)

Lok (1998) pointed that women obtain greater knowledge about herbaceous species that grow in the homegarden while men manage and have more knowledge about woody species of the area and species that grow inside the agricultural parcels.

Parvathi *et al.,* (1998) reported that more than half of the farm women (58.33 per cent) possessed medium level of knowledge on the post harvest technologies. 23.30 per cent of the respondents had high level and 35.37 per cent had low level of knowledge on post harvest technologies, respectively.

Manoj (2000) reported that education, annual income, social participation, innovativeness, exposure to information, economic motivation, risk preference were found to have positive relationship with knowledge.

Sasankan (2004) reported that 54 per cent of the respondents possessed high level whereas 46 per cent possess low level of knowledge about cassava cultivation.

Jaganathan (2004) stated that 70 per cent of the vegetable growers had medium level of knowledge followed by high (18%) and low (12%) levels of knowledge.

Das and Das (2005) reported that the technique of management and high diversity of homegardens reflect the wisdom of traditional culture and ecological knowledge that have evolved over the years. Many of the species were reported to have medicinal properties, which are retained in the traditional knowledge of the people.

Miller (2006) reported that homegardens enhance household food security status because older people are more experienced with agricultural practices (home gardening) and have inherited such knowledge from their forefathers.

Jayawardhana (2007) reported that 68% of coconut based homestead farmers had medium level of knowledge followed by high (21%) and low (11%) levels of knowledge about organic farming practices.

Schneider (2007) reported that diversity and species composition of homegardens depend on requirements of the families, preferences and knowledge about use of the species. Many of the species were reported to have medicinal properties, which are retained in the traditional knowledge of the people.

Mayor *et al.,* (2009) stated that homegardening activities demand a lesser amount of horticultural and agronomic know-how, crop losses and other negative implications can be reduced when the household members are empowered with better skills and knowledge.

2.4 TECHNOLOGY NEEDS (GAPS) WITH SPECIAL REFERENCE TO VERTICAL DIVERSIFICATION

Hoda (1979) reported that technology involves the application of science and knowledge to practical use, enabling man to live more comfortably and securely.

Mc Graw (1982) described technology as systematic knowledge and action, usually of industrial processes, but, applicable to any recurrent activity.

Raju (1982) pointed that 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.

Rajendran (1992) identified 14 dimensions that were related with technology and its feasibility using the mean relevancy score. They were initial cost, income generation potential, regularity of returns, availability of raw materials, availability of supplies and services, time utilization pattern, rapidity of returns, physical

compatibility efficiency, profitability, availability, simplicity, viability, suitability and social acceptability.

Muthuraman (1995) in his article on sustainable agriculture has quoted some dimensions of sustainable agriculture identified by Swaminathan covering the social, economical, technological, political and environmental facets of sustainability as technological appropriatly, economic feasibility, economic viability, environmental soundness, temporal stability, resource-use-efficiency, local adaptability, social acceptability, social sustainability, political tackiness, administrative manageability, cultural desirability, renewability, equity and productivity.

Rao (1998) opined that the rapid technology progress and the increased rate of obsolescence of technologies necessitate technology forecasting for any planning process. Technology forecast can be defined as a probabilistic prediction of technological changes in terms of future characteristics of useful machines, systems or procedures and needs of the clients.

KAU (2002) identified five dimensions for technology assessment as productivity, adaptability, identity, continuity and security. Small producers particularly those operating in resource-poor areas and in small holdings (homegarden) have benefited much less from the recent technological breakthrough in agriculture.

Uaiene *et al.,* (2009) studied that further away a village or a household is from input and output markets, the smaller is the likelihood that they will adopt new technology.

Akinnifesi *et al.,* (2010) suggested that, there is need for research and investment on the post-harvest storage and handling of fruits and other products to reduce the high rate of spoilage from collection to consumption.

Zaman *et al.,* (2010) in their study found that, farmers depended on the naturally growing trees on the homegarden. The modern technologies and extension supports to develop the traditional production systems were almost not available.

2.5. CONSTRAINTS AND SUGGESTION AS PERCEIVED BY HOMEGARDEN FARMERS WITH SPECIAL REFERENCE TO VERTICAL DIVERSIFICATION

Research studies pertaining to the constraints encountered in practicing horizontal and vertical diversification in homegarden was thoroughly reviewed. A summarised list of the important constraints experienced by farmers in the utilization of agricultural technologies as identified and reported by the researchers is presented below:

Ramanathan *et al*. (1987) reported constraints in cassava cultivation are lack of marketing system, high cost of cultivation, non-availability of planting material on time and low cost of tubers of HYV.

Pandya and Trivedi (1988) defined constraints as 'those items of difficulties or problems faced by individuals in the adoption of technology'

Menon and Bhaskaran (1988) found that lack of sufficient land and fragmented land holding were the major constraints to agricultural technology transfer in Kerala.

Muliyar (1989) stated several reasons and constraints were identified by workers in the research and development organizations responsible for low productivity of the coconut crop in Kerala. Low adoption of fertilizers is one of the major reasons.

Anantharaman (1991) reported constraints in cassava cultivation are uncertainty in resource mobilization, production and marketing, shortage of labour during peak periods, lack of timely and accurate information.

John (1991) reported constraints in pepper cultivation lack of assistance of government agency in organizing the farmers and providing proper guidance and lack of knowledge and awareness.

Janadevan (1993) reported that high cost of labour, non availability of labourers in time, inadequate and timely supply of seedlings, lack of adequate financial assistance and subsidies were the major constraints faced by coconut growers .

Bhaskaran and Sushama (1994) cited lack of infrastructure facilities, absence of technology evaluations and up gradation efforts, inadequate training for farmers, extension personnel's and researchers, lack of functional linkages among the research ,extension, input and farmer sub- systems as some constraints in technology transfer in Kerala agriculture.

Chandrabindu *et al*. (1995) found the following constraints experienced by farmers who were having agriculture – livestock component in their homestead farming. Physical constraints like lack of scientific management, use of local implements, lack of irrigation facilities and difficulty to do intercultural operations which were mainly experienced due to inappropriateness of recommended technology. The economic constraints like lack of money, high cost of organic and inorganic fertilizers and debt. The managerial constraints like inadequate veterinary service and incidence of endemic and epidemic disease to the livestock which could not be managed by the farmers.

Sivaprasad (1997) reported that lack of assured price, small holding size, non availability of credit, lack of marketing facilities as the major problems in sericulture enterprise.

Sherief (1998) reported constraints in homegarden as lack of information, low yield, high cost of organic inputs, high labour cost, problem of pest and diseases,

skilled labour requirement, lack of credit facilities, lack of government support and lack of extension support.

Thomas (1998) observed that inadequate financial assistance, non availability of quality planting material, political interference and inadequate training were the major problems in implementing waste land development programme.

According to Miller (2001) the main constraints to further developing home-gardens or expanding them out to fields for greater productivity and income generation are the lack of adequate germplasm, risk of accidental fires, survival of seedlings in the dry season and soil fertility.

Resmy *et al.,* (2001) reported constraints among coconut and banana growers as lack of knowledge of technical guidance and lack of information resources.

According to Ongusumi *et al.,* (2002) constraints among cowpea growers are non availability of inputs transportation and finance and lack of market information.

Anonymous (2003) classifies the constraints to crop diversification into technical, economic and institutional:

• Technical constraints:

- Water availability especially in the dry season. Note that many alternative crops are grown during the dry season. In many cases, land is left fallow when water is not available;
- Lack of seeds or plant materials. In some places, it is not always easy for farmers to find seeds or plant materials of alternative crops;
- High production risks of alternative crops.
- Perishable nature of alternative crops. Farmers have less scope to store these commodities until the prices are high.

• Economic constraints:

- High volatility of output prices, increasing the risk of growing these crops.

Farmers are generally risk averse;

- Access to capital

- Increasing input prices. Regardless of the net returns, input prices can be a

disincentive to growing a certain crop; and

- Lack of processing facilities in rural areas. Proximity to such facilities is a

crucial factor in farmers' decision-making.

• Institutional constraints:

- Cultivated land size per household is small, worsening the risk of growing

crops with uncertain returns

- Tenancy status of farmers. In a shared-cropping arrangement, the crop grown is the prerogative of the land owner.

According to Thomas (2004) major constraint in homegardens as surplus cannot be marketed.

Choudhary *et al.*, (2004) concluded that the imperfection noted in the coconut-copra-coconut oil value chain arise from the following factors:

- Price volatility of copra and coconut oil in the markets
- Absence of market intelligence mechanism based on real time price quotes
- Relatively poor understanding of risk management instruments and future trading by coconut farmers, copra makers and oil mill owners
- Imperfection in the system of quality determination and grading
- Inadequate flow of institutional finance in the coconut –copra-coconut value chain
- Imperfection in the working of the copra future exchange by First Commodities Exchange of India (FCEI) in Cochin.

Rahul (2013) reported that the major constraint identified were ‘surplus but insufficient for marketing which was on par with, low price of produce, high labour cost, lack of markets for homegarden products and lack of extension service.

METHODOLOGY

3. 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

'Ex-post-facto' and 'explorative' research designs were used for conducting this study. 'Ex-post-facto' research design 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 to in this study, as there was no scope for manipulation of any variables under study. Since the researcher had to probe for crop resource and diversification components in the homegardens, explorative design too was used for the study.

3.2 LOCALE OF STUDY

Thiruvanathapuram district is selected for the study owing to the wide variability in the structure and cropping pattern of homegarden systems in the southern zone, which is predominantly the *erstwhile* Travancore state. The study area was stratified according to five different agro climatic units (AEU-1, AEU-8, AEU-9, AEU-12, AEU-14) as identified by Kerala Agricultural University and State Planning Board. A list of all panchayats in each stratum was prepared and panchayats with maximum active and operational homegarden units was identified. From this set of panchayats one panchayat from each agroclimatic units was selected in consultation with officials. Those panchayats are Mangalapuram, Pallichal, Nedumangadu, Amboori and Peringamala. Fig.1 shows the map of location of the study.

3.3. SELECTION OF THE RESPONDENTS

The respondent groups of the study comprises of homegarden farmers of Thiruvanathapuram district. From each of the 5 agroclimatic units, one panchayat with maximum active and operational homegarden units was identified in consultation with officials. From this panchayats, 20 homegarden farmers with holding size not less than 0.1 ha were selected. Thus a total of 100 homegarden farmer respondents were selected for the study.

3.4. OPERATIONALISATION AND MEASUREMENT OF THE VARIABLES

3.4.1 Distribution of the respondents based on their personal and social characteristics

In order to assess the influence of the profile characteristics of the homegarden respondents for meeting the objectives of the study, the characteristics of the homegarden farmers were identified as detailed further.

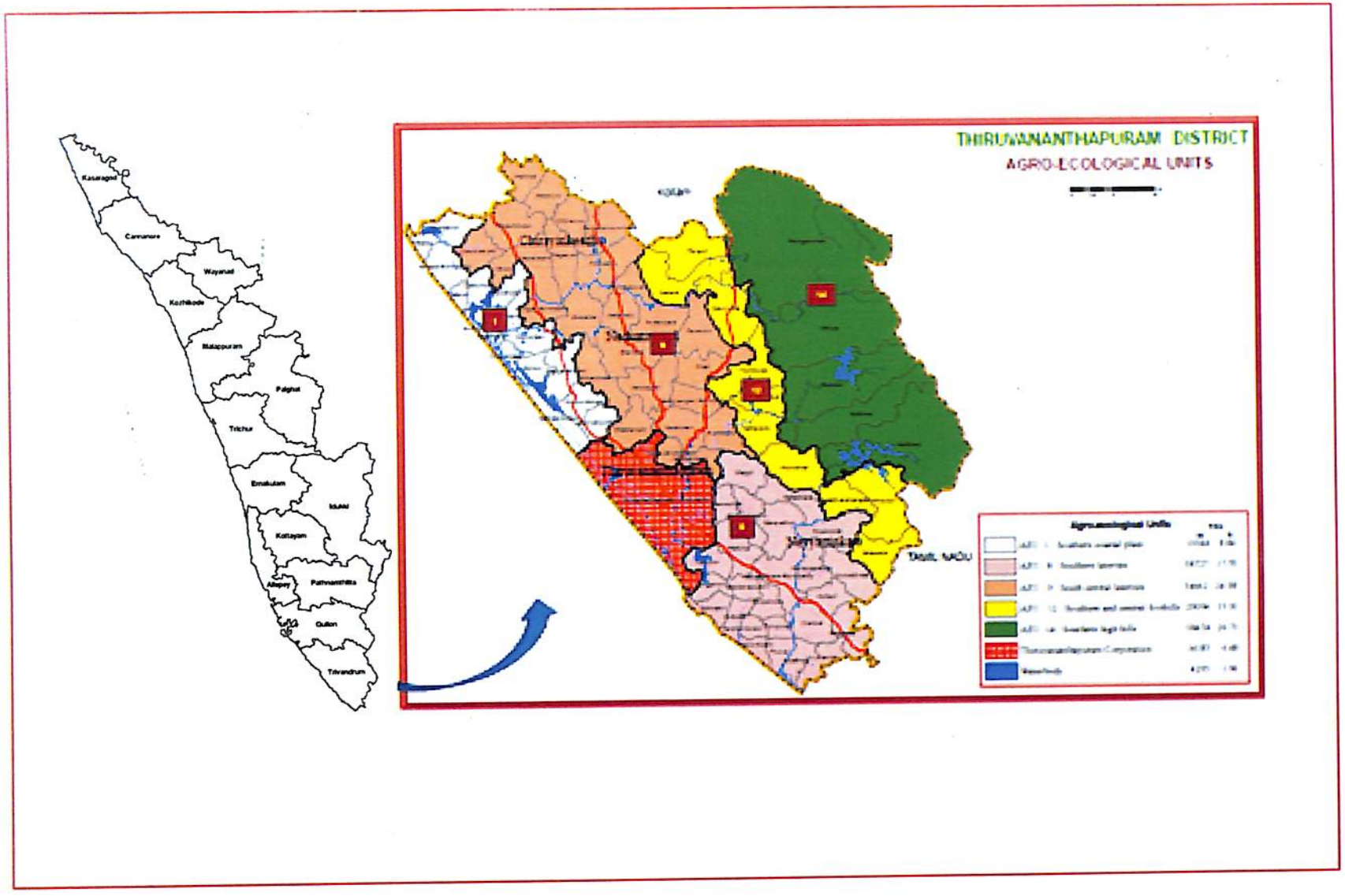

Fig 1. Map showing district of study

A list of 25 independent variables related to the personal characteristics of the home garden farmer respondents and important for meeting the objectives of the study were collected after detailed review of literature and discussion with subject matter specialists. The lists of variables were then sent to 30 judges comprising extension scientists and homegarden 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 21 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 were selected for the study. The variables with the mean relevancy scores are presented in Appendix II.

The personal characteristics of the homegarden respondents which constituted the independent variables thus selected for the study were age, education, occupation, family size, annual income from homegarden, effective homegarden area, social participation, market orientation, risk orientation, mass media exposure and evaluative perception of homegarden respondent farmers in relation to sustainability of the homegardens with reference to horizontal and vertical diversification.

The selected 11 independent variables and their measurement for study

Sl. No.	**Independent variables**	**Measurement and scoring procedures developed or adopted by**
1	Age	Actual chronological age and classification based on census report, 2011
2	Education	Thomas (2004)
4	Occupation	Vocation of homegarden respondents at the time of interview
3	Family size	Number of family members depend on the head of family at the time of interview
5	Effective homegarden area	Actual homegarden area in acre
6	Social participation	Scoring procedure developed for the study
7	Market orientation	Samantha (1977)
8	Risk orientation	Selvanayagam (1986)
9	Annual income from homegarden	Actual income from farm and non farm
10	Mass media contribution	Scoring procedure developed for the study
11	Evaluative perception	Arbitrary scale developed for the study

1) Age

Age was operationally defined as the number of years completed by the respondent at the time of investigation.

This was measured as the total number of years completed by the head of the homegarden owning family at the time of interview and was classified based on census report, 2011.

Age category	Years
Young	(< 35)
Middle aged	(35-55)
Aged	(>55)

2) Education

In this study education is operationalised as the extent of non-formal or formal learning possessed by the homegarden respondent.

The scoring procedure adopted by Thomas (2004) with slight modifications was used for the study and was as follows.

Category	Code
Illiterate	1
Primary	2
secondary	3
High school	4
Collegiate	5

One score was added to every successful completion of formal schooling and the home garden respondent farmers were categorized under the classification, illiterate, primary, secondary, high school and collegiate education.

3) Family size

This refers to the number of members of either sex living in a household/family dependent on the head of the family. This was measured in numbers.

Category	Code
2-4	1
5-6	2

4) Occupation

Occupation was operationalised as the professional status for a farmer respondent possessing at the time of interview with an aim to know whether agriculture was the respondents chief occupation. The scoring procedure developed for the study was as described below.

Category	Code
Farming as Primary Occupation	1
Farming as secondary Occupation	2

The maximum and minimum score in accordance with the code assigned that could be attained by the respondent was 'two' and 'one' respectively.

5) Effective area of homegarden

It was operationalised as the effective homegarden area measured in acres.

Category	Code
< 1 acre	1
1-2 acres	2
>2 acres	3

6) Social participation

Social participation is operationally defined as the degree of participation of the respondents in formal and non formal social organisations. It is measured in terms of "degree of involvement" and "frequency" of participation in organisation activities.

6) a. Degree of involvement

The degree of involvement in formal and non formal social organisations were categorized based on membership in seven organisations (Appendix 111).

6) b. Frequency

The frequency of attending in various formal and non formal social organisations were categorized as "very often", "often" and "not often" with scores three , two and one.

Category	score
Very often	2
Often	1
Not often	0

7) Market orientation

Market orientation is one of the three sub-scales of the scale developed by Samantha (1977) for measuring management orientation, which is 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.

Market orientation was measured using the sub-scale with slight modification from Samantha (1977), which consisted of five statements (interview schedule - Appendix III). These statements were suggested to the respondents in the following scoring continuum.

Category	score
Very much	4
much	3
less	2
Very less	1

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 'twenty' and 'five', respectively. The mean values of market orientation, scores obtained by 100 respondents for five statements were computed and the respondents were grouped into two categories 'greater than mean value' and 'less than mean value' categories based on the mean score.

8) Risk orientation

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

To measure the variable, the scale adopted by Selvanayagam (1986) was used with slight modification for the present study. The scale consisted of four statements. These statements were suggested to the respondents in the following scoring continuum.

Category	Score
Agree	2
Disagree	1

9) Annual income from homegarden

This refers to the total annual earnings from the farm and non-farm activities in the homegarden. This was measured in terms of rupees per year as expressed by the homegarden respondents**,**

10) Mass Media Contribution

The respondents was categorized into two categories *viz*., Those who fell under 'less than or equal to 3 mass media sources' or 'more than 3 mass media sources'. The frequency and percentage of respondents falling under the two categories was worked out under each AEU's and thereafter it's total. Mass media contribution to homegarden respondents was then measured in terms of frequency and perceived usefulness of the mass media.

10) a. Frequency to mass media

The frequency to various mass media were categorized for seven sources (appendix 2) as "very often", "often" and "not often" with scores two, one and zero respectively.

Category	score
Very often	3
Often	2
Not often	1

10) b. Perceived usefulness

Perceived usefulness of categorised mass media sources were measured in three point continuum as "very useful" ,"useful" and "not useful" which were scored as "two", "one" and "zero".

Category	score
Very useful	2
useful	1
Not useful	0

11) Evaluative perception of homegarden farmers in relation to sustainability of the horizontal and vertical diversification in homegardens

The evaluative perception of homegarden respondents in relation to sustainability horizontal and vertical diversification in homegardens varies . The purpose of perception is to help individual to cope with the world by assigning meaning to it, which can stand the test of subsequent experiences (Toch and Maclean, 1970)

Evaluative perception of homegarden respondents on the sustainability of farming system and cropping patterns was measured using an arbitrary scale developed by Thomas (2004) for the purpose with slight modifications. The scale was considered as an arbitrary one since the various procedures of standardisation by estimating reliability and validity of the scale were not attempted in that study.

Evaluative perception of homegarden respondents on sustainability of the horizontal and vertical diversification in homegardens was thus operationally defined as the respondent's meaningful sensation about the worth and efficiency of homegardens, horizontal and vertical diversification The perception of homegarden respondents on these items was measured on a four-point continuum varying from most important to least important with scores 'four' to 'one' respectively as given in the interview schedule (Appendix-III).

The scores for the evaluative perception of a homegarden respondent on each item were summed up to get the overall perception score for an individual respondent. The maximum and minimum scores were 60 and 15, respectively. The mean values of the evaluative perception scores obtained by 100 respondents were computed and the respondents were grouped into greater than mean value and less than mean value categories based on the mean score.

3.4.2 Horizontal and vertical diversification in homegardens

3.4.2.1 Dominance profile of homegarden

The dominance of crops in the homegardens was measured in terms of economic dominance as developed by Thomas (2004).

The economic dominance was worked out in a 'seven point' scale continuum with assigning a rank 'one' for the most remunerative crops and subsequently the other ranks of two, three, four, five, six and seven for the lesser remunerative crops in the order.

3.4.2.2 Horizontal and vertical diversification in homegardens

Agricultural diversification means growing/engaging new to an existing farm/non-farm activities using farm resources (Kasryno, 1992; Ali, 2004). The main advantage of the study of diversification in a region lies in the fact that it enables us to understand the impact of physical and socio-economic conditions on the agriculture. Moreover, it helps us in knowing the contemporary competition among crops for area, for rotation and effect on double cropping, total production and per hectare productivity (Bhalsing, 2009).

The main form and the commonly understood concept is the addition of more crops to the existing cropping system, which could be referred to as horizontal diversification. The other type of crop diversification is vertical crop diversification, in which various other downstream activities are undertaken. This could be illustrated by using any crop species, which could be refined to manufactured products, such as fruits, which are canned or manufactured into juices or syrups as the case may be. In this study, the horizontal and vertical diversification was measured as given below:

The horizontal diversification was computed based on the number of levels of crop component observed in each of the homegardens with special reference to the economic dominance. The results were expressed in terms of the mean score.

Likewise the vertical diversification was computed based on the number of levels of economically dominant crops (Seven most economically dominant crops as already computed) to the levels of value addition until it reaches the market. The results were expressed in terms of the mean score obtained in the homegardens understudy. The method of measurement of extent of horizontal and vertical diversification was included in the interview schedule (Appendix 111).

3.4.3 Knowledge level of farmers on horizontal and vertical diversification in the homegardens

English and English (1958) defined knowledge as the body of understood information possessed by an individual by a culture.

Knowledge on horizontal and vertical diversification was operationally defined as the extent of information possessed by a farmer regarding different aspects of horizontal and vertical diversification in the homegardens.

In the present study, a knowledge test was developed for measuring the knowledge of the homegarden farmers about horizontal and vertical diversification. To measure this variable, pretested structured schedule was prepared.

For this an item of pool of questions was prepared based on the review of relevant literature and discussion with the experts. These questions were administered to non sample respondent on a pilot study prior to the preparation of final interview schedule. Scores of one and zero were given to the correct and incorrect answers respectively. The scores obtained for all questions were found out separately and these questions were arranged in the descending order of the final scores obtained by them. For effective discrimination twenty questions were retained for (ten questions each for horizontal and vertical diversification) after eliminating terminal questions with low and high scores. These twenty questions were included in the final interview schedule. To measure the level of knowledge of homegarden farmers about horizontal and vertical diversification ,the same twenty questions were used. The mean values of the scores obtained by 100 respondents were computed and the respondents were grouped into low and high categories based on the mean score.

3.4.4. Diversification preferences

Diversification preferences are operationally defined as the reason for diversification by homegarden farmers.

In the present study, an arbitrary scale was developed and used for the study to identify the preference for horizontal and vertical by the homegarden farmers. To measure this variable, an arbitrary scale was developed.

For this an item of pool of statements/reasons was prepared based on the review of relevant literature and discussion with the experts. This statements were administered to non sample respondent in a pilot study prior to the preparation of final interview schedule .Seven items were retained for final interview schedule. Ranking method based on preference was used to evaluate the diversification preference of homegarden farmers. Thus a score with a range of seven to one will be obtained.

3.4.5 Technological gap in horizontal and vertical diversification in homegarden

The technology need/gap assessment was worked out using the method developed by Thomas (2004) as stated below.

Score/Rank	Criteria
1	Technology not available (Most Needed)
2	Technology available but not applicable
3	Technology available but not sustainable
4	Technology available, applicable and sustainable

The technology needs of farmers vary according to the crops they cultivate, the managerial levels in which they operate, the deficits in the demand and supply of the crops they raise with reference to the specificities of the land they engages for cultivation and the agronomic norms the plant demands. It was with these perspectives; grouping of technology needs of the farmers was done

and classified into the aforesaid broad categories. Thus technology needs scores of all the 100 farmers were tabulated and subjected to statistical analysis.

3.4.6 Constraints experienced by homegarden respondents

Based on discussion with farmers and also through relevant review of literature, some of the constraints faced by homestead farmers were identified. A list containing twenty-six such constraints was included in the final interview schedule. The list was open ended so that the additional constraints expressed by the homegarden farmer respondents at the time of interview could also be included.

The response to each constraint was obtained on a four-point continuum namely, most important, important, less important and least important, with the score 'four', 'three', 'two' and 'one' respectively. Mean rank cumulative index for each constraint was worked out and the constraints were ranked and catalogued under different subheads.

3.5 DATA COLLECTION PROCEDURE

The data were collected using a well-structured interview schedule prepared for the purpose (Appendix III). A draft interview schedule was prepared which was pre-tested by conducting a pilot study in non sample area and suitable modifications were made in the final interview schedule which was then directly administered to the homegarden farmers by the investigator and responses recorded at the time of interview.

3.6 STATISTICAL TOOLS USED IN THE STUDY

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

3.6.1 Mean

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

3.6.2 Percentage Analysis

After grouping the farmers into various categories based on the score of items of observation, 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.

3.6.3 Correlation analysis

In order to measure the degree of relationship between the independent variables and the dependent variable, knowledge level on horizontal and vertical diversification correlation coefficient was worked out.

3.7 Hypothesis of study

Hypothesis is a tentative statement about the relationship between two or more variables. Thus hypothesis predicts expected results and based on actual results, it is able to determine the prediction right or wrong. Hypothesis set for study are:

1. There is no significant technology need for homegarden farmers with reference to economically dominant crops of homegardens in the process of horizontal and vertical diversifications.
2. There are no specific preferences for the homegarden farmers with respect to horizontal and vertical diversifications.
3. There exists no relationship between the independent variable of study and knowledge level of farmers on both horizontal and vertical diversifications.

RESULTS AND DISCUSSIONS

4. RESULTS AND DISCUSSIONS

This chapter deals with the results and discussion based on the analysis of data obtained from the study. They are presented based on the objective of the study. The findings of the present study are presented in this chapter under the following heads.

4.1 DISTRIBUTION OF THE RESPONDENTS BASED ON THEIR PERSONAL AND SOCIAL CHARACTERISTICS

A clear understanding of personal and social characteristics of the respondents is necessary to interpret the data properly. The results on distribution of homegarden farmers based on their personal and social characteristics are presented below.

4.1.1 Age

Age was operationally defined as the number of years completed by the respondent at the time of investigation. The result of the respondents age category is presented in table 1.

Table 1. Age of the homegarden respondents

n=100

Category (Years)	AEU-1 (n=20)		AEU-8 (n=20)		AEU-9 (n=20)		AEU-12 (n=20)		AEU-14 (n=20)		Total	
	No	%	No	%	No	%	No	%	No	%	No	%
<35	2	10	4	20	0	0	2	10	1	5	9	9
35-55	5	25	4	20	10	50	5	25	11	55	35	35
>55	13	65	12	60	10	50	13	65	8	40	56	56

Table 1 revealed that more than half of homegarden respondents fell in the category of ‘old age’ followed by 35% in the ‘ middle age’ category and only 9 % in the ‘young age’ category. A further analysis in the AEU wise distribution states that, majority of the respondents in the 4 AEU’s out of 5 AEU’s belonged to ‘old age’ category. The only exception is for AEU 14 where the majority of respondents belonged to ‘middle age’ category.

The benefit obtained from agriculture, in terms of economics of running a farm, with remunerativeness, which in today’s context of agriculture with special reference to homegarden has become difficult. It even becomes more problem as the profit generated out of such farms may not be in tandem with effort put by an individual in the farming enterprise. This could be the reason why youngsters are not considering this has a viable option as a means of living. Majority of homegarden farmers belonging to ‘old age’ category and this is because majority of respondents undertaking homegarden farming with commercial interest were retired personnel from government and non government sectors. They have

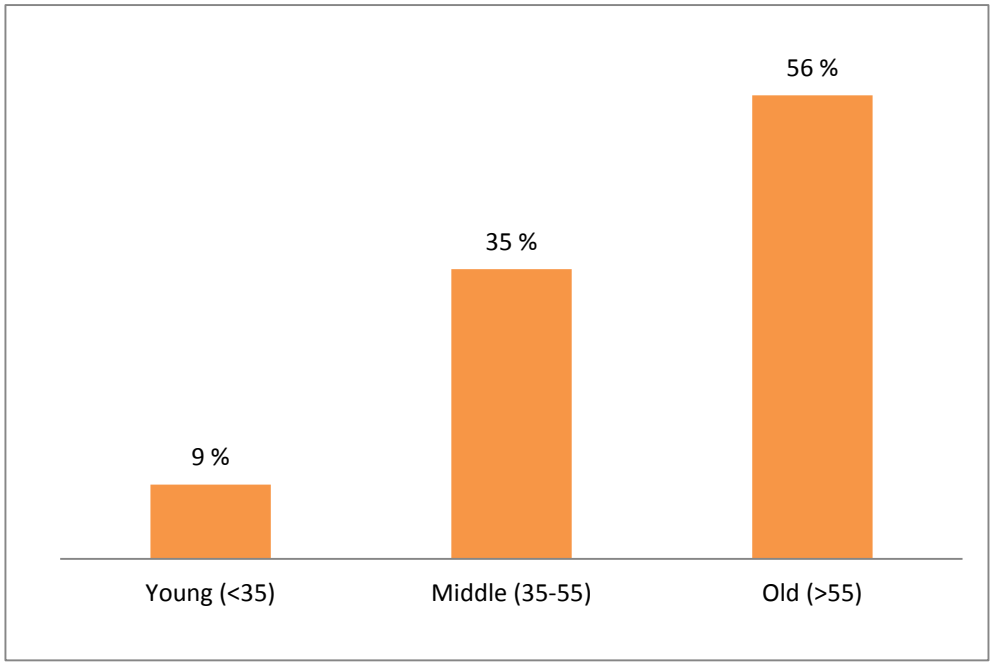

Fig 2. Distribution of homegarden respondents based on age

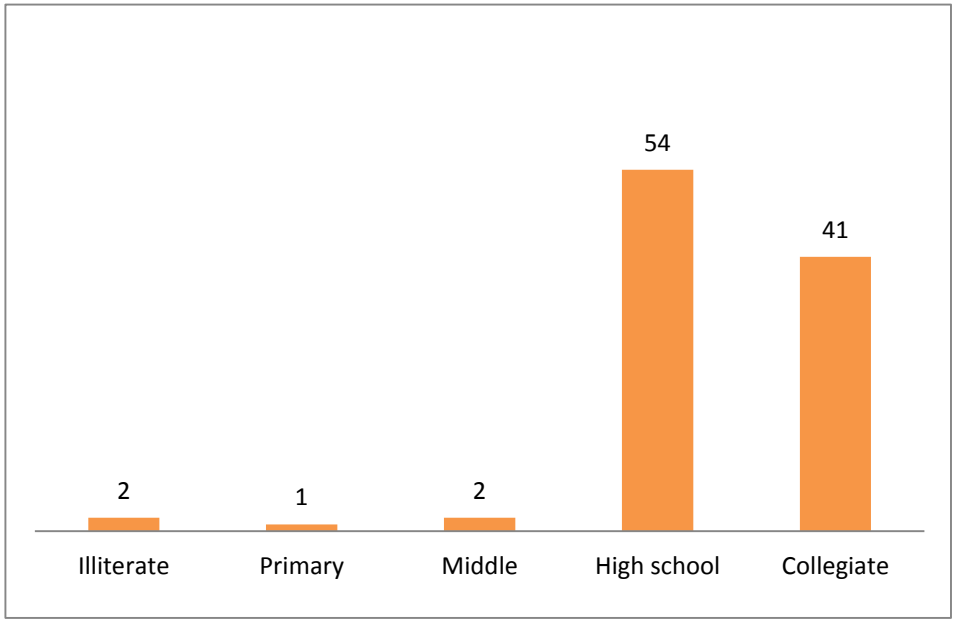

Fig 3. Distribution of homegarden respondents based on education

adequate time and could have considered it as a means for healthy life through daily activities. The result is in line with Jayawadhana (2007) and Hanjabam (2013)

4.1.2 Education

Education was operationalised as the extent of non-formal or formal learning possessed by the homegarden respondent. The result of the respondents education is presented in table 2.

Table 2. Education of the homegarden respondents

n=100

Category	AEU-1 (n=20)		AEU-8 (n=20)		AEU-9 (n=20		AEU-12 (n=20)		AEU-14 (n=20)		Total	
	No	%	No	%	No	%	No	%	No	%	No	%
Illiterate	0	0	0	0	2	10	0	0	0	0	2	2
Primary	0	0	1	5	0	0	0	0	0	0	1	1
Middle	0	0	0	0	0	0	1	5	1	5	2	2
High school	7	35	9	45	8	40	14	70	16	80	54	54
Collegiate	13	65	10	50	10	50	5	25	3	15	41	41

A perusal of results presented in table 2 on the education status of the respondents revealed that majority (54%) were having high school education. It was also observed that about 41 per cent of the respondents were educated up to collegiate level. The respondents with upto primary level education were found to be negligible. A detailed analysis of agro ecological unit wise distribution shows the same trend in all AEUs and is not that different from overall distribution.

This trend of majority respondents having high school to collegiate education is a typical case of Kerala. Educated homegarden farmers will interpret information in a better way and plan the inclusions of crops of high value for

generating more profit. The results are in line with findings of Rahul (2013) and Hanjabam (2013)

4.1.3 Family Size

Family size was operationalised as the number of members of either sex living in a household/family dependent on the head of the family. The result classifying respondents based on family size is presented in table 3.

Table 3. Family size of the homegarden respondents.

n=100

Category	AEU-1 (n=20)		AEU-8 (n=20)		AEU-9 (n=20)		AEU-12 (n=20)		AEU-14 (n=20)		Total	
	No	%	No	%	No	%	No	%	No	%	No	%
2-4	18	90	18	90	17	85	15	75	15	75	83	83
5-6	2	10	2	10	3	15	5	25	5	25	17	17

Family size of the respondents from table 3 revealed that 83 per cent of the respondents belonged to a family size of 2-4 members followed by 17 per cent with a family size of 5-6 members. A detailed analysis of AEU wise distribution also shows a same trend, with majority 2-4 family members in each AEUs.

This shows the typical trend, moving towards nuclear system of living. This finding was in line with results of Verma and Rao (1969) and Rahul (2013)

4.1.4 Occupation

The result classifying respondents based on occupation is presented in table 4.

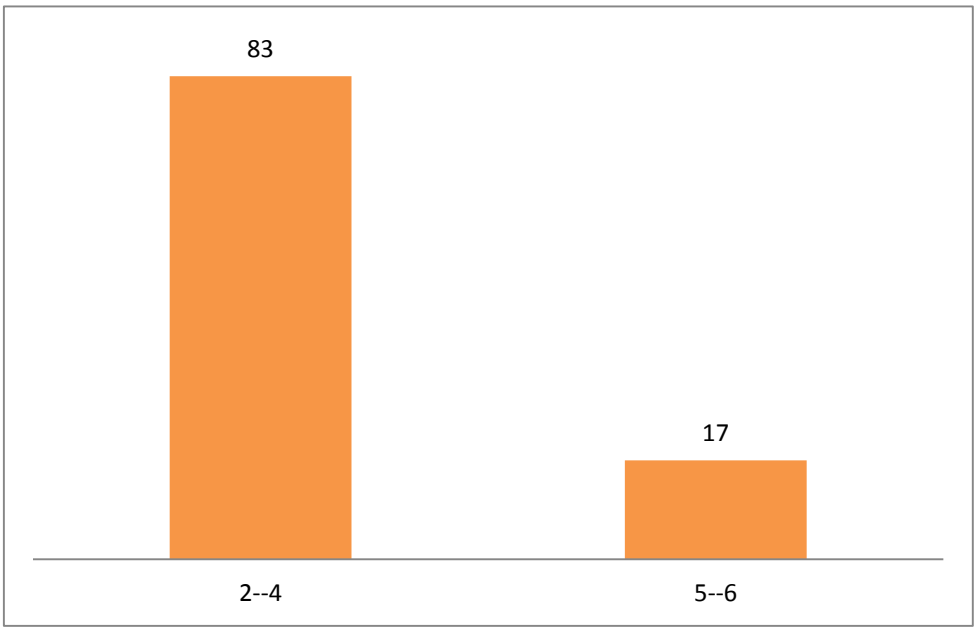

Fig 4. Distribution of homegarden respondents based on family size

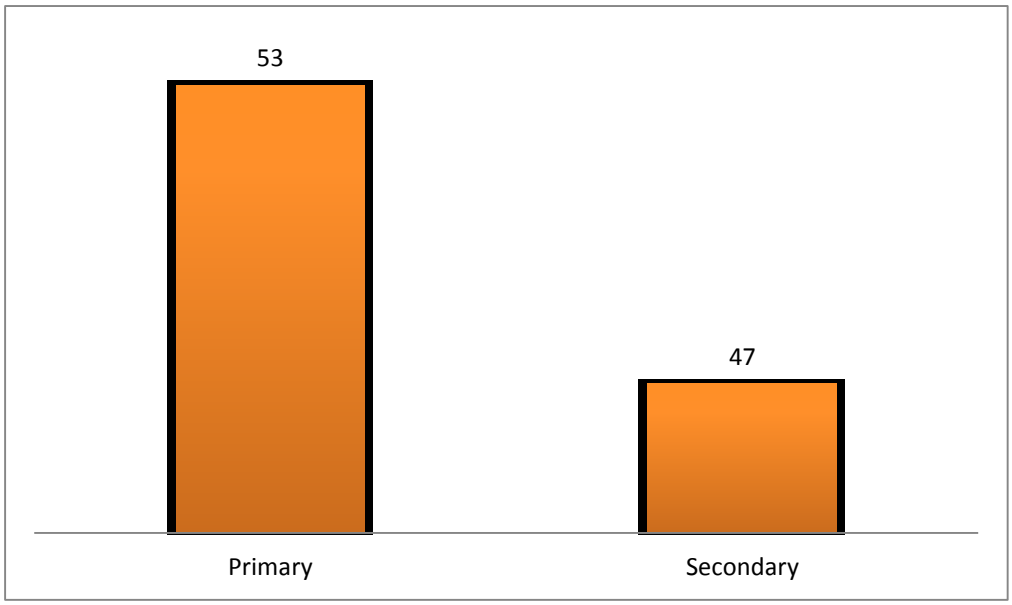

Fig 5. Distribution of homegarden respondents based on occupation

Table 4. Occupation of the homegarden respondents.

n=100

Category	AEU-1 (n=20)		AEU-8 (n=20)		AEU-9 (n=20)		AEU-12 (n=20)		AEU-14 (n=20)		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No	%
Primary (Agriculture)	13	65	13	65	6	30	9	45	12	60	53	53
Secondary (Others+ agriculture)	7	35	7	35	14	70	11	55	8	40	47	47

Occupational status of the respondents as stated in table 4 revealed that 53 per cent were doing agriculture as primary occupation and 47 per cent were doing agriculture as secondary occupation.

A further analysis of AEU wise distribution showed that in AEU 8 and 1, majority of respondents engaged in agriculture as their primary occupation. But in AEU 9 and 12 majority were doing agriculture as their secondary occupation.

Hence it was inferred that agriculture is still primary occupation of homegarden respondents even though it varies with different AEUs. This is because there are persons interested in agriculture and it is evident that homegardening helps them for a better earning. This finding was in line with results of Rahul (2013).

4.1.5 Effective Homegarden Area

It is operationalised as the effective area contributing to homegarden measured in acres. The result classifying respondents based on effective homegarden area is presented in table 5.

Table 5. Effective homegarden area of the homegarden respondent

n=100

Category	AEU-1 (n=20)		AEU-8 (n=20)		AEU-9 (n=20)		AEU-12 (n=20)		AEU-14 (n=20)		Total	
	No	%	No	%	No	%	No	%	No	%	No	%
< 1 acre	15	75	9	45	6	30	7	35	12	60	49	49
1-2 acre	2	10	5	25	6	30	9	45	6	30	28	28
>2 acre	3	15	6	30	8	40	4	20	2	10	23	23

A perusal of results presented in table 5 revealed that 49 per cent had less than one acre of area and 28 per cent had 1-2 acres and 23 per cent had more than 2 acres.

A detailed analysis of agro ecological unit wise distribution showed that in AEU 1, AEU 8 and AEU 14, majority of homegarden farmers had less than one acres of effective homegarden area. Contrary to the above, in AEU 9 and 12 had more than 1 acres of effective homegarden area.

This concern of depleting land area of agriculture under homegarden signifies the importance towards policies and support schemes so as to help in the inclusion of high value crops for horizontal and vertical diversification. This finding was in line with results of Esakkimuthu (2012).

4.1.6 Social Participation

Social participation is operationalised as the respondents affiliation towards different organizations that help them for better agricultural activity and social participation is measured in terms of the membership and extent to which respondents actively involving in organizations. The result of the respondents age category is presented in table 6 and 7.

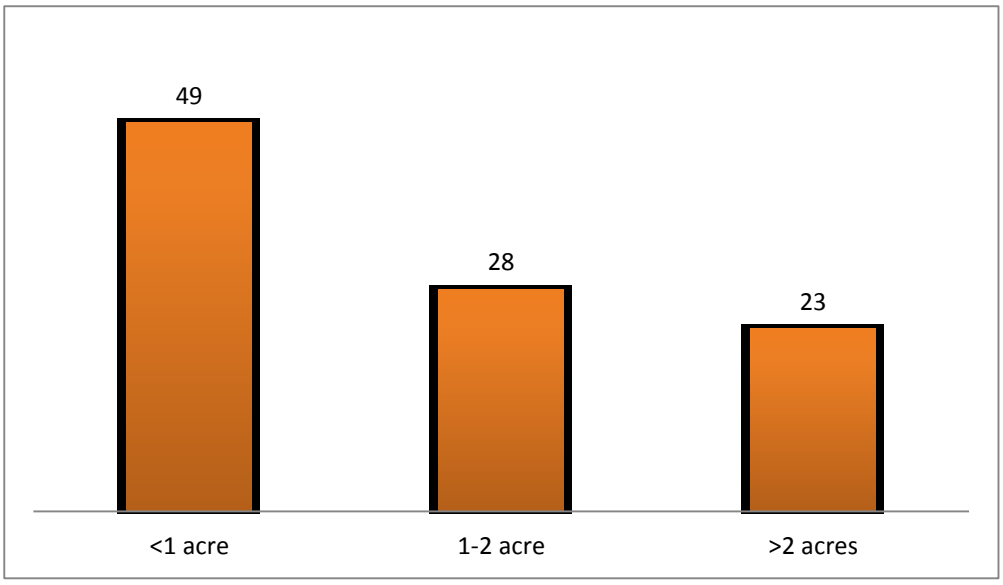

Fig 6. Distribution of homegarden respondents based on effective homegarden area

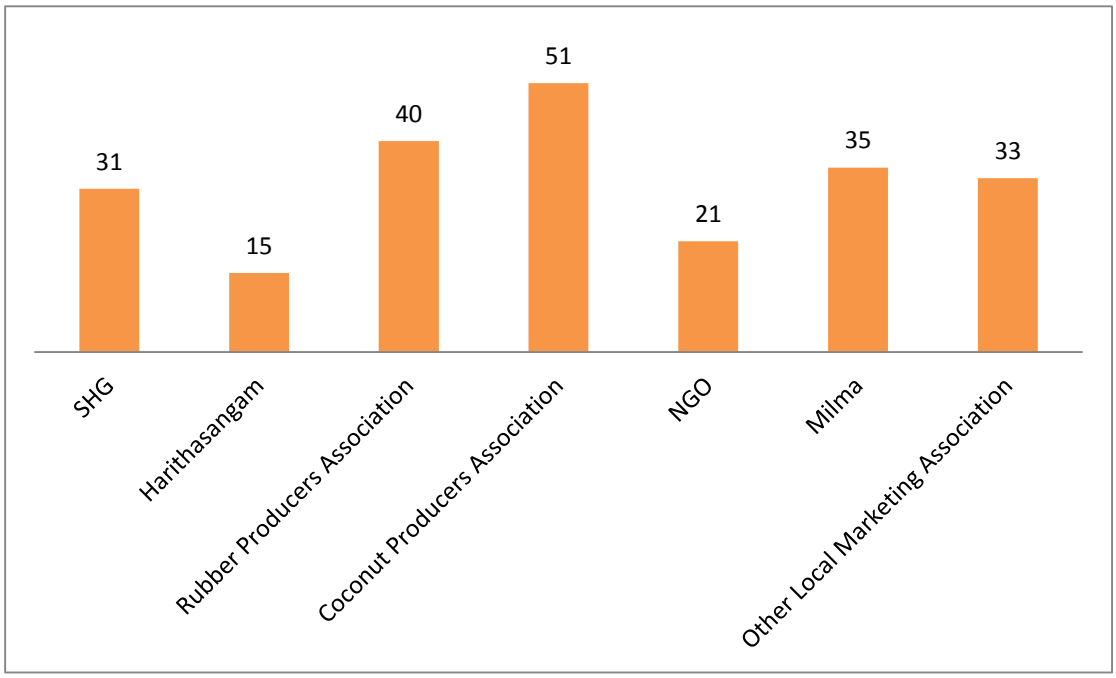

Fig 7. Distribution of homeogarden respondents based on social participation (membership)

Table 6. Social participation (Membership) of the homegarden respondents

n=100

Category	AEU-1 (n=20)		AEU-8 (n=20)		AEU-9 (n=20)		AEU-12 (n=20)		AEU-14 (n=20)		Total	
	No	%	No	%	No	%	No	%	No	%	No	%
SHG	7	35	7	35	8	40	5	25	4	20	31	31
Harithasangam	7	35	8	40	0	0	0	0	0	0	15	15
Rubber Producers Society	10	50	13	65	5	25	6	30	6	30	40	40
Coconut Producers Society	10	50	8	40	7	15	13	65	13	65	51	51
NGO	1	5	5	15	15	75	0	0	0	0	21	21
Milma	7	35	7	35	9	45	6	30	6	30	35	35
Other Local Marketing Society	2	10	3	15	6	30	13	65	9	45	33	33

Status of respondents on social participation (Membership) from table 6 revealed that 51 per cent of the respondents had membership in Coconut Producers Society followed by 40 per cent in Rubber Producers Society and 33 per cent in other local marketing societies. Further analysis of AEU wise distribution showed that AEU 8 had high membership level, followed by AEU 9, AEU 1, AEU 12 and AEU 14.

Table 7. Extent of Social participation of the homegarden respondents

n=100

Category	AEU-1 (n=20)		AEU-8 (n=20)		AEU-9 (n=20)		AEU-12 (n=200		AEU-14 (n=20)		Total	
	No	%	No	%	No	%	No	%	No	%	No	%
High	14	70	3	15	5	25	12	60	14	70	48	48
Low	6	30	17	85	15	75	8	40	6	30	52	52
Mean	1.8		2.1		2.15		2.45		1.8			

Status of respondents on extent of social participation from table 7 revealed that majority of homegarden farmers belong to low level of social participation (52%) and 48 per cent of the homegarden farmers belonged to high level of social participation.

A detailed analysis of AEU wise distribution showed that, AEU 1 and 14 had high level of social participation with 70 %, followed by AEU 12 (60%) AEU 9 (25%) and AEU 8 (15%).

This is the typical case of Kerala, where lot of participatory programmes engaging like Kudumbhasrees, SHGs else are being initiated for group ventures, Respondents belonging to majority of social groups indicates that they have less aptitude in group related activities. It will be due to need for full time engagement in homegarden/secondary activities. Eventhough they belong to some groups through membership.

4.1.7 Market Orientation

Market orientation is operationally defined as the degree to which a farmer is oriented towards scientific farm management with special reference to marketing functions/activities of his farm enterprises. The result of the respondents market orientation is presented in table 8.

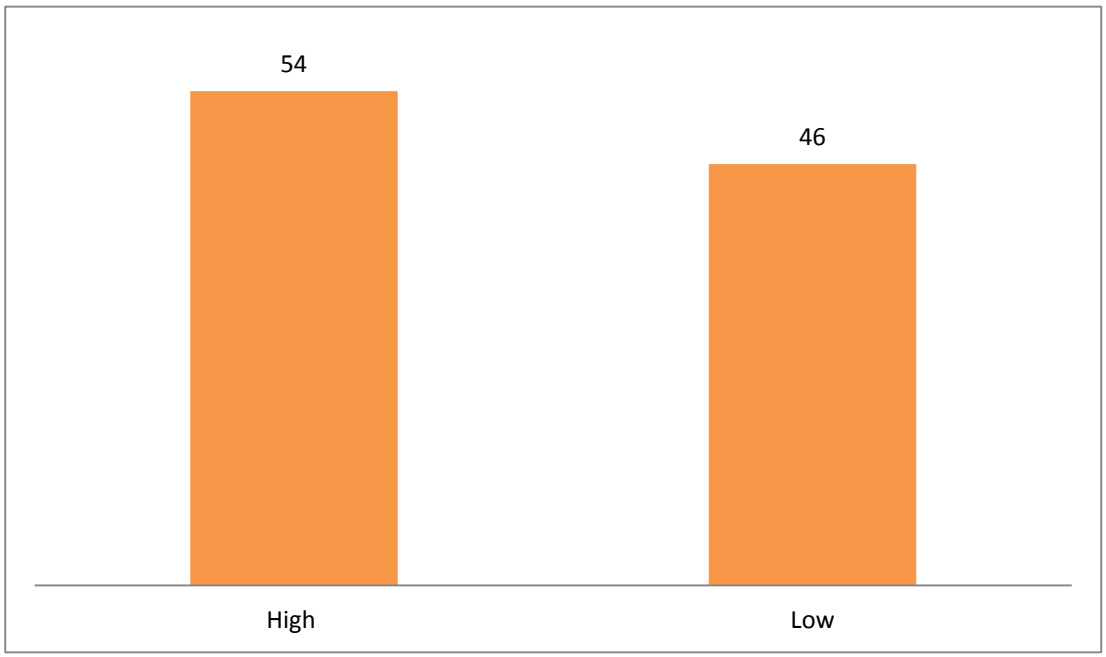

Fig 8. Distribution of homegarden respondents based on extent of social participation

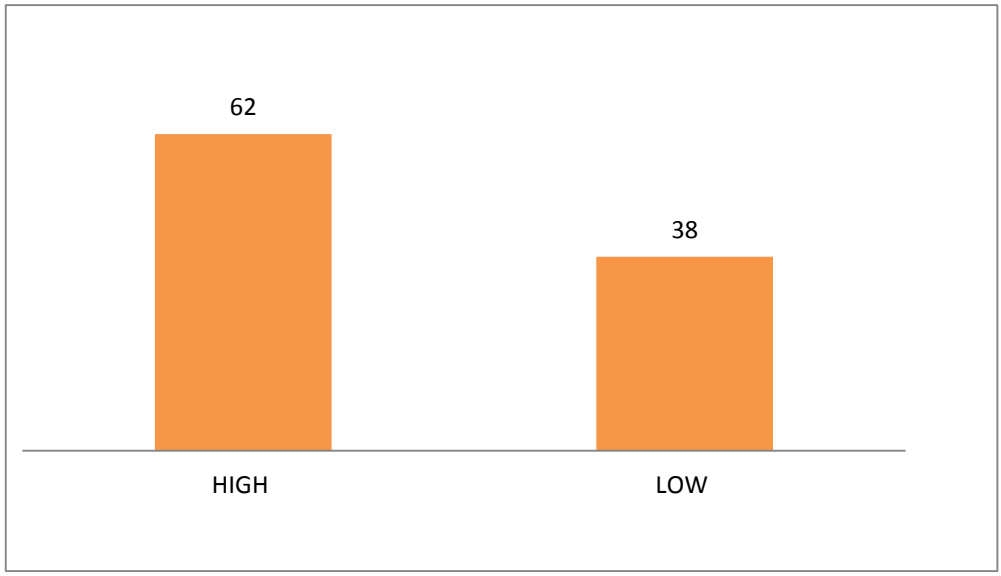

Fig 9. Distribution of homegarden respondents based on market orientation

Market orientation of homegarden respondents presented in table 8 was derived from the scores obtained by 100 respondents and the respondents were grouped into greater than mean value and less than mean value categories based on the mean score as the obtained mean value was skewed towards the higher side. The maximum and minimum score that could be attained by the respondent was 'twenty' and 'five', respectively and the mean score obtained was skewed towards 20 and hence, categorization as high and low became difficult.

Table 8 . Market Orientation of the homegarden respondents

n=100

Category	AEU-1 (n=20)		AEU-8 (n=20)		AEU-9 (n=20)		AEU-12 (n=20)		AEU-14 (n=20)		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No	%
Greater than mean	12	60	16	80	11	55	14	70	9	45	62	62
Less than mean	8	40	4	20	9	45	6	30	11	55	38	38
Mean	15.15		15.85		14.45		15.15		14.25			

Status of respondents on market orientation from table 8 revealed that 62 per cent of the homegarden farmers belonged to the category of greater than mean value of market orientation and 38 per cent with less than mean value of market orientation.

A detailed analysis of agro ecological unit wise distribution showed that the respondents of AEU 8 fells in the category of greater than mean value of market orientation with (80 %), followed by AEU 12 (70%), AEU 1 (60%), AEU 9 (55%) and AEU 14 (45%). Hence it was inferred that majority of homegarden farmers had a market orientation that was greater than mean value.

This indicates that any enterprise is taken up by homegarden farmers with an eye on profitability. They are very eager to incorporate high value and demand oriented crops with a market motive. Hence market orientation among them will be high. This finding was in line with results of Rahul (2013)

4.1.8 Risk Orientation

Risk orientation is operationally defined as the degree to which a farmer is oriented towards risk and uncertainty and portrayed the courage to face problems in farming. The result of the respondents risk orientation is presented in table 9.

Table 9. Risk orientation of the homegarden respondents

n=100

Category	AEU-1 (n=20)		AEU-8 (n=20)		AEU-9 (n=20)		AEU-12 (n=20)		AEU-14 (n=20)		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No	%
High	9	45	12	60	5	25	10	50	7	35	43	43
Low	11	55	8	40	15	75	`10	50	13	65	57	57
Mean	4.7		5.35		4.75		4.9		4.5			

Table 9 revealed the status of respondents on market orientation that 43 per cent of the homegarden farmers belonged to high risk orientation category and 57 per cent of the homegarden farmers fell in low risk orientation category.

Further analysis of agro ecological unit wise distribution showed that AEU 8 belongs to high risk orientation category with 60%. Followed by AEU 12 (50%), AEU 1 (45%), AEU 14 (35%) and AEU 9 (25%).

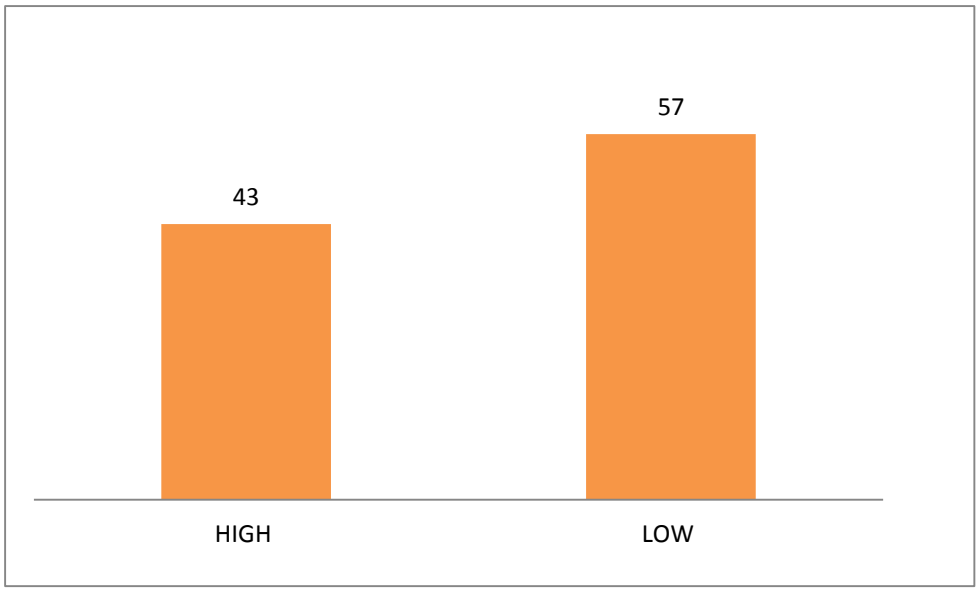

Fig 10. Distribution of homegarden respondents based on risk orientation

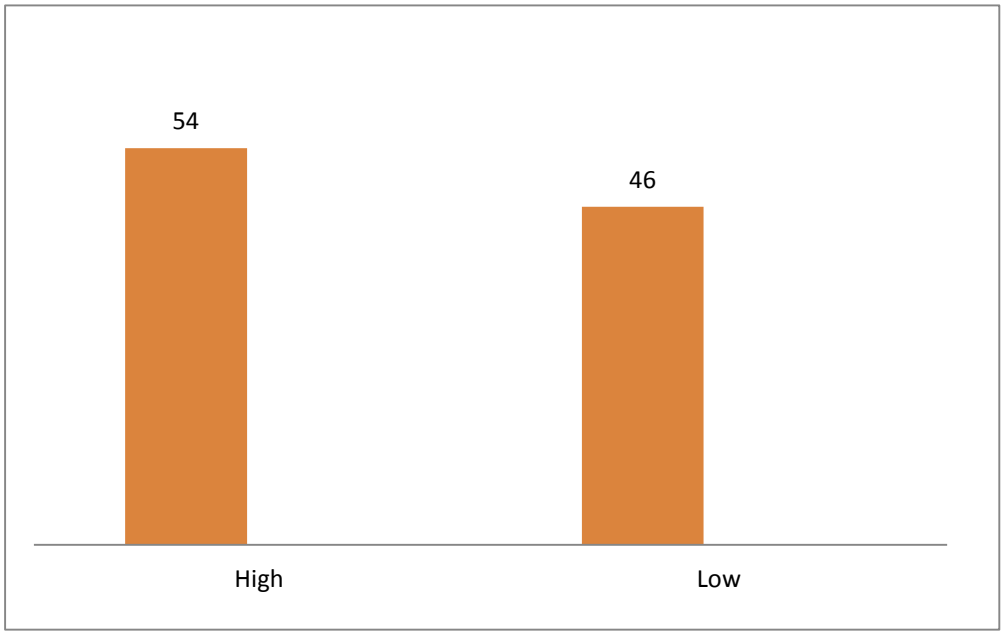

Fig 11. Distribution of homegarden respondents based on income

The functional aspect of homegarden is determined based on components integrated in the homegarden. However farmers are very skeptical in the process of horizontal integration due to doubts regarding profitability of enterprise as it starts to generate income. This could be the reason why risk orientation is low among homegarden respondents.

4.1.9 Annual Homegarden Income

Annual homegarden income is operationally defined as the total annual earnings from the farm and non-farm activities in the homegarden. The result of the respondents annual homegarden income is presented in table 10.

Table 10 . Annual Homegarden Income of the homegarden respondents

n=100

Category	AEU-1 (n=20)		AEU-8 (n=20)		AEU-9 (n=20)		AEU-12 (n=20)		AEU-14 (n=20)		Total	
	No	%	No	%	No	%	No	%	No	%	No	%
High	9	45	11	55	12	60	13	65	9	45	54	54
Low	11	55	9	45	10	40	7	35	11	55	46	46
Mean (Lakhs)	1.6		2.1		2.25		2.4		1.2			

It seemed from the table 10 that, 54 per cent of respondents belong to high annual homegarden income category and 46 per cent belonged to low category.

A detailed analysis of agro ecological unit wise distribution showed that in AEU 12, homegarden farmers had high homegarden income. However in AEU 1 and 14 majority fells in low income category with mean as check.

It could be made more profitable with right choice in diversification. However it should be understood that the interpretation of the data, the income status of homegarden farmers are high or low, is based on the mean value as

check. This doesn't mean that the farmers belonging to high category are rightly rich. This is in line with finding of Esakkimuthu 2012.

4.1.10 Mass Media Contribution

The result of the classifying mass media contribution as perceived by homegarden farmers is presented in table 11.

Since majority of the respondents had access to more than 3 mass media sources for seeking information an attempt to categorize the respondents based on high or low category became unrealistic and therefore the respondents was categorized into two categories *viz*., less than or equal to 3 mass media sources or more than 3 mass media sources. The frequency and percentage of respondents falling under the two categories was worked out under each AEU's and thereafter its total.

Table 11. Mass Media Contribution as perceived by homegarden respondents

n=100

Category	AEU-1 (n=20)		AEU-8 (n=20)		AEU-9 (n=20)		AEU-12 (n=20)		AEU-14 (n=20)		Total	
	No	%	No	%	No	%	No	%	No	%	No	%
> 3	17	85	18	90	17	85	18	90	14	70	84	84
< or = 3	3	15	2	10	3	15	2	10	6	30	16	16

It was observed from table 11, that the mass media contribution as perceived by homegarden farmers, majority of the respondents fell under category 'more than 3 mass media sources' (84%) and 16 per cent fell under category of less than or equal to 3 mass media sources.

Further analysis of agro ecological unit wise distribution showed that respondents of AEU 8 and 12 fell in the 'more than 3 mass media sources' followed by AEU 1 and AEU 9 (85% each) and AEU 14 (70%).

Table 12. Mass media contribution (frequency) as perceived by homegarden respondents

Category	AEU-1			AEU-8			AEU-9			AEU-12			AEU-14			Total		
	VO	O	NO	VO	O	NO	VO	O	NO	VO	O	NO	VO	O	NO	VO	O	NO
Newspaper	15	4	1	14	6	0	15	5	0	9	11	0	14	5	1	67	31	2
Television	11	8	1	20	0	0	16	4	0	18	2	0	10	5	5	75	19	6
Magazine	11	5	4	0	13	7	0	9	11	3	10	7	2	8	10	16	45	39
Radio	5	7	8	0	6	14	6	14	0	3	3	14	1	8	11	15	38	47
Friends	7	13	0	3	10	7	0	5	10	3	10	7	4	16	0	17	54	24
MAS	0	5	15	0	4	16	0	6	14	0	8	12	1	4	15	1	27	72
Kiosk	0	4	16	0	3	17	0	6	14	0	10	10	0	3	17	0	26	34

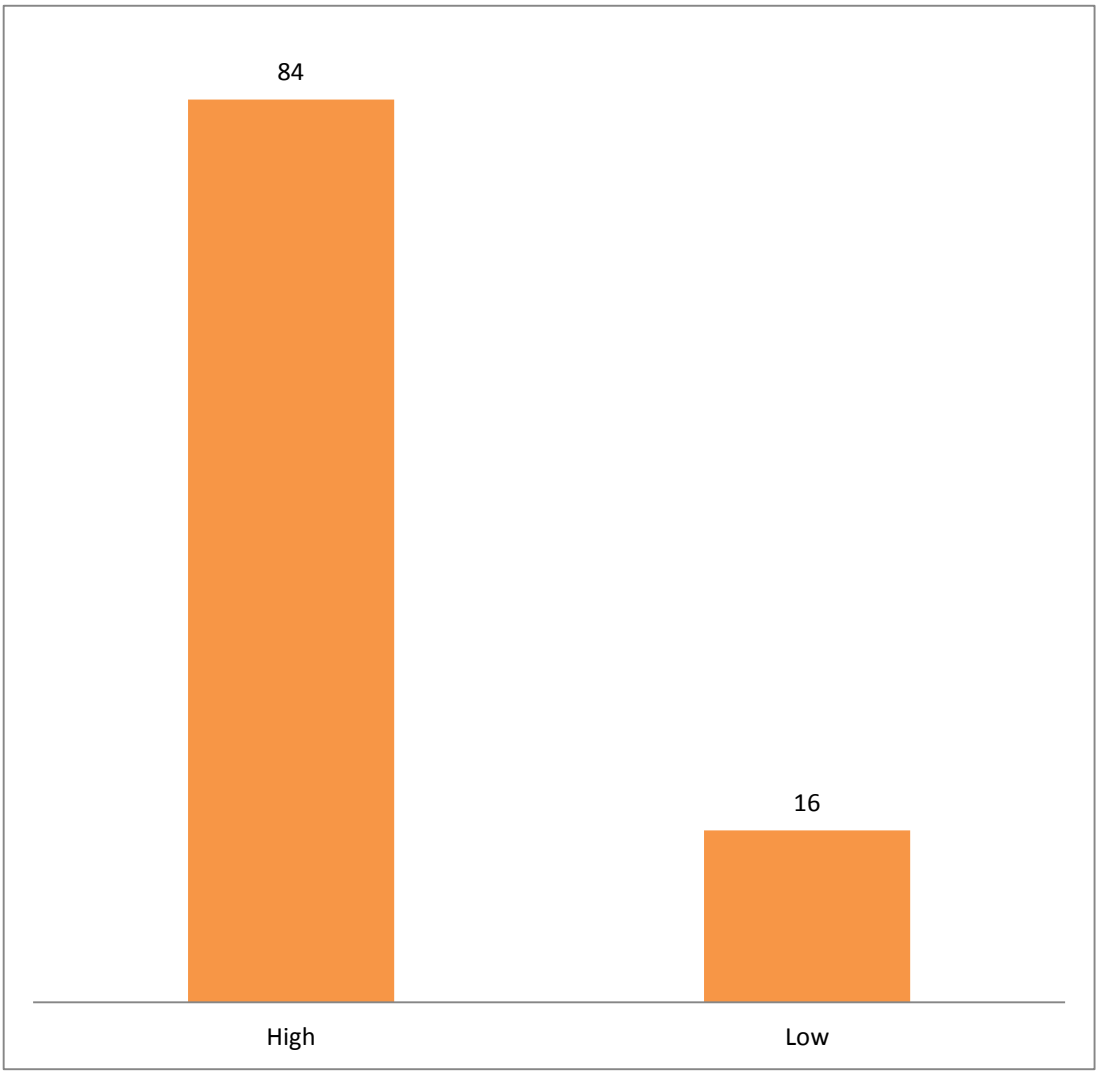

Fig 12. Distribution of homegarden respondents based on mass media contribution

From table 12 frequency of mass media contribution revealed that television ranked top in the category of ‘very often’, followed by newspaper, friends, magazine, radio, Mobile Advisory Service (MAS) and Kiosk. In category of ‘often’ friends ranked top followed by magazine, radio, newspaper, Mobile Advisory Service (MAS), Kiosk and television. In the category ‘not often’ Kiosk was most preferred followed by Mobile Advisory Service (MAS), radio, magazine, friends, television and newspaper.

From table 13 usefulness of mass media revealed that television ranked top in the category of ‘very useful’. In category of ‘useful’ magazine and newspaper ranked top and in category ‘not useful’ Kiosk was most preferred.

People in Kerala are highly literate. Homegarden respondents are subjected to frequent use of different mass media sources like television, newspaper, magazines etc. This is because those sources are accessible and felt useful for homegarden respondents. These results are in line with finding of Ahire and shinoy (2005).

Table 13. Mass media contribution (usefulness) as perceived by homegarden respondents

Category	AEU-1			AEU-8			AEU-9			AEU-12			AEU-14			Total		
	VU	U	NU	VU	U	NU	VU	U	NU	VU	U	NU	VU	U	NU	VU	U	NU
Newspaper	2	8	10	0	10	10	5	15	0	4	8	8	7	11	1	18	52	29
Television	8	11	1	14	6	0	15	5	0	12	8	0	13	3	4	62	33	5
Magazine	8	7	5	8	11	1	0	13	7	9	8	3	2	13	5	27	52	21
Radio	5	5	10	0	7	13	6	11	3	2	8	10	1	6	13	14	37	49
Friends	5	8	7	5	10	5	0	6	14	5	12	3	1	12	7	16	48	36
MAS	3	8	9	0	3	17	2	9	9	7	8	5	4	7	9	16	35	49
Kiosk	3	4	13	3	3	14	5	5	10	9	6	5	2	3	15	22	21	57

MAS-Mobile Advisory Service

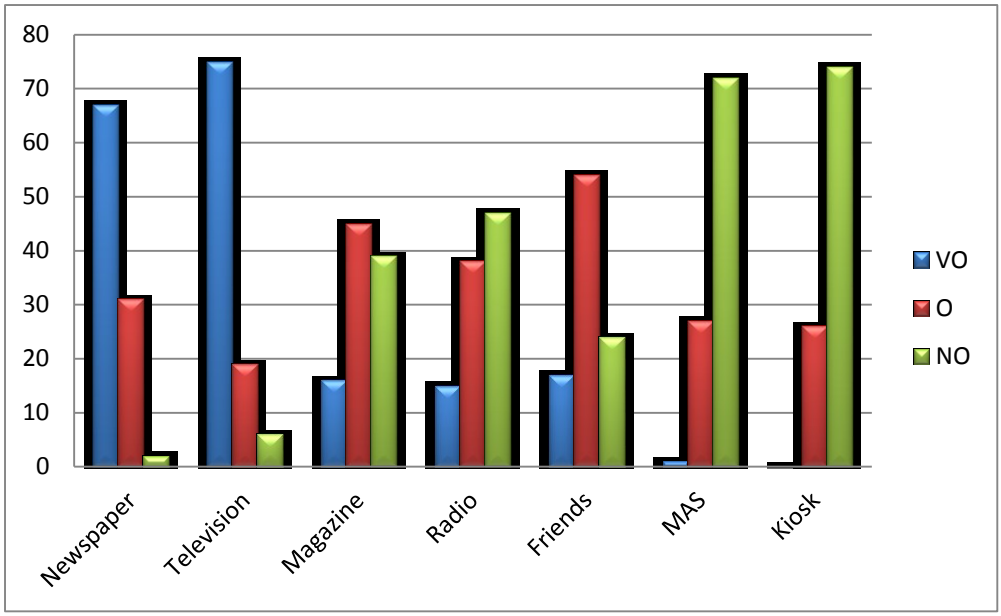

Fig 13. Distribution of homegarden respondents based on mass media contribution (frequency)

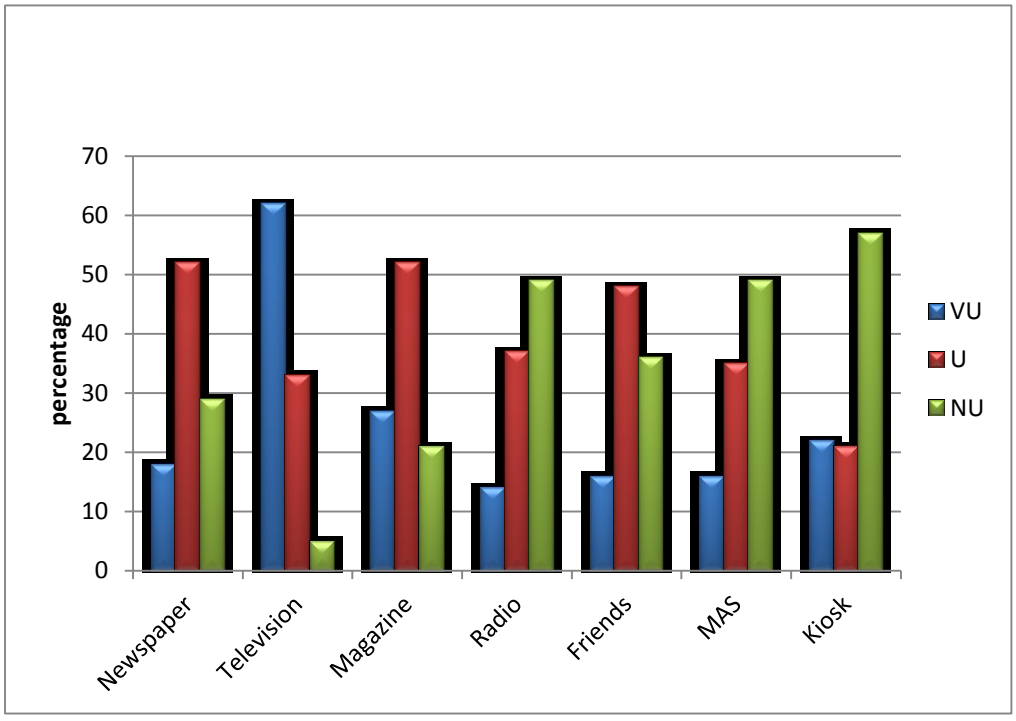

Fig 14. Ddistribution of homegarden respondents based on mass media contribution (Usefulness)

4.1.11 Evaluative perception of homegarden farmers in relation to sustainability of the horizontal and vertical diversification of the homegarden respondents

The result classifying the respondents evaluative perception with special reference to the sustainability aspects of horizontal and vertical diversification is presented in table 14.

Table14.Evaluative perception of homegarden farmers with special reference to the sustainability aspects of horizontal and vertical diversification.

Market orientation of homegarden respondents presented in table 14 was derived from the scores obtained by 100 respondents for 15 statements in a four point continuum. The score obtained was 40-60 range. Hence the respondents were grouped into greater than mean value and less than mean value categories based on the mean score, as the obtained mean value was skewed towards the higher side.

n=100

Category	AEU-1 (n=20)		AEU-8 (n=20)		AEU-9 (n=20)		AEU-12 (n=20)		AEU-14 (n=20)		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No	%
Greater than mean value	12	60	14	70	9	45	11	55	10	50	56	56
Less than mean value	8	40	6	30	11	55	9	45	10	50	44	44
Mean	55.7		53.7		54.55		51.95		53.5			

It was evident from table 14 that, more than half of the respondents fell in the category of greater than mean value of evaluative perception with special reference to the sustainability aspects of horizontal and vertical diversification.

It is interesting to note that the respondents of AEU 8 top the table with 70% belonging to the category of greater than mean value of evaluative perception followed by AEU 1 with 60% respondents. However, majority of the respondents in AEU 9 had less than mean value category of evaluative

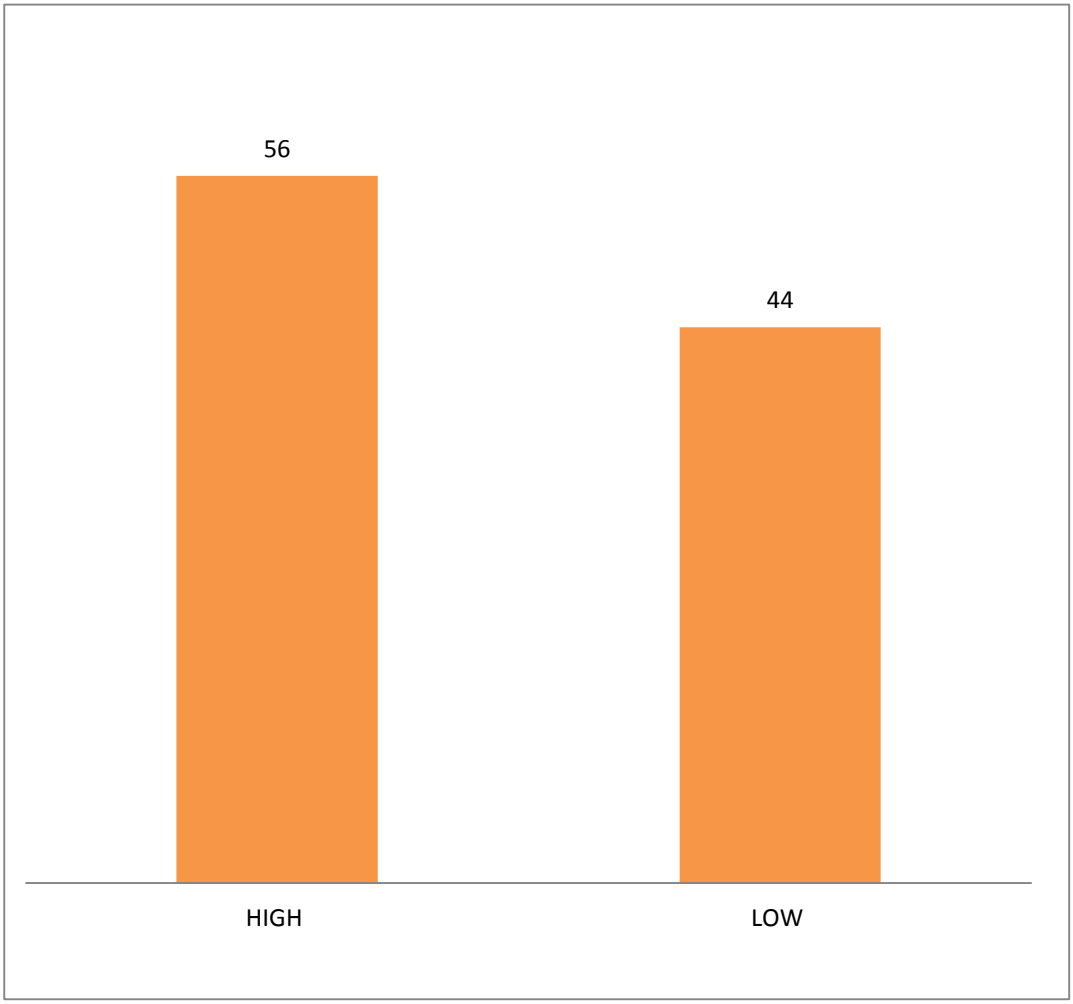

Fig 15. Distribution of homegarden respondents based on evaluative perception on sustainability

perception on sustainability aspects of homegarden. Hence in general it was inferred that majority of homegarden had high level of sustainability.

Homegarden farmers are not just concerned on the economic aspect in every stage of planning of homegardens. They consider the component advantage in terms of the ecosystem contribution *viz*, biodiversity contribution, safe agricultural practices etc. This could be the reason why homegarden farmers are perceived to have high perception on horizontal and vertical diversification.

4.2 HORIZONTAL AND VERTICAL DIVERSIFICATION IN THE HOMEGARDENS

The results for the horizontal and vertical diversification in the homegardens are presented under the following subheads.

4.2.1 Dominance Profile of Homegarden

The result of dominance profile of crops is presented in table 15 in terms of economic dominance as perceived by the homegarden farmers was rated in a 7 point continuum with the scale value 1 for most economically dominant crop and the scale value of 7 for least economically dominant crop. When the rank position based on the mean scale value depicts the position of dominance, the mean scale value designated the extent of dominance of one crop to the other.

Table 15. Dominance profile of homegarden

Crops	Mean scale value	Rank
Coconut	1.59	1
Banana	1.68	2
Tapioca	2.94	3
Pepper	3.33	4
Vegetables	3.47	5
Yams and Colocasia	4.22	6
Areca nut	4.56	7

The table revealed that the maximum economic dominance was seen for coconut followed by banana, tapioca, pepper, vegetables, yams and colocasia and areca nut in the decreasing order of economic dominance. However these were not only the economically dominant crops as perceived by the homegarden farmers. With regard to farmers perception there were a collection of 23-24 crops that were economically dominant in their homegardens. Therefore in this study the top 7 crops were considered as the economically dominant crops based on the mean values.

The finding obtained from the study was in line with result of Meerabhai *et al*., (1991) and Thomas (2004) According to them coconut based farming system is commonly practiced in the homestead agriculture especially in coastal and mid-land Kerala.

4.2.2 Horizontal diversification in homegardens and its technology needs

4.2.2.1 *Extent of Horizontal diversification of economically dominant crops in homegardens*

Horizontal diversification is a measure of both the cropping intensity and the structure of homegardens. The scale ranges from 1 to 8 levels of horizontal diversification. Hence results were categorized as more than mean and less than

mean. The result of extent of horizontal diversification of economically dominant crops in homegardens are presented in table 16.

Table 16. Extent of Horizontal diversification of economically dominant crops in homegardens

n=100

Category	AEU-1 (n=20)		AEU-8 (n=20)		AEU-9 (n=20)		AEU-12 (n=20)		AEU-14 (n=20)		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No	%
High (More than 4 tiers)	14	70	16	80	9	45	13	65	10	50	62	62
Low (Less than 4 tiers)	6	30	4	20	11	55	7	35	10	50	38	38
Mean	4.6		4.55		3.9		3.95		4.5		4.3	

The results of the data furnished in table 16 revealed that the extent of horizontal diversification of the 62 per cent of the homegardens are 4 tiers or above and 38 per cent of homegardens are less than 4 tiers, based on total mean as check.

A detailed analysis of agro ecological unit wise distribution showed similar result noticed for AEU 1, 8 and 14 where the horizontal diversification is more than 4 tiers whereas for AEU 9 and AEU 12, the table revealed that the horizontal diversification is less than 4 tiers. Hence it can be inferred that in general the majority (62%) of homegardens in thiruvanathapuram district selected for study has 4 or more levels of horizontal diversification.

The mean value for horizontal diversification is 4 and majority of the respondents belonged to category ‘more than 4 tiers’. This indicates that majority of the homegardens of Thiruvanathapuram district were with high level of

horizontal diversification. In those selected homegardens, a horizontal diversification of up to 6 tiers were noticed which disclose the acceptability of horizontal diversification among the farmers. There were so many reasons behind the increased level of horizontal diversification. One of the major reason for this is the traditional practice of growing shrubs, bushes, fruit trees and tuber crops in the courtyards of every human dwelling unit of Kerala. The other reasons include the guaranteed economic returns from the component crops, to ensure food security as well as food safety. Now it became a felt need to maintain a homegarden, for a sustainable healthy living. Also certain dominant crops indicate likeness of homegarden farmers to incorporate more remunerative crops to homegardens.

In spite of all the above reasons the inclusion of non commodity crops in the homegarden was a usual phenomenon especially by those homegarden farmers who integrate whatever new components available. More and more integration of such crops to the homegardens by the farmers could be due to the concern for their dwelling ecosystem in terms of socio-economic and environmental advantages.

4.2.3 Vertical diversification in homegardens and its technology needs

4.2.3.1. Extent of vertical diversification for the economically dominant crops in the homegardens

Vertical diversification throws light into the economic entities in the homegarden as a result of value addition or product diversification. The result of extent of vertical diversification for the economically dominant crops in the homegardens is presented in table 17.

Table 17. Extent of vertical diversification for the economically dominant crops in the homegardens

Economically dominant crop	Levels	Total levels
Coconut	Nut/copra/oil	3
Banana	Fruit/chips	2
Pepper	Raw/Dried/powder	3
Tapioca	Tuber/blanched/Chips	3
Yams and Colocasia	Tuber/chips	2
Arecanut	Nuts/dry nuts/seedlings	3
Vegetables	Raw	1

For each economically dominant crops the maximum vertical diversification level was three, which was noticed for coconut, pepper, tapioca and arecanut, followed by 2 levels of diversification for banana and tubers (yams and Colocasia) and the least vertical diversification was noticed in vegetables with one level of vertical diversification, that is they sell produce as such.

The results clearly show that vertical diversification of economically dominant crops are low. Also while comparing vertical diversification with the results generated from table.16, it was evident that vertical diversification was not taking place at pace of horizontal diversification. It indicates, the necessity for more value addition for economically dominant crops integrated into homegarden system.

As coconut based farming system is predominant in Kerala, maximum value addition is also noticed in it. The tradition of using coconut oil by every household increases its level of vertical diversification. Majority of homegarden farmers are drying pepper to black pepper, which is a three level diversification. Same as in case of arecanut, homegarden farmers sell it in dried form. Banana and tubers are usually sold as such and at a maximum level they are converted to

chips. In case of vegetables, usually homegarden farmers produce it for theirown needs and a least level of vertical diversification was observed.

The study points out the fact for further policy support schemes and research for enabling maximum value addition in homegarden before sale of product which ensures more profitability at production catchment area itself in order to directly benefit the homegarden farming community.

4.2.3.2 Vertical Diversification Based on Number of levels practiced by each of the homegarden respondents

All the crops in the homegarden are identified based on number of levels of vertical diversification. The more level of diversification could be due to the inclusion of rubber and livestock in the homegarden components, where generally the number of value addition is more compared to the agricultural crops. The result of the Vertical Diversification Based on Number of levels practiced by each of the homegarden respondents is presented in table 18.

Table 18. Vertical Diversification Based on Number of levels practiced by each of the homegarden respondents

n=100

Category	AEU-1 (n=20)		AEU-8 (n=20)		AEU-9 (n=20)		AEU-12 (n=20)		AEU-14 (n=20)		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No	%
High (More than 3 levels)	8	40	11	55	6	30	10	50	7	35	42	42
Low (less than 3 levels)	12	60	9	45	14	70	10	50	13	65	58	58
Mean	2.55		4.2		3.8		5.1		2.65		3.66	

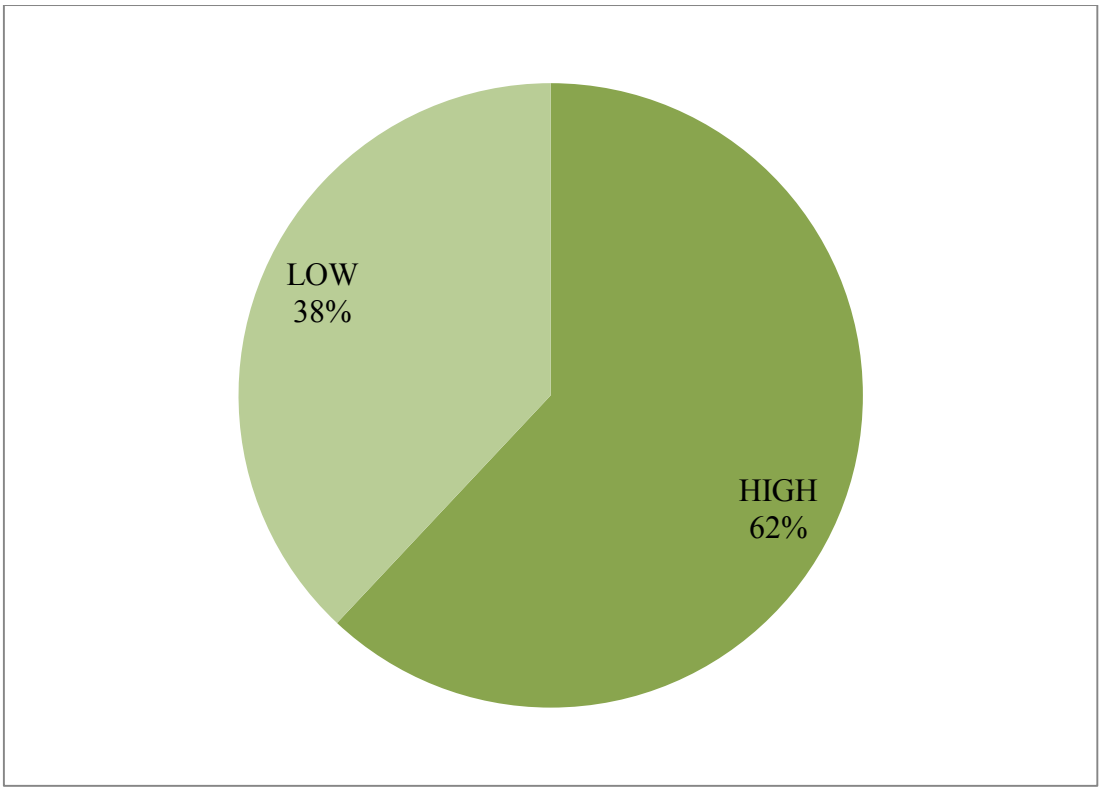

Fig 16. Horizontal Diversification in Homegardens

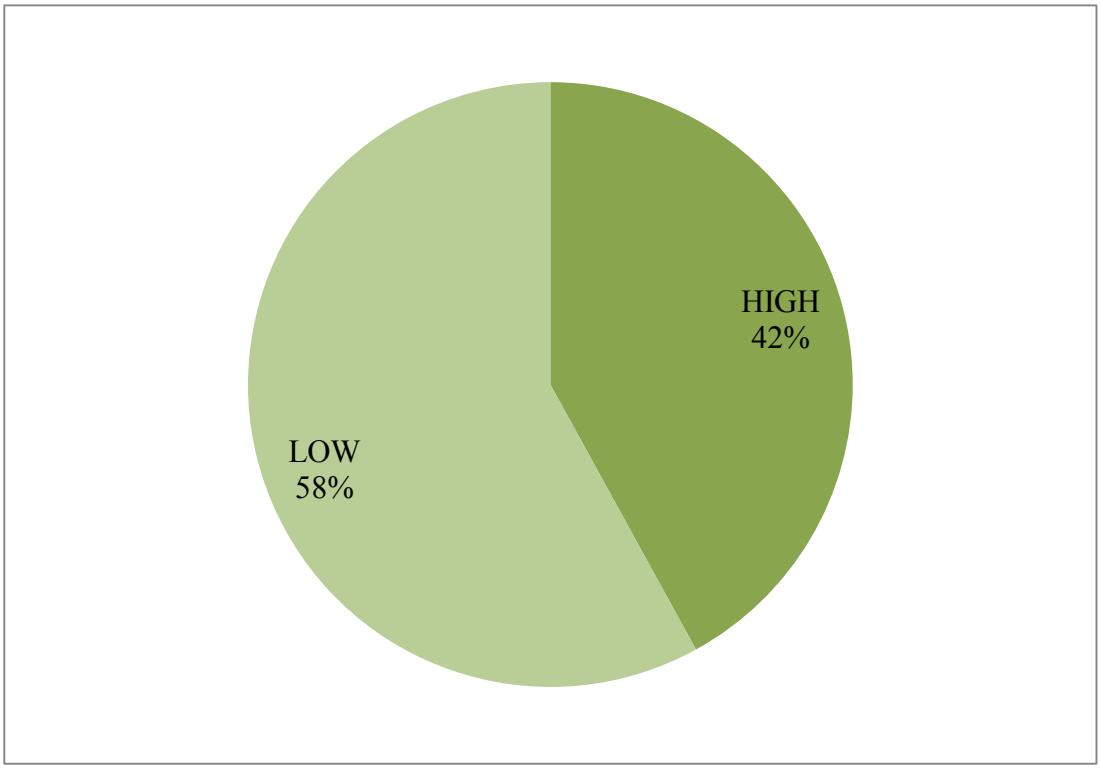

Fig 17.Vertical Diversification in Homegardens

The data presented in table 18 revealed that 42 per cent had 3 or more level of vertical diversification and 58 per cent of the homegardens had 3 or less level of vertical diversification based on mean as check. The more level of diversification in some of the AEU's could be due to the inclusion of rubber and livestock in the homegarden components, where generally the number of value addition is more compared to the agricultural crops. Hence in those units the level of vertical diversification is 3 or more as per the mean value (3.66) obtained in this study

A detailed analysis of agro ecological unit wise distribution showed that AEU 8 had high level of vertical diversification with 55 %, followed by AEU 12 (50%), AEU 1 (40%), AEU 14 (35%) and AEU 9 (30%). The mean value obtained from the study is 3.66, which is much less. It indicates the need for value addition at homegarden level.

4.2.4 Knowledge level of farmers on horizontal and vertical diversification in the homegardens

The result of the knowledge on horizontal diversification and vertical diversification for all AEU's are presented in table 19.

Table19. Knowledge on horizontal and vertical diversification of the homegarden

n=100

Knowledge level of homegarden farmers	Horizontal diversification		Vertical diversification	
	No.	%	No.	%
High	60	60	34	34
Low	40	40	66	66

A perusal of results presented in table 19 revealed that majority (60%) homegarden respondents had fairly high level of knowledge on horizontal diversification. It implies that homegarden respondents knew about which crop to

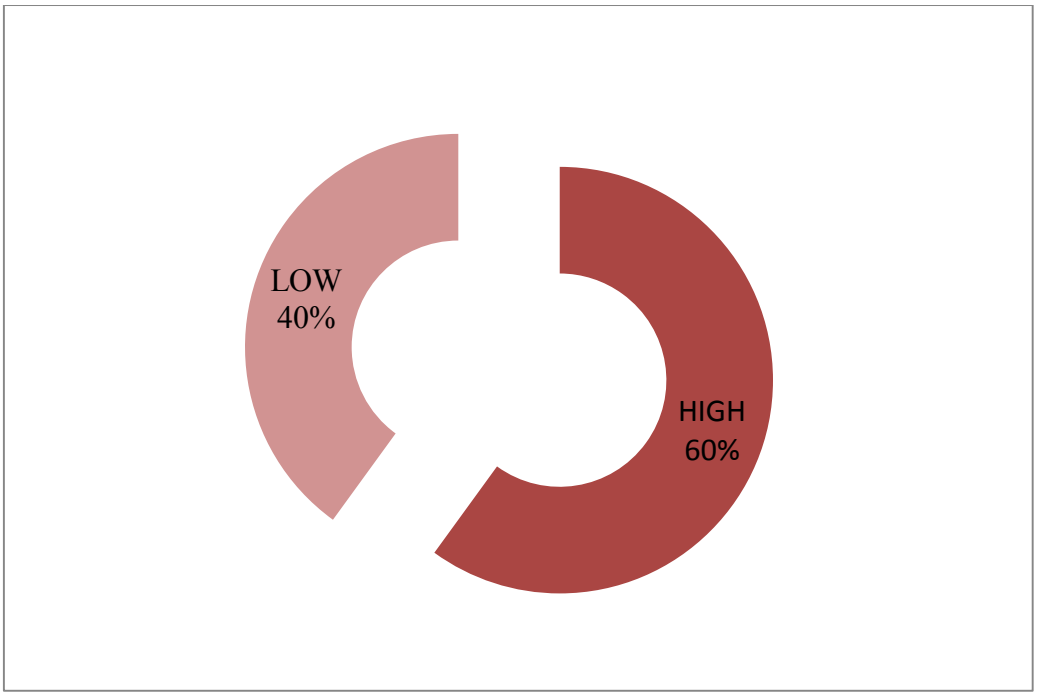

Fig 18. Knowledge level on horizontal diversification

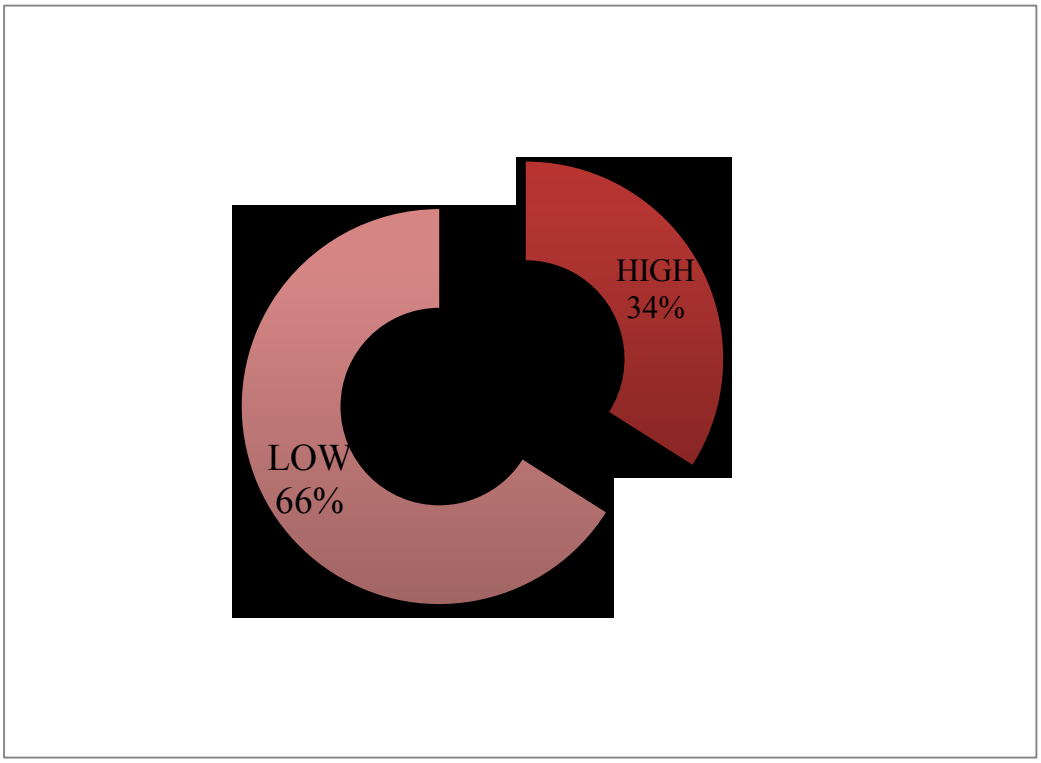

Fig 19.Vertical Diversification in Homegardens

be included in the homegarden as intercrops. However 40 per cent had low level of knowledge on horizontal diversification.

The results of the data also revealed that majority (66%) of homegarden respondents had low level of knowledge on vertical diversification and only 34 per cent had fairly high level of knowledge on vertical diversification.

Hence, it was inferred that majority of homegarden farmers had high level of knowledge on horizontal diversification and low level of knowledge on vertical diversification. It indicates the fact that, homegarden farmers are integrating various crops to their farming system but they lack further knowledge to make it remunerative. Typically Kerala homegardens are rich with crop diversity. But due to various reasons land area got depleted and one should diverse their homegarden to make it rich. Therefore along with horizontal diversification an equal balance should be given for value addition process.

Very often, value addition and product diversification are easier said than done in homegarden level. The biggest constraint is the lack of technological know-how on value addition. It has to develop in consonance with the needs of homegarden to stimulate agricultural production; prevent post-harvest losses, improve nutrition and add value to the products. The available value addition technologies were amenable for lab scale production and not fitting to homegarden. Therefore, wherever necessary, technologies were tailored to fit into the homegarden environment and refined to result in more value addition.

The result indicates lack of awareness and training programmes in value addition. Homegarden farmers should be made educated about proper methods of processing, storage, packaging, transport and marketing of household crops such as jack, mango, banana, vegetables and spices. Various Government agencies such as Department of Agriculture and Vegetable and Fruit Promotion Council Keralam are supporting farmers in marketing agricultural produce of the state. But there are no such agencies for promotion of value addition of these products. Presently, the homegarden farmers sell their products without processing. If they

do primary processing and value addition at homegarden level, it will generate more income from homegarden.

4.2.4.1 Influence of personal and social characteristics of the respondents on the knowledge on horizontal diversification and vertical diversification

The relationship of the 11 personal and social characteristics on the knowledge on horizontal diversification was established in this study by correlation and findings are presented in table 20.

Table 20. Relationship of independent variables with knowledge on horizontal and vertical diversification of the homegarden respondents.

SL No	Independent variables	Correlation coefficient(r_h)	Correlation coefficient(r_v)
1	Age	-0.0152	**-0.051**
2	Education	0.190	0.371**
3	Family size	0.139	0.309
4	Occupation	0.085	0.141
5	Effective homegarden area	0.337**	0.150
6	Social participation	0.124	0.318
7	Market orientation	0.209	0.325
8	Risk orientation	0.203	0.366*
9	Annual homegarden income	0.004	0.128
10	Mass media contribution	0.358**	0.365**
11	Evaluative perception on sustainability on horizontal and vertical diversification	0.135	0.160

* Significant at 5% level, ** Significant at 1% level
r_h- Correlation coefficient for horizontal diversification
r_v-Correlation coefficient for vertical diversification

Table 20 revealed that, out of 11 independent variables, 2 independent variables namely effective homegarden area and mass media contribution had positive and significant influence on knowledge level aspects on horizontal diversification at 1% level. This could be because, the respondents are made known about new varieties/technologies through mass media especially by using television, newspaper, magazines etc, that aids more horizontal diversification. When farmers posses more homegarden area there is a natural tendency to learn more about horizontal diversification, introduce more remunerative components in their homegardens and in turn for increasing the net profit.

Table also revealed that, out of 11 independent variables, 3 independent variables mainly education and mass media contribution at 1% level and risk orientation at 5% level, had positive and significant influence on knowledge level aspects on vertical diversification.

Hence, education, effective homegarden area, risk orientation and mass media contribution had positive and significant influence on knowledge level aspects on horizontal and vertical diversification. Other independent variables, family size, occupation, social participation, market orientation, risk orientation and evaluative perception on sustainability on horizontal and vertical diversification had positive relationship with knowledge on horizontal and vertical diversification.

The fact that education is positively and significantly influencing the knowledge level of respondents on vertical diversification reposits that, skill acquisition and understanding on value addition cum product diversification technologies through training. The significance of education in knowledge level on vertical diversification again assumes importance, as knowledge level horizontal diversification being non significant, which points out the fact that

farmers do require more training on area of vertical diversification more than horizontal diversification.

4.2.5 Diversification preferences

Homegardens are diversified for several reasons. The result of the diversification preferences is presented in table 21. Diversification preference is ranked based on mean score value ranging from 7 as high score and 1 as least score. When the rank position based on the mean score depicts the position of diversification preferences, the mean score value designated the extent of diversification preferences for different items mentioned under the category.

Table 21. Diversification preferences of the homegarden

n=100

Category	Rank	Mean Score Value
For Family Needs	1	6.85
For Profit Making	2	5.7
To Reduce Risk	3	4.65
For Increasing Shelf Life	4	3.6
As Part of Culture	5	2.7
For Sustainability	6	1.75
Employment Generation	7	1.15

Results from table 21 revealed the diversification preferences was mainly to cater the family needs which ranked topped with a mean rank value of 6.85 followed by, for profit making, to reduce risk, for increasing shelf life, as part of culture, for sustainability and employment generation.

The current low level of vertical diversification clearly indicates that whatever value addition takes place is for family needs. Second preference of the homegarden farmers for horizontal and vertical diversification was profit making

which was basically derived by selling the surplus after home use. Diversification have offered more quantity and profit, as it inclusion could be purposive in nature. However the result points to the fact that if more technology to value addition and policy support for market is provided the preference by homegarden farmers for such type of farming system could shift to profit making on par with family needs.

More crops are integrated into the homegarden with the fundamental belief of reducing the risk or dependence on particular component in homegardens. Diversification of crops and products help farmers to mitigate uncertainties in market price. It will also make farmers to withstand in calamities and weather variations by offering a year round income. Hence to reduce risk was ranked third.

The preference four was for sustainability nature of diversification in homegarden. It helps to to increase yield and income, capable to maintain soil health, ensure environment safety contribute towards nutritional security, energy needs and income generation. Even under conditions of high population densities homegarden is able to adjust to socio-economic changes, prevents soil erosion, provides habitat to soil micro-organisms and promote a favorable microclimate for the household. The results was in line with findings of Soemarwoto (1986) and Tynsong and Tiwari (2010).

Employment generation stood least in preference ranking. The activities within the homegarden are managed by family labour. The results indicated that family size of majority homegarden respondents in Thiruvanathapuram district were with two to four members. The other major factor are non availability of labour and high labour cost. The more inclusion of crops and value addition adds the need for labour. To some extend those reasons holding back homegarden farmers from more value addition activities. Even though the high involvement of family labour is enough to manage a homegarden.

4.2.6 Characterisation of homegardens in terms of technology needs (gaps) as perceived by the homegarden farmers in the process of horizontal and vertical diversifications.

4.2.6.1 Technology needs (gaps) as perceived by the homegarden farmers in the process of horizontal diversification

The technology need was measured in 1 to 4 scale range. The result of technology needs as perceived by the homegarden farmers in the process of horizontal diversification is presented in table 22.

Table 22 . Technology needs (gaps) as perceived by the homegarden farmers in the process of horizontal diversification

n= 100

Category	AEU-1 (n=20)		AEU-8 (n=20)		AEU-9 (n=20)		AEU-12 (n=20)		AEU-14 (n=20)		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No	%
High	13	65	14	70	8	40	11	55	9	45	55	55
Low	7	35	6	30	12	60	9	45	11	55	45	45
Mean	2.45		3.5		2.3		3.45		2.4		2.82	

The results from table 22 on technology needs as perceived by homegarden farmers in horizontal diversification based on scale range (1-4) revealed 45 per cent belonged to low level category which conveys they had high technology need and majority (55%) of the respondents belonged to high category which means that need for technology was less. A detailed analysis of agro ecological unit wise distribution showed that AEU 9 had high technology needs/gaps with 60 % followed by AEU 14 (55%), AEU 12 (45%), AEU 1 (35%) and AEU 8 (30%).

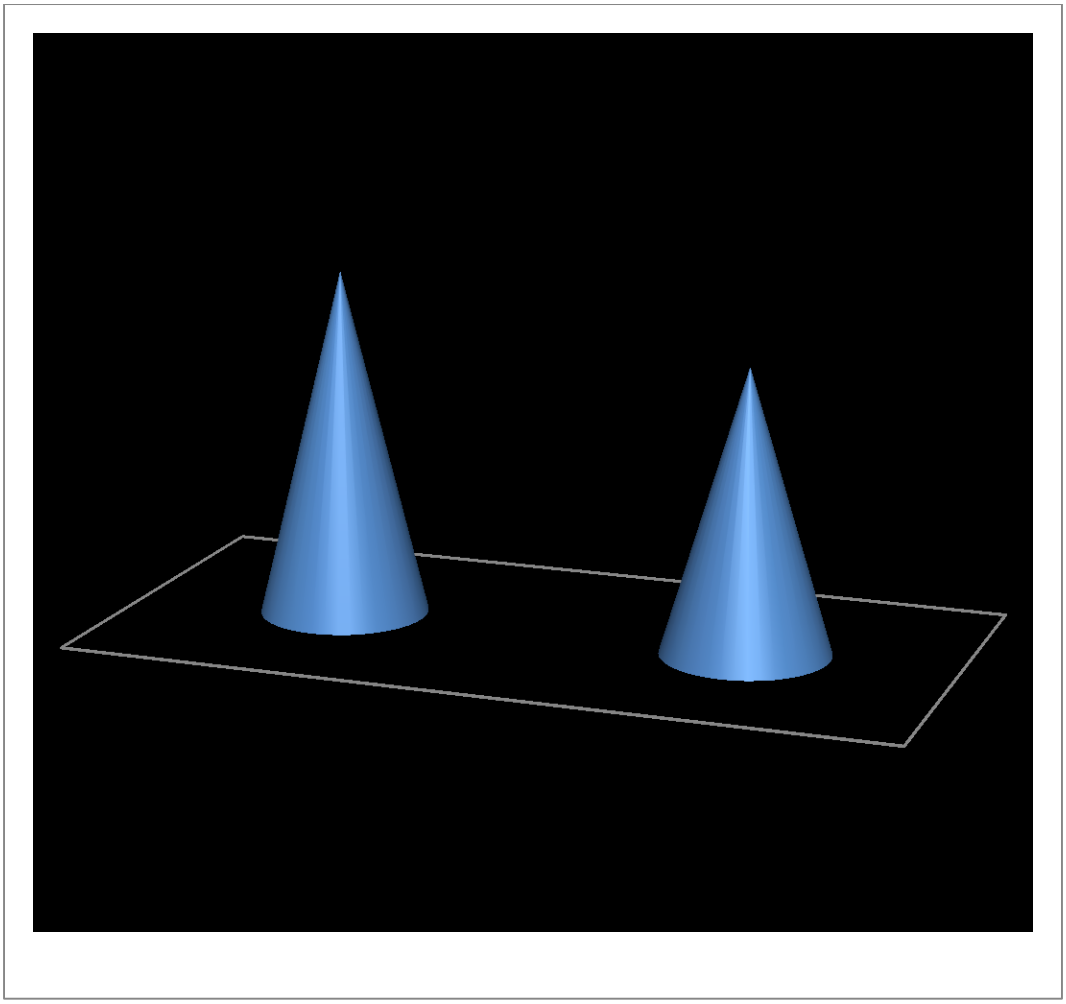

Fig 20. Technology need in Horizontal diversification

Hence, it was inferred that technology needs as perceived by homegarden farmers were low in horizontal diversification. This is a good indication as majority of the farmers contended with the technology generated in the process of horizontal diversification.

4.2.6.2 Technology needs/gaps as perceived by the homegarden farmers in the process of vertical diversification

The result of Technology needs/gaps as perceived by the homegarden farmers in the process of vertical diversification is presented in table 23.

Table 23.Technology needs (gaps) as perceived by the homegarden farmers in the process of vertical diversification

n= 100

Category	AEU-1 (n=20)		AEU-8 (n=20)		AEU-9 (n=20)		AEU-12 (n=20)		AEU-14 (n=20)		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No	%
High	7	35	8	40	5	25	7	35	6	30	33	33
Low	13	65	12	60	15	75	13	65	14	70	67	67
Mean	1.8		2.5		1.6		2.1		1.9		1.9	

From table 23 it was identified that the total mean technology need value is only 1.9. It shows there is a deficit in the technology availability for value addition. It was identified from table 23 that majority of farmers (67%) require more technology in the case of vertical diversification and only 33 per cent had the opinion that the need for technology is low. A detailed analysis of agro ecological unit wise distribution showed that all the AEUs felt high technology needs with respect to vertical diversification.

Hence, it was inferred that majority of homegarden farmers of all the AEUs had perceived the need for value addition technology for vertical diversification.

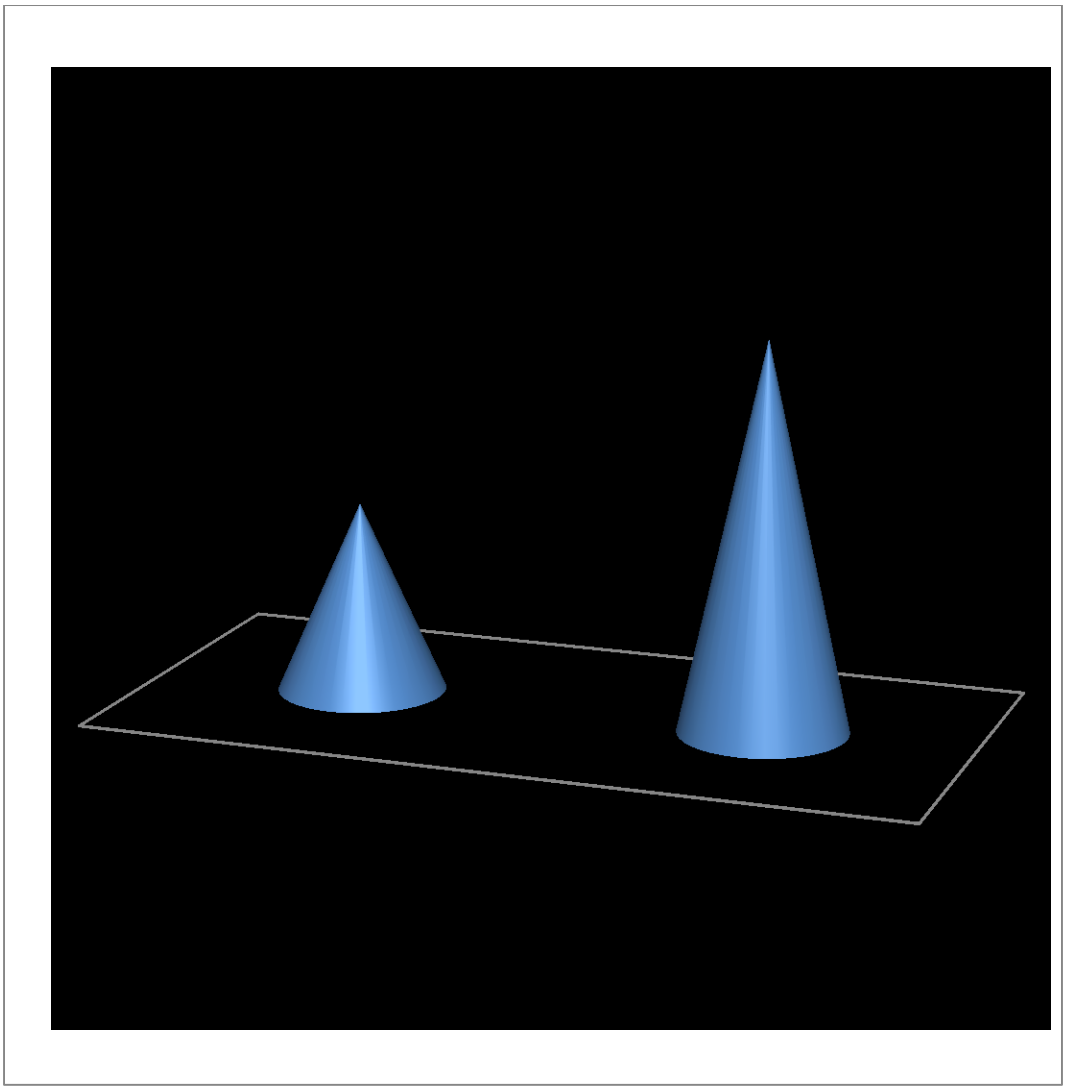

Fig 21. Technology need in vertical diversification

4.2.6.3 Technology needs assessment on vertical diversification based on ranking

Technology need is assessed based on mean score. The result of technology needs assessment on vertical diversification of homegardens is presented in table 24. The mean score based on scale range 1 to 8 designated the extent of technology needs on vertical diversification for different items mentioned under the category.

Table 24. Technology needs assessment on vertical diversification of homegardens

Sl No	Category	Rank	Mean Score
1.	Storing Technologies	1	7.45
2.	Harvesting Technologies	2	7.05
3.	Processing Technologies	3	6.95
4.	Packaging Technologies	4	4.95
5.	Waste Management Technologies	5	3.65
6.	Grading Technologies	6	2.45
7.	Product Diversification Technologies	7	1.35
8.	Sorting Technologies	8	1.15

Results from table 24 on technology needs assessment on selected parameters for vertical diversification of homegardens revealed that storage technologies (score7.45) is the most needed technology followed by harvesting technologies (score 7.05), Processing technologies (score 6.95), Packaging technologies (score 4.95), waste management technologies (score 3.65), grading technologies (score 2.45), product diversification technologies (score 1.35) and sorting technologies (score 1.15).

This showcases the need for research and extension to focus on generation and dissemination of technologies for vertical diversification. So that the farmers can derive more profit from each of the existing contributing components of the homegardens.

4.2.7. Constraints experienced by homegarden farmers in the process of horizontal and vertical diversification of agricultural technologies in homegardens.

The result of constraints in horizontal and vertical diversification of the homegarden respondents is presented in table 25. The mean score value designated the extent of constraints for different items mentioned under the item

Table 25. Constraints in horizontal diversification and vertical diversification of the homegarden respondents

n=100

Sl No	Items	Rank	Mean Score Value
1.	Poor storage facilities	1	8.9
2.	Poor harvesting technologies	2	8.3
3.	Lack of knowledge on post harvest handling	3	7.2
4.	Lack of homegarden suited post harvest technologies	4	6.4
5.	Lack of varieties suited for value addition	5	6
6.	Non availability of supplies and services	6	5.6
7.	Lack of post harvest implements suited for homegardens	7	5.2
8.	High labour cost	8	4.9
9.	Low price of produce	9	4.6
10.	Crop damage due to animal attack	10	4.5
11.	Lack of time in homegarden activity	11	4.1
12.	Shade due to plantation crops	12	4

Result of the study showed that farmers felt more constraints on vertical diversification rather than horizontal diversification. The major constraint experienced by homegarden farmers was lack of availability of low cost storage facilities. Therefore there should be suggestive measures to solve farmers'

problem giving more technologies for vertical diversification in order to increase the profitability of homegardens.

Adequate and timely training with special reference to post harvest practices for the homegarden farmers will help to solve the problem of lack of knowledge on post harvest handling.

Need based extension and research will help the homegarden farmers to solve the problems of lack of varieties suited for value addition and non availability of supply and services. Hence the findings of the study lights attention towards solving the mentioned constraints through policy/service support to make the system more productive.

4.2.8 HYPOTHESIS

A research hypothesis is the statement created by researchers when they speculate upon the outcome of a research or experiment. A hypothesis must be testable, taking into account current knowledge and techniques, and be realistic. A hypothesis must be verifiable to allow a verification or falsification. In this study hypothesis set and established were:

1. There is no significant technology need for homegarden farmers with reference to economically dominant crops of homegardens in the process of horizontal and vertical diversifications.

The results from table 22 and 23 on technology needs as perceived by homegarden farmers on horizontal and vertical diversification revealed that when only 45 per cent of respondents felt that there was a need for technologies for horizontal diversification, 67 per cent of respondents felt that there was a need for more technologies for vertical diversification in homegardens. This also proved that the farmers felt that they needed more technologies for homegarden vertical diversification than that of horizontal diversification. Hence, hypothesis was falsified.

2. There are no specific preferences for the homegarden farmers with respect to horizontal and vertical diversifications.

Results from table 21 revealed that there are specific diversification preferences for the homegarden farmers. Diversification preferences was mainly to cater the family needs which ranked topped with a mean rank value of 6.85 followed by, for profit making, to reduce risk, for increasing shelf life, as part of culture, for sustainability and employment generation. Hence the hypothesis was falsified.

3. There exists no relationship between the independent variable of study and knowledge level of farmers on both horizontal and vertical diversifications.

Results of Table 20 and 21 revealed that, there exists relationship between the independent variable of study and knowledge level of farmers on both horizontal and vertical diversifications**.** Out of 11 independent variables, 2 independent variables namely effective homegarden area and mass media contribution had positive and significant influence on knowledge level aspects on horizontal diversification at 1% level and 3 independent variables mainly education and mass media contribution at 1% level and risk orientation at 5% level, had positive and significant influence on knowledge level aspects on vertical diversification. Hence, there exists a relationship between the independent variable of study and knowledge level of farmers on both horizontal and vertical diversifications.

SUMMARY

5. SUMMARY

Homegardens are dynamic entity in agriculture and they play a vital role in supporting households in many diverse ways such as provision of food, fuelwood, building materials, cooking utensils, fodder for livestock, and cash income among others. Homegarden agro forestry is believed to be more diverse and provide multiple services for household than other monocropping system and this is due to the combination of crops, trees and livestock. Homegarden with trees are one of agro forestry practices known to be ecologically sustainable and diversifies livelihood of local community. Diversification can better tolerate the ups and downs in the market value of farm products and adverse effects of aberrant weather. It may ensure economic stability for farming families in the country. The low yield per unit area, high population pressure, and negligible scope for expansion of the area of land for cultivation are major problems. Increase in intensity of cultivation and in yields per unit area are the only available options to meet future food needs to feed an ever increasing population. Hence homegarden diversification may be a useful tool to mitigate various early said problems. Against this background, the present study was undertaken with the following specific objectives.

1. To determine the technology needs of horizontal and vertical diversifications for the economically dominant crops in the homegardens
2. To identify the diversification preferences and knowledge level on both horizontal and vertical diversifications within each homegardens
3. To delineate constraints experienced by farmers in the process of these diversifications in the homegardens

The study was conducted during 2014-2015 in Thiruvanathapuram district of Kerala, comprising five agro ecological units. From each of the 5 agroclimatic units, one panchayat with maximum active and operational homegarden units was identified in consultation with officials. From this panchayats, 20 homegarden farmers with

holding size not less than 0.1 ha were selected. Thus a total of 100 homegarden farmer respondents were selected for the study.

The independent variable selected for the study were age, education, occupation, family size., annual income from homegarden, effective homegarden area, social participation, market orientation, risk orientation, mass media exposure and evaluative perception of homegarden respondent farmers in relation to sustainability of the homegardens with reference to horizontal and vertical diversification. The economic dominance was also worked out in a 'seven point' scale continuum with assigning a rank 'one' for the most remunerative crops and subsequently the other ranks of two, three, four, five, six and seven for the lesser remunerative crops in the order.

The horizontal diversification was computed based on the number of levels of crop component observed in each of the homegardens with special reference to the economic dominance. The results were expressed in terms of the mean score. Likewise the vertical diversification was computed based on the number of levels of economically dominant crops (Seven most economically dominant crops as already computed) to the levels of value addition until it reaches the market. The results were expressed in terms of the mean score obtained in the homegardens understudy. A knowledge test was developed for measuring the knowledge of the homegarden farmers about horizontal and vertical diversification. A test for diversification preferences for measuring the horizontal and vertical diversification of the homegarden using an arbitrary scale was developed. The technology gaps assessment of homegarden farmers was worked using a 'four-point ordinal scale'. A constraint index was worked out for identifying the constraints experienced by homegarden farmers. The independent variables were quantified using already existing scales or following established procedures. The data were collected by conducting personal interviews with the homegarden farmers, using well-structured and pre-tested interview schedule developed for the purpose. Percentage analysis, means and

correlation analysis were employed in the analysis of the data and interpreting the results.

The salient findings of the study are furnished below.

1. More than half of the respondents were in the old aged category.
2. More than half of the respondents were having high school education.
3. More than 80 per cent of the respondents belonged to a family size of 2-4 members.
4. More than half of the respondents were doing agriculture as primary occupation
5. About 50 per cent had less than one acre of area and 28 per cent had 1-2 acres and 23 per cent had more than 2 acres.
6. More than half of the respondents belong to low level of social participation and 51 per cent of the respondents had membership in coconut producers association followed by 40 per cent in rubber producers association and 33 per cent in other local marketing associations.
7. More than half of the respondents (62 per cent) belonged to the category of high market orientation and 38 per cent with low market orientation.
8. 43 per cent of the homegarden farmers belonged to high risk orientation category and 57 per cent of the homegarden farmers fell in low risk orientation category .
9. More than half of the respondents (54 per cent) belong to high annual homegarden income category and 46 per cent belonged to low category
10. The mass media contribution as perceived by homegarden farmers, majority of the respondents fell under high category (84 %) and 16 per cent fell under low category. Frequency of mass media contribution revealed that television ranked top in the category of ‘very often’, followed by newspaper, friends, magazine, radio, MAS and Kiosk. Usefulness of mass media contribution revealed that television ranked top in the category of ‘very useful’.
11. Majority of the respondents fell in the high category of evaluative perception with special reference to the sustainability aspects of horizontal and vertical diversification.

12. The maximum economic dominance was seen for coconut followed by banana, tapioca, pepper, vegetables ,yams and Colocasia and areca nut in the decreasing order of economic dominance.
13. The extent of horizontal diversification of the 62 per cent of the homegardens are 4 tiers or above and 38 per cent of homegardens are less than 4 tiers.
14. For each economically dominant crops the maximum vertical diversification level was three which was noticed for coconut, pepper, tapioca and areca nut, followed by 2 levels of diversification for banana and tubers (yams and Colocasia) and the least vertical diversification was noticed in vegetables with one level of vertical diversification, that is they sell produce as such. 58 per cent of the homegardens had 3 or less level of vertical diversification and 42 per cent had 3 or more level of vertical diversification.
15. Majority (60%) homegarden respondents had fairly high level of knowledge on horizontal diversification. However 40 per cent had low level of knowledge on horizontal diversification.
16. Majority (66%) of homegarden respondents had low level of knowledge on vertical diversification and only 34 per cent had fairly high level of knowledge on vertical diversification with mean as check.
17. The diversification preferences was mainly to cater the family needs which ranked top with a mean value of 6.85 followed by, for profit making, to reduce risk, for increasing shelf life, as part of culture, for sustainability and employment generation.
18. The technology needs for vertical diversification as perceived by homegarden farmers was high (67%), when compared to the technology needs for horizontal diversification (45%).
19. Technology needs assessment on selected parameters for vertical diversification of homegardens revealed that storage technologies (score 7.45) is the most needed technology followed by harvesting technologies (score 7.05),Processing technologies(score 6.95), Packaging technologies (score 4.95), waste management

technologies (score 3.65), grading technologies (score 2.45), product diversification technologies (score 1.35) and sorting technologies (score 1.15)

20. Study shows that farmers felt more constraints on vertical diversification rather than horizontal diversification. The major constraint was poor storage facilities. Therefore measures to solve farmers problem focusing more on technologies for vertical diversification should be put in place to the profitability of homegardens.

To conclude, in general, the technology needs for vertical diversification as perceived by homegarden farmers was high, when compared to the technology needs for horizontal diversification. The homegarden farmers preferred diversification mainly to cater the family needs followed by profit making, reducing risk and increasing the shelf life of the produce. When the majority (60 per cent) of the homegarden respondents had fairly high level of knowledge on horizontal diversification, 66 per cent of homegarden respondents had low level of knowledge on vertical diversification. The major constraints experienced by homegarden farmers were poor storage facilities, poor harvesting technologies, lack of knowledge on post harvest handling, lack of homegarden suited post harvest technologies and lack of varieties suited for value addition in decreasing order of importance.

5.1 SUGGESTIONS FOR FUTURE RESEARCH

1. As this study was concentrated only to the Thiruvanathapuram district of Kerala similar studies should be initiated in other parts of the state.
2. Research on identification, characterization and documentation of homegarden crop specific technologies related to vertical diversification should be undertaken.
3. Research on technology needs on vertical diversification for homegarden farming /cropping system should be given priority.

Plate.1. Conducting survey among homegarden respondents in Thiruvanathapuram district

Plate.2. Collecting data on diversification in homegarden

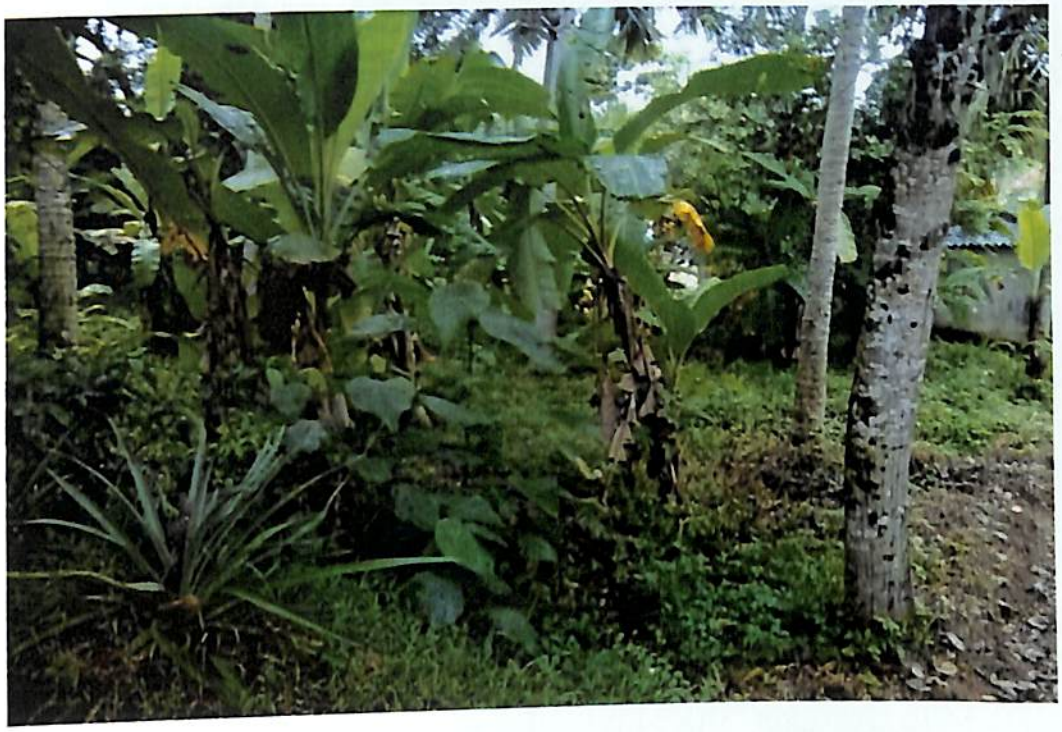

Plate.3. Horizontal diversification in homegarden

Plate.4. Horizontal diversification in homegarden

Plate.5. Vertical Diversification in homegarden

Plate.6. Vertical Diversification in homegarden

Plate.7. Vertical Diversification in homegarden

REFERENCES

REFERENCES

Abdoellah O. S., Hadikusumah H. Y., Takeuchi K., Okubo, S. and Parikesit. 2006. Commercialization of homegardens in an Indonesian village: vegetation composition and functional changes. *Agrofor. Syst.* 3:232-250

Abebe. 2005. *Diversity in homegarden agroforestry systems of southern Ethiopia*. Wageningen University, the Netherlands, Tropical Resource Management Paper No. 59, 143p.

Ahire, I. M. and Shenoy, S. 2005. Utilisation of Communication channels by Mango growers. *Res. J. Agric. and Biol. Sci.*1: 256-278.

Akinnifesi, F. K., Sileshi, G., Ajayi, O. C., Akinnifesi, A. I., de Moura, E.G., Linhares, J.F.P. and Rodrigues, I. 2010. Floristic composition and canopy structure of home-gardens in São Luís city, Maranhão State, Brazil. *J Hortic. and For.* 2(4): 72-86

Alam, M. S. and Masum, K. M. 2005. Status of homestead biodiversity in the offshore Island of Bangladesh. *Res. J. Agric. and Biol. Sci.* 1: 246-253.

Altieri, M. A. 2008. "The ecological role of biodiversity in agroecosystems." Agriculture, Ecosystems & Environment 74(1-3): 19-31.

Anantharaman, M. 1991. Managerial efficiency of cassava farmers. Ph.D. thesis, Kerala Agricultural University, Thrissur. p.265

Anonymous 2003. Review of Significant Trade *Aquilaria malaccensis*. Available at http://www.cites.org/eng/com/PC/14/E-PC14-09-02-02-A2.pdf; accessed 31 Jan 2012.

Aravind, N.,Gangadharappa, N. R., Ganeshamoorthy, S. and Ibrahim, S. 2004. Homestead agroforestry system. *LEISA*, India. 21p.

Bagson, E. and Beyuo, E,. N. 2012. Home gardening: the surviving food security strategy in the nandom traditional area - upper west region Ghana. *J. Sustainable Development in Africa*, 14 (1).

Bhalsing, R. R. 2009. Impact of irrigation on crop diversification in: Ahmed Nagar district (Maharashtra). *International Research Journal* 11 (7): 111-113

Bhaskaran, C. and Kumari Sushama, N. P. 1994. Problems of technology transfer in Kerala agriculture. Abstract of International Congress on Kerala Studies, AKG Centre for Research and Studies. Thiruvananthapuram, 82-83p.

Boster, 1985. Taxonomy of educational objectives. *The Cognition Domain.* Longman Greens and Company, New York, 97p.

Cafenica. 2013. *El Impacto de la Roya: Nuestra estrategia de Productividad y Calidad.* Matagalpa, Nicaragua: Cafenica.

Chandrabindu, K. R., Athimuthu, P. and Anamalai, R. 1995. "Constraints involved in homestead farming". *J. Ext. Edu*., 6(3): 1250-1251.

Chavan, C. R., Gohad, V. V., and Mal, R. A. 2010.Effectveness of Agricultural Programmes Perceived by Televiewing Farmers.*Agriculture Update*15(2):59-60.

Chemonics International, Inc. 2002. *LAC Bureau: Diversification options for coffee production. American J. Alternative Agriculture* 1: 30-38

Choudhary, L. M. and Mathew, M. T. 2004. Coconut industry in India: issues and perspectives. National seminar on strategies for enhancing competitiveness of coconut industry, 17 –18 July, 2004,Bangalore, Abstract: 15.

CIMMYT. 2009. Economic Program: The Adoption of Improved Agricultural Technology: A Guide for Survey Design. Mexico, D.F.

Das, P. K. 1988. Economics of coconut based farming systems. *National Symposium on Coconut Breeding and Management,10-13 February, 1988*. Kerala Agricultural University, Thrissur. pp. 42-43.

Das, T. and Das, A. K., 2005. Inventorying plant biodiversity in homegardens: A case study in Barak Valley, Assam, North East India. *Current Science* 89: 155-163.

Devi, N. L. and Das, A. K. 2010. Plant species diversity in the traditional homegardens of Meitei community: a case study from Barak Valley, Assam. *J. Trop. Agric*., 48: 45–48.

Dilrukshi, H. G., Russell, F. and Karim, M. M. 1996. Home gardens: a promising approach to enhance household food security and wellbeing. *Agric. and Food Security*, 2: 8

Dorsey, B. 1999. Agricultural intensification, diversification, and commercial production among smallholder coffee growers in central Kenya. *Econ. Geogr.,* 75(2): 178-195.

Ellis, F. 2000. The determinants of rural livelihood diversification in developing countries. *J. Agric. Econ.,* pp. 289-302.

English, H. B. and English, A. C. 1958. *A comprehensive Dictionary of Psychological and Psycho-Analytical Terms.* Longmans Green and Co., New York, 210 p

Esakkimuthu, M. 2012. Innovations in Technical Backstopping for the Thiruvananthapuram district Panchayat- a Critical Appraisal of the Samagra 130 project on Banana Cultivation. M.Sc (Ag) thesis, Kerala Agricultural University, Thrissur. p 365

FAO. Food and agriculture organization. 2004. Knowledge and Information for food security in Africa from traditional media to Internet. Communication for Development Group, Sustainable Development Department, Rome.

Fayas, A. M. 2003. Viability of self-help groups in vegetable and fruit promotion council, Keralam – A multidimensional analysis, M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 111 p.

Fernandes, E. C. M .and Nair 1986. Multipurpose trees and shrubs on farmlands in Tamil Nadu State, India. *Agroforestry Systems* 4: 17-32.

Galhena. 2013. Agriculture & Food Security. Proceedings of the Second International Home Gardens Workshop.2:8, p 12

Govind, S. 1984.Participation of farm women in farm and home activities. M.Sc.(Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, 140p.

Hanjabam, S. 2013. Analysis of constaints and strategies for scaling up precision farming in kerala M.Sc (Ag.) thesis, Kerala Agricultural University, Vellanikkara, 156p.

Haque, T. 1996. 'Small Farm Diversification: Problems and Prospects, NCAP, New Delhi.

Hedley, D. D. 1987. Diversification: Concepts and Diversification in Indonesia Agricultural Policy.In Bottema,J.W.T.,Dauphin,F. and Gijsbers, G. (eds): Soyabean Research and Development in Indonesia, CGPRT No. 10

Hoda, M. M. 1979. Concepts and models for the development of appropriate technology for rural area in Fundamental aspects of appropriate technology. Delft University Press, Sijthoft and Noordhofr, International Publication, p.55

Hoogerbrugge, I. and Fresco, L. O. 1993. Homegarden Systems: Agricultural Characteristics and Challenges. London, UK: International Institute for Environment and Development*, Gatekeeper*, 39.

Howard, P. L. 2006. Gender and social dynamics in swidden and homegardens in Latin America. In Tropical Homegardens: A Time-Tested Example of Sustainable Agroforestry. *Springer Sci.,* 23(2): 230.

Jaganathan, D. 2004. Analysis of organic farming practices in vegetable cultivation in Thiruvananthapuram district, M.Sc. (Ag) thesis, Kerala Agricultural University, Thrissur, 115p.

Jambulingam, R. and Fernandes, E. C. M. 1986. Multipurpose trees and shrubs on farmlands in Tamil Nadu State, India. *Agroforestry Systems* 4: 17-32.

Janadevan, R. 1993. An analysis of selected development programmes for promoting coconut production in Kerala. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 198 p.

Jayawardhana, J.K.J.P. 2007. Organic agricultural practices in coconut based homesteads in Thiruvananthapuram district. M.Sc (Ag.) Thesis, Kerala Agricultural University, Thrissur, 99p.

Jha, B¸N.Kumar and Mohanty. B.2000. 'Pattern of Agricultural Diversification in India', Institute of Economic Growth, Working Paper No. E/302/2009.

Jha, D. (1996). Rapporteur's report on diversification of agriculture and food security in the context of new economic policy. *Indian Journal of Agricultural Economics,* 51(4), 829-832.

Jha, P. N. and Shaktawat, G.S. 1972. Adoption behaviour of farmers towards hybrid bajra cultivation. *Indian J. Ext. Edn.,* 8: 24-31.

John, T. D. 1991. Feasibility analysis of group approach in the transfer of pepper production technology. M.Sc.(Ag.) thesis*,* Kerala Agricultural University, Thrissur, p. 185.

Joshi, P. K, Birthal, P. S., and Ashok, G. 2003. Vertical Coordination in High Value Commodities: Implications for Smallholders. Markets, Trade and institutions Division Discussion Paper no. 85.

Karma, A. S., Erwidodo, D. A Darmawan ,and E.b.OYER,1992. Agricultural diversification and Its Impact On Income Generation In Rural Areas. In proceeding of seminar and workshop on Poverty Alleviation With Sustainable Agricultural and Rural Development in Indonesia ,organized by CASER and CIIFAD, Bogor.

KAU. 2002. *Checklist of Criteria for Assessing Agricultural Technology Development- a Reader Concept and Methodology*. College of Agriculture, Padanakkad, Kerala Agricultural University, p.15-17.

Kerlinger, F. N. 1983. Foundations of Behavioural Research. Holt, Rinehart and Winston, New York, p.531.

Krishna, G. C. 2006. Home Gardening as a Household Nutrient Garden. Pokhara, Nepal: Paper presented at Home Gardens in Nepal: Proceeding of a workshop on Enhancing the contribution of home garden to on-farm management of plant genetic resources and to improve the livelihoods of Nepalese farmers: Lessons learned and policy implications.

Kumar, B. M. and Nair, P. K. R. 2004. *The enigma of tropical homegardens. Agroforestry Systems*, 61: 135 – 152.

Kumar. 2014. A Farming System Model to Leverage Agriculture for Nutritional Outcomes. Agric Res 3(3):193–203

Lad, A. S. and Wattamwar, V. T. 2009. Correlates of Participation of Farm Women in Decision Making. *Agri. Sci. Digest* 32(1): 52-54. Savitha, S. S. (2004).

Role of Rural Women in Animal Husbandry. *M.Sc. (Ag.) Thesis*, University of Agricultural Sciences, Dharwad.

Leiva J. M., Azurdia C., Ovanda W., Lopez, E. and Ayala H. 2002. Contributions of homegardens to in situ conservation in traditional farming systems – Guatemalan component. In: Watson J. W. and Eyzaguirre P. B. (eds), Homegardens and in situ conservation of plant genetic resources in farming systems. Proceedings of the Second International homegarden workshop, Witzenhausen, Germany, International Plant Genetic Resources Institute, Rome.pp 56 – 72.

Lok, R. 1998. Huertos caseros tradicionales de América Central: características, beneficios e importancia desde un enfoque multidisciplinario R. Lok (Eds), CATIE, Turrialba, Costa Rica, 7.

Lok, R. and Méndez, V. E. 1998, Huertos caseros tradicionales de América Central: características, beneficios e importancia desde un enfoque multidiciplinario, R. Lok, (Ed), CATIE, Turrialba, Costa Rica., 129.

Majjusha, A. R. 2000. Techno – Socio-economic assessment of farmer's practices in the cultivation of cowpea (*Vigna unguiculata* (L.) in Thiruvananthapuram district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 126 p

Manju, S. P. 1997. Indigenous practices in coconut farming in Thrissur district, M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 107 p.

Manjusha, J. 1999. Techno-socio-economic assessment of farming practices in the cultivation of bittergourd (Momordica charantia (L.) in Thiruvananthapuram District. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 112 p.

Manoj, S. 2000. Techno-socio-Economic Assessment of Farmer's Practices in Rice Cultivation in Thiruvananthapuram District, M.Sc. (Ag.), thesis, Kerala Agricultural University, Thrissur, 122 p.

Marsh, R., Fernandez, 1998. Building on traditional gardening to improve household food security. Food, Nutrition and Agriculture. 22: 4-14.

Mayor, Z., Shagarodsky, T., and Castiñeiras, L. 2009, Home gardens and Goodland, R. , Annual Review of Ecology and Systematic, 26, 1.

Mc Graw, H. 1982. *Mc Graw Encyclopaedia of Science and Technology.* Mc Graw Hill Book Company, New York, 502p.

Meerabai, M., Jayachandran, B. K., Salam, A. M. and Kunjamma P. Mathew, K. 1991. Cooking Fuel Productivity of Coconut Trees, *Indian Coconut J*., 22(8):

Menon, A. G. G. and Bhaskaran, C. 1988.Technology alters traditional attitudes- *Indian Farming, 28(8): 45-47.*

Miller, R. P. 2001. Extractive forest products and agroforestry on an agricultural frontier: A case study with the Parakanã tribe ã of the trans-Amazon region, Pará, Brazil. PhD dissertation. University of Florida, Gainesville, 227p.

Miller, R. P., Penn, J.J.W., and Leeuwen, J. 2006, Tropical homegardens: a timetested example of sustainable agroforestry, B.M. Kumar and Nair P.K.R., (Eds), Springer Science, Dordrecht, 43.

Muchara, B. 2009. *Impact of Zimbabwe's Fast Track Land Reform Programme on the Production and Marketing of Maize in the Smallholder Sector*. Publication Paper, University of Fort Hare, South Africa.

Muliyar, M. K., 1989. Production of coconut hybrids - present and future. In: National Symposium of Coconut Breeding and Management, Kerala Agricultural University, Vellanikkara, Thrissur, Nov.23-26.

Muthuraman, P. 1995. Towards sustainable agriculture: dimensions and components, Employment news 20: 1

Ninez, A. 1984. *Household gardens- Theoretical Considerations on an Only Survival Strategy*. International Potato Centre, Lima, p.60

NMBA, 2004. *Bamboo for the 21st Century – Translating Potential toReality*, Technology, Information, Forecasting and Assessment Council, Department of Science and Technology, New Delhi,

Ongunsumi, L.O., Ladele, A. and Agustus, E. O. 2002. Assessment of cowpea production technologies in Southwest Nigeira. J. Ext. system. 18: 111 – 115

Oxfam 2005. Diversification in agriculture: concept, rationale and approaches. Indian Journal of Agricultural Economics, 51(4).

Pandhya .L ., Trivedi. 1988. *Defining small-scale farmers in the South African context Agrekon, 37*(4).

Parvathi, S. Chandrakandan, K. and Karthikeyan, C. 1998. Measurement of knowledge of farmers on post harvest technologies. *J. tropical Agric*.39:200-202.

Petit, M. and Barghouti, S. 1992. Diversification: Challenges and opportunities. In S. Barghouti, L. Garbas, & D. Umali, *Trends in Agricultural diversification: Regional Perspectives,* pp. 1-14.

Peyre, A., Guidal, A., Wiersum, K. F. and Bongers, F. 2006. Dynamics of homegarden structure and function in Kerala, India. Agroforest Syst 66: 101 – 115.

Pingali, P. L. 2005. Agricultural diversification: opportunities and constraints. FAO Rice Conference. Rome, Italy: Food and Agricultural Organization of United Nations. 12-13. February 2004.

Pinton, F. 1985. The tropical garden as a sustainable food system: A comparison of Indians and settlers in Northern Colombia. *Food and Nutrition Bulletin* 7: 25-28p.

Rahul, K. 2013. Techno socio-economic characterization of specialized homegardens: a dominance-diversity approach. M.Sc. (Ag.) thesis. Kerala Agricultural University, Thrissur, 136p

Rajendran, P. 1992. Feasibility and utilization of agricultural technologies among scheduled caste farmers. Ph.D. thesis. Kerala Agricultural University, Thrissur, p. 272

Raju, V. T. 1982. *Impact of New Agricultural Technology on Farm Income Distribution and Employment*. National Publishing House, New Delhi, 260 p.

Ramanathan, S., Anantharaman, M. and Lakshmi, K. R. 1987. Constraints in adoption of high yielding cassava varieties. *Ind. J. Extn. Edn.* 23: 55-59

Rao, A. A. 1998. Group farming as a basis for efficient resource utilization for small and marginal farmers. *Regional workshop on group farming.* National Institute of Rural Development, Hyderabad. 55p.

Rathinasabapathi, S. 1978. A study on knowledge and extent of adoption of integrated pest management for cotton. M.Sc (Ag.). thesis, Tamil Nadu Agricultural University, Coimbatore, 155 p

Resmy, C., Shivamurthy, P. and Japre, V. 2001. Constraints in adoption of sustainable practices in coconut and banana. *Indian J. Ext. Edu.* 37(1&2): 99-101p.

Rogers, E.M. and Shoemaker, E.F. 1971. *Communication of Innovations – A Cross Cultural Approach.* The Free Press, Collier Macmillan Ltd., New York, 323 p.

Rowe, W.C. 2009. Kitchen gardens in Tajikistan: the economic and cultural importance of small-scale private property in a post-soviet society. *Hum. Ecol.*, 37(6):691–703.

Ryan, J.G., Spencer, D.C. 2001. Some challenges, trends and opportunities in agriculture. *J. Fmg. Syst*, 2: 52-57.

Saikia, P. and Khan, M.L. 2012. Agar (*Aquilaria malaccensis Lam*.): a promising crop in the homegardens of Upper Assam, northeastern India, *J. Tropi Agri* 50 (1-2): 8-14, 2012

Sairam, C.V. 1997. Estimation of cost of production of coconut under optimum management condition in North Kerala, *J. Plantation Crops* 25(2): 163-168

Sajeevchandran, A. 1989. Impact development programmes in promoting pepper products in Kerala. M.Sc (Ag.) thesis, Kerala Agricultural University, Vellanikkara, 76p.

Salam, M. A, Babu, K. S. and Sreekumar, D. 1991. *Multupurpose farming system-A model.* Kerala Agricultural University, Sadanandapuram, Kottarakara, pp. 45

Salam, M. A. and Sreekumar, D. 1990. Coconut based mixed farming system to sustain productivity. *Indian Cocon*. *J*. 20: 3-5

Samantha, R. K. 1977. Some agro-economic, socio-psychological and communication variables associated with repayment behaviour of agricultural credit users of nationalised bank. Ph.D. thesis. Bidhan Chandra Krishi Viswa Vidyalaya Kalyani, West Bengal, p.245

Santhasheela, M. 1999. “Plant Protection Behaviour of Vegetable Growers in Plains and Hills.” M.Sc. (Ag.) thesis. Coimbatore: Tamil Nadu Agricultural University.

Sasankan, V. R. 2004. Production system typology and technology utilization pattern in cassava cultivation in Thiruvananthapuram district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 97 p.

Schneider, J. 2007, Homegardens and Agrobiodiversity P. B. Eyzaguirre (Eds), (8 Pt 2): 664-72.

Selvanayagam, M. (1986). Techno-Cultural Profile of dry land farming. M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Sengupta D (2008) Bt cotton and farmer suicides in India, reviewing the evidence. IFPRIDiscussion Paper 00808. International Food Policy Institute (IFPRI).http://www.ifpri.org/publication/bt-cotton-andfarmer-suicides-india

Sharma, K. K. 2001. Agroforestry in farming systems development. *The Indian Forester* 122: 547-559

Sharma, N. K. 1996. Need for Eco-friendly Farming. *Employment news weekly*, 16p

Shehana, R. S., Kunjamma, P. M. and Girija, V. K. 1992c. Structural and functional analysis of homestead farming system in Kerala. *J. Fmg. Syst*, 2: 52-57.

Sherief, A. K. 1998. Sustainable agriculture appropriate to homestead farming in Kerala. Ph.D. thesis, Annamalai University, Annamalai Nagar, 172 p

Sindu, S. 2002. Social Cost-Benefit Analysis in Vegetable Development Programmes in Kerala Through Participatory approach. Ph.D thesis, Kerala Agricultural University,Vellanikkara,145 p.

Sivaprasad, S. 1997. Problems and prospects of self-employment of trained rural youth in agriculture. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 123 p.

Soemarwoto, O. 1986. Homegardens: a traditional agroforestry system with a promising future. In Agroforestry: A Decade of Development. Eds. Steppler H, Nair, P.K.R. Nairobi, Kenya: International Council for Research in Agroforestry.

Soemarwoto, O. and Christianity, L. 1985. Homegarden in the tropics. *Proceedings of the First International Workshop on Tropical Homegarden*, *December 2-9, 1985.* Institute of Ecology, Padjadjaran University, Bandung, p. 160

Soemarwoto, O., Soemarwoto, I., Karyono, Soekartadireja, E. M, Ramlan A. 1985. The Javanese home garden as an integrated agroecosystem. *Food Nutr. Bull.* 7(3): 44–47.

Sreedaya, G. S. 2000. Performance analysis of the self help groups in vegetable production in Thiruvananthapuram district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 150 p

Start, D. 2001. Rural Diversification: What hope for the poor?' Summary Themes from Start and Johnson 2001: Transformation, Well Being and the State: Rural Livelihood Diversification in South Asia, ODI Working Paper.

Surendran, G. 2000. Participatory group approach for sustainable dvelopment of agriculture in Kerala. Ph.D thesis, Kerala Agricultural University, Vellanikkara 268p.

Suthan, L. 2003. Analysis of Farmers Participation in the Participatory Technology Development (PTD) Process vis-a-vis plant protection in vegetables at Kunnathukal Panchayat, M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 113 p

Tabora, P. C. 1992. Central America and South America's Pacific rim countries: Experience with export diversification. In Barghouti, L. Garbas, & D. Umali, *Trends in agricultural diversification: Regional perspectives,* pp. 93-106.

Talukder, A., Kiess, L., Huq, N., Pee S., Darnton-Hill, I, Bloem, M.W. 2000. Increasing the production and consumption of vitamin A–rich fruits and vegetables: lessons learned in taking the Bangladesh homestead gardening programme to a national scale. *Food Nutr. Bull*., 21(2): 165–172.Tapasi, D. and Ashesh K.D. 2005. Inventorying plant biodiversity in homegardens: A case study in Barak Valley,*Curr. sci*., 89: 1.

Thampan, P. K. 1996. Profitability of Coconut based farming systems and case studies. In : Thampan, P. K. Coconut for prosperity. Peekay Tree zcrops Development Foundation, Kochi. pp 71-125.

Thomas, A. 2000. Problems and prospects of medicinal plant cultivation in Thiruvananthapuram district, M.Sc. (Ag.), thesis, Kerala Agricultural University, Thrissur, 110 p.

Thomas, A. 1998. Problems and prospects of Medicinal plant cultivation in Thiruvananthapuram district. M.Sc.(Ag.) thesis, Kerala Agricultural University, Thrissur, p.190.

Thomas, A. 2004. Technology assessment in the homegarden systems. Ph.D. (Ag.) thesis. Kerala Agricultural University, Thrissur. 176p.

Thomas, A. 2004. Technology assessment in the homegarden systems. Ph.D. thesis. Kerala Agricultural University, Thrissur, p.230.

Thomas, P., 1998,Fisherman Development theory, thrift &credit.Indo german reservoir Fishermen Development Project, Malampuzha, Palakkad, College of Cooperation Banking & Management, Kerala Agricultural University, Vellanikkara,Thrisur,p16-2.

Timmer, S., 1990,Poverty and agricultural diversification in developing countries. Washington, DC, USA: The World Bank (Memio). p401.

Toch, H. and Maclean, M. S. 1970. Perception and communication: A transactional view. *Foundations of Communication Theory* (eds. Sereno, K. K. and Mortensen, C. D.). Harper and Row, New York. p. 285.

Torquebiau, E., and Penot, E. 2006. Tropical homegardens: a time-tested example of sustainable agroforestry, B. M. Kumar and Nair P. K. R., (Eds), Springer Science, Dordrecht, 269.

Tynsong, H. and Tiwari, K. 2010. Plant diversity in homegardens and their significance in the Livelihoods of War Khasi community of Meghalaya. North East *India J. Biodivers.* 1:1–1.

Uaiene, R. N. Arndt, C. and Masters, W. A. 2009. Detreminants of agricultural technology adoption in Mozambique. National Directorate of Atudies and Policy Analysis. Discussion papers. No. 67 upload-00001.pdf Accessed 16.07.15

Verma, H. S. and Rao, J. V. R. 1969. Impact of farmers' training programme on adoption of recommended practices. *Khadi Gramodyog* 15: 808-816.

Voeks, R. A.2007. *Are women reservoirs of traditional plant knowledge?* Gender, ethnobotany and globalization in Northeast Brazil. Singapore J. of Tropical Geography, v. 28, n. 1, p7-20.

Wickaramasinghe, A. 1995. Do homegardens vary in spatial arrangements? *Sri Lankan J. Agric. Sci.* 32: 89-113.

Wiersum, K. F.,Dorsy,S.,Rao. 1982. Tree gardening and taungya in Java-Examples of agroforestry techniques in the humid tropics. *Agroforestry Syst.* 1: 53-70.

Yao, S., 2004. "Comparative Advantages and Crop Diversification: A Policy Analysis Matrix for Thai Agriculture", *Journal of Agricultural Economics* 48(2): 211-222.

Zaman, S., Siddiquee, S. U. and Katoh. M. 2010. Structure and Diversity of Homegarden Agroforestry in Thakurgaon District, Bangladesh. *The Open Forest Science Journal*, 2010, 3, 38-44.

APPENDICES

APPENDIX I

KERALA AGRICULTURAL UNIVERSITY

College of Agriculture, Vellayani, Thiruvananthapuram. 695 522

DEPARTMENT OF AGRICULTURAL EXTENSION

Dr. R. Prakash

Professor and Chairman

Date: 18-09-2014.

Sir,

Greetings.

Sir/Madam,

Ms. Iby Sebastian (Ad. No. 2013-11-200), one of the M.Sc. Scholar, Department of Agricultural Extension, College of Agriculture, Vellayani is undertaking a research study entitled "**TECHNOLOGY NEED ASSESSMENT ON HORIZONTAL AND VERTICAL DIVERSIFICATIONS FOR THE ECONOMICALLY DOMINANT CROPS IN HOMEGARDENS**" as part of her PG research work.

After extensive review of the available literature and discussion with extension scientist's and other experts, variables supposed to have close association with the study have been identified.

Considering your vast experience and professional expertise you have been selected as a judge to rate the relevancy of the variables. I request you to kindly spare some of your valuable time for examining the questionnaire critically. Kindly return the list duly filled at the earliest.

Thanking you.

Yours sincerely

Dr. R. Prakash

OPERATIONAL DEFINITION AND OBJECTIVES OF THE STUDY

In this study horizontal and vertical diversification in homegarden is operationally defined as the addition of new crops to existing system and value addition process of the produce, at homegarden level and marketing.

The overriding objective of the study is to determine the technology needs of horizontal and vertical diversifications for the economically dominant crops in the homegardens. The study also aimed to identify the diversification preferences and knowledge level on both horizontal and vertical diversifications within each homegardens. Constraints experienced by farmers in the process of these diversifications in the homegardens was delineated, categorized and documented.

Please rate the independent variables to be included in the study based on its relevancy from the most relevant to the least relevant by ticking against each variable under the respective rating scale.

Sl. No.	Independent variables	Relevancy rating				
		Most R	More R	R	Less R	Least R
1	**Age**- number of years completed by the respondent at the time of investigation					
2	**Education**- extent of non-formal or formal learning possessed by the homegarden respondent					
3	**Occupation**- the main vocation and other additional vocations that the respondents were possessing at the time of interview					
4	**Family size**- number of members of either sex living in a household/family dependent on the head of the family					
5	**Mass media Contribution**- degree of contribution of different mass media sources to the homegarden farmers to avail information on horizontal and					

	verticaldiversification in homegardens.					
6	**Homegarden farming Experience**- total years of experience in farming					
7	**Literacy**- The degree to which respondents could read and write					
8	**Irrigation potential**- extent to which irrigation water was available in the holding and the extent of area irrigated. (in terms of physical water scarcity, economic water scarcity and little or no water scarcity)					
9	**Availability of homegarden inputs**- The extent of availability of homegarden suited inputs.					
10	**Effective homegarden area**- The actual area of homegardens inclusive of the home area in hectare(s).					
11	**Economic motivation**- degree of awareness on incentives (subsidy etc.,) available for home gardens and specialised components in it.					
12	**Market orientation**- degree to which a farmer is oriented towards the market in terms of the profit from his homegarden / specialised components and marketing channels					
13	**Extension participation**- homegarden farmers gain a lot of information especially on specialised components by participating in extension programmes organized by developmental agencies and input dealers which would help them in implementing profitable technologies in their homegarden					
14	**Extension contribution-** extent of contribution of technology for the specialised components in					

	homegardens as perceived by the farmers					
15	**Innovativeness**- extent of innovativeness in the homegarden components (with special reference to the specialisation in homegardens).					
16	**Social participation**- Extent of participation of the homegarden farmer with social and public organisations especially related to agriculture.					
17	**Labour utilisation**- extent of utilisation of family labour and hired labours for homegarden activities.					
18	**Scientific orientation**- extent of awareness/ knowledge of a homegarden respondent in relation to the different scientific recommend ations of the specialised enterprise in the homegarden					
19	**Credit availability** – the degree to which respondents are accessible to various credit sources					
20	**Livestock possession** – the degree to which respondents posses livestock .					
21	**Risk orientation**- degree of uncertainty involved with the incorporation of specialised components in homegarden					
22	**Annual homegarden income**- total annual earnings from farm activities in the homegarden.					
23	**Knowledge on scientific practices in homegarden farming**-Knowledge on horizontal and vertical diversification in homegarden farming					

24	**Evaluative perception on the sustainability of horizontal and vertical diversification in homegardens**- respondent's meaningful sensation about the worth and efficiency of horizontal and vertical diversification in homegarden in terms of environment, quality of life-food, nutritional, medicare and aesthetic aspects, resource/technology utilisation and economic aspects.					
25	Others, if any: Please specify					

R-relevant

Thanking you

Name and Designation

APPENDIX II

TECHNOLOGY NEED ASSESSMENT ON HORIZONTAL AND VERTICAL DIVERSIFICATIONS FOR THE ECONOMICALLY DOMINANT CROPS IN HOMEGARDENS

Code:

Date:

Interview Schedule

1. District: 2. Taluk: 3. Village: 4.Phone number:

5. Address:

6.(a) Total area of homegarden (in ha): 6. (b)Infrastructural holding area:

7. Effective homegarden area:

a) Type: Irrigated/ Rainfed/ Gardenland

b) Topography: Level/ Undulating/Gentle slope/Steep

8. Family structure and characteristic

Sl. No	Name	R/n with head	Sex	Age	Caste	Education	Occupation/Employment			
							p	Income/year	S	Income/year

8. Social participation

Mark response to membership and extend of social participation

a).Membership

Association	(✔/ X)
SHG	
Harithasangam	
Rubber producers society	
Coconut producers society	
NGO	
MILMA	
Other local marketing association	

b).Extend of social participation

If you are a member how frequently do you attend its meeting and other activities :

Very often/Often/Not often

9. Risk orientation

Whether the respondent agrees with the following statements?

Sl no:	Statements	Agree	Disagree
1	A farmer should take more chance in making big profit than to be content with a smaller but a less risky profit		
2	A farmer who is willing to take greater risk than the average farmer usually does better financially		
3	It is good for a farmer to take risk when he knows his chance of success is fairly high		
4	Trying entirely a new method in farming by a farmer involves risk but it is worth it		

10. Market orientation

Whether the respondent agrees with the following statements?

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

11. Mass media

Mark response to frequency and perceived usefulness of mass media

a) Frequency to mass media

Sl no:	Sources	Very often	Often	Not often
1	Television			
2	Newspaper			
3	Magazine			
4	Friends			
5	MAS			
6	Radio			
7	Kiosk			

b) **Perceived usefulness**

Sl no:	Sources	Very useful	Useful	Not useful
1	Television			
2	Newspaper			
3	Magazine			
4	Friends			
5	MAS			
6	Radio			
7	Kiosk			

12 . Crop components

a) Details of crop components

Type of canopy arrangement ; - (multi tier :- 6 tier,5 tier,4 tier,3 tier,2 tier,1 tier)

Whether the homegarden structure is planned/unplanned?

If planned,since when it has been planned?

If planned or unplanned it's observable structure and rationale behind the same

Sl No:	Crop/species	No: of species/area

13 . Horizontal diversification in homegardens and its technology needs.

Make response (tick) by choosing one statement

Sl No:	Statements	
1	Technology Not Available (Most Needed)	
2	Technology available but not applicable	

3	Technology available but not sustainable	
4	Technology available,applicable and sustainable	

14. Vertical diversification in homegardens and its technology needs.
a). Make response (tick) by choosing one statement

Sl No:	Statements	
1	Technology Not Available (Most Needed)	
2	Technology available but not applicable	
3	Technology available but not sustainable	
4	Technology available,applicable and sustainable	

b). Extend of vertical diversification

Crop	Levels	Total levels

c). Technology needs on vertical diversification based on ranking

Category	Rank
Harvesting	
Sorting	
Grading	
Storing	
Product Diversification	
Packaging	
Processing	
Waste Management	

15. Sustainability on vertical and horizontal diversification of homegardens

Indicate the extent of evaluative perception on sustainability of production practices in homegardens

Sl. No.	Statements	Evaluative perception			
		VM	M	L	VL
1	Homegarden provides for year round income				
2	Homegarden ensures highest returns per year				
3	Homegarden helps to get the farmer engaged in farm throughout the year				
4	Homegarden ensures more family input				
5	Homegarden help to reduce cost of cultivation				
6	Multi-tier cropping helps to exploit resources effectively				
7	Integrated farming practices make homestead an economically viable unit				
8	Structural and functional diversity of the component in a homegarden provides for multiple demands of the family				
9	Horizontal and Vertical Diversification ensure reasonable income through the sale of surplus so as to purchase unproductive article in the farm				
10	Horizontal and Vertical Diversification provides for risk reducing practices				
11	Livestock components in a homegarden helps to improve the quality of agricultural produce				
12	Horizontal and Vertical Diversification ensures better resource management				
13	Horizontal diversification increases resilience to pests, diseases, weeds and aberrant weather				
14	Vertical diversification increase household food security and nutrition.				
15	Horizontal diversification improves soil fertility compared to monocropping				

16	Horizontal and vertical diversification help to withstand in price fluctuations				

VM: VERY MUCH M: MUCH L: LESS VL: VERY LESS

16. Knowledge on horizontal diversification

Sl no:	Statements	Yes	No
1	Palms in age group of 8-25 yrs are not suitable for intercropping / mixed cropping		
2	Greater yam and Elephant foot yam are best to intercropped with Nendran banana		
3	Njalipoovan,Robusta,BRS-1 and BRS-2 are best suited for intercropping in coconut garden		
4	Cucumber and Amaranth can be cultivated in banana raised during sept-oct.		
5	Banana as intercrop reduces pepper yield beyond after 4 yrs of planting		
6	Vellayani Samrudhi a chilly variety is suitable for intercropping		
7	Cowpea can be cultivated as Floor crop in coconut garden		
8	Cowpea can be Intercropped in tapioca during May-Sept		
9	Pepper can be intercropped with ginger/turmeric/colocasia/amorphophallus		
10	Amorphophallus can be intercropped with other crops		

17. Knowledge on vertical diversification

Sl no:	Statements	Yes	No
1	Virgin coconut oil is a value added oil from coconut		
2	After making copra , coconut cake can be used as cattle feed		
3	Banana powder is a good baby food		
4	Banana chips/jam/powder are value added products of banana		
5	White pepper is a value added product of pepper		
6	Starch can be extracted from tapioca		
7	Tapioca flour is a value added product		

8	Cassava leaf can be used for preparation of biopesticide		
9	Chilly sauce is a value added product of chilly		
10	Amorphophallus chips/pickle are value added products of amorphophallus		

18. Diversification preference

Rank based on preference

Category	Rank
1.For family needs	
2.For profit making	
3.To reduce risk	
4.For sustainability	
5.As part of culture	
6.For increasing shelf life	
7.Employment generation	

19. Constraint analysis

Constraints and solutions as perceived by the farmers in homegardens in the order of importance

Sl. No.	Constraints	MI	I	LI	Li	NI	Perceived solutions
1	Lack of proper knowledge						
2	Prohibitive cost of inputs						
3	Non availability of labour						
4	High labour cost						
5	Inadequacy of capital						
6	low price of produce						
7	Uneconomic holding						
8	Lack of technology						
9	Scarcity of quality irrigation water						
10	Non availability of credit						
11	poor storage facilities						
12	Interrupted power supply						
13	Lack of knowledge on post harvest handling						
14	Non availability of implements						
15	Lack of processing implements						
16	Lack of post harvest implements						
17	poor transportation facilities						
18	Lack of extension services and assistance						
19	Non availability of supply and service						
20	Lack of time in home garden activities						
21	lack of motivational factors						

22	Poor economic status						
23	Lack of markets for products of home gardens						
24	Surplus but insufficient for marketing						
25	Trade unionism						
26	Crop damage due to animal attack						

Other constraints

ABSTRACT

TECHNOLOGY NEED ASSESSMENT ON HORIZONTAL AND VERTICAL DIVERSIFICATIONS FOR THE ECONOMICALLY DOMINANT CROPS IN HOMEGARDENS

by

IBY SEBASTIAN

(2013-11-200)

ABSTRACT

of the thesis submitted in the partial fulfillment of the

requirements for the degree of

MASTER OF SCIENCE IN AGRICULTURE

Faculty of Agriculture

Kerala Agricultural University

DEPARTMENT OF AGRICULTURAL EXTENSION
COLLEGE OF AGRICULTURE
VELLAYANI, THIRUVANANTHAPURAM - 695 522
KERALA, INDIA

2015

ABSTRACT

This study entitled 'Technology need assessment on horizontal and vertical diversifications for the economically dominant crops in homegardens' was conducted at Thiruvanathapuram district comprising 5 agro ecological units covering 100 respondents with 20 each from each agro ecological units. The objective of the study was to determine the technology needs of horizontal and vertical diversifications for the economically dominant crops in the homegardens. The study also aimed to identify the diversification preferences and knowledge level on both horizontal and vertical diversifications within each homegardens. Constraints experienced by farmers in the process of these diversifications in the homegardens was delineated, categorized and documented.

The maximum economic dominance was noticed for coconut followed by banana, tapioca, pepper, vegetables, yams and colocasia and areca nut in the decreasing order of economic dominance.

The personal characteristics of the homegarden respondents which constituted the independent variables selected for the study were age, education, occupation, family size, annual income from homegarden, effective homegarden area, social participation, market orientation, risk orientation, mass media contribution and evaluative perception of homegarden respondent farmers in relation to sustainability of the homegardens with reference to horizontal and vertical diversification

The technology needs of horizontal and vertical diversifications for the economically dominant crops in the homegardens revealed that extend of Horizontal diversification in 62 per cent of the homegardens are 4 tier or above and 38 per cent of homegardens are less than 4 tier. 58 per cent of the homegardens had 3 or less level of vertical diversification and 42 per cent had 3 or more level of vertical diversification. Detailed study revealed that for each economically dominant crops the maximum vertical diversification level was three which was noticed for coconut,

pepper, tapioca and arecanut, followed by 2 levels of diversification for banana and tubers (yams and Colocasia) and the least vertical diversification was noticed in vegetables with one level of vertical diversification, that is they sell produce as such.

The result of the knowledge on horizontal diversification revealed that majority (60%) homegarden respondents had fairly high level knowledge on horizontal diversification but 66% of homegarden respondents had low level of knowledge on vertical diversification and only 34 per cent had high level of knowledge on vertical diversification with mean value as check.

Results on relationship of personal and social characteristics of the respondents on the knowledge on horizontal diversification and vertical diversification revealed that effective homegarden area and mass media contribution had positive and significant relationship with knowledge on horizontal diversification. Education, risk orientation and mass media contribution had positive and significant relationship with knowledge on vertical diversification.

The result of the diversification preferences showed that respondents prefer diversification mainly to cater the family needs which ranked topped with a mean rank value of 6.85 followed by for profit making, to reduce risk and for increasing shelf life, and employment generation.

Majority of the respondents (55%) perceived less need for technologies on horizontal in case of vertical diversification 67 per cent perceived that they require more technology. Technology needs assessment as perceived by homegarden farmers revealed that maximum technology need was reported for storage facilities/technologies. The major constraints experienced by farmers were poor harvesting technologies, lack of homegarden suited post harvest technologies, lack of varieties suited for value addition, non availability of supplies and services, lack of homegarden suited post harvest implements and high labour cost.

Thus the study revealed that the technology needs for vertical diversification as perceived by homegarden farmers was high, when compared to the technology needs for horizontal diversification. The homegarden farmers preferred diversification mainly to cater the family needs followed by profit making, reducing risk and increasing the shelf life of the produce. When the majority (60 per cent) of the homegarden respondents had fairly high level of knowledge on horizontal diversification, 66 per cent of homegarden respondents had low level of knowledge on vertical diversification. The major constraints experienced by homegarden farmers were poor storage facilities, poor harvesting technologies, lack of knowledge on post harvest handling, lack of homegarden suited post harvest technologies and lack of varieties suited for value addition in decreasing order of importance.