EXPLORATORY ANALYSIS OF INTEGRATED FARMING SYSTEMS OF KERALA

THESIS SUBMITTED TO THE

ICAR-NATIONAL DAIRY RESEARCH INSTITUTE, KARNAL

(DEEMED UNIVERSITY)

IN PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE AWARD OF THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

AGRICULTURAL EXTENSION EDUCATION

BY

VANI CHANDRAN
M.Sc. (Agricultural Extension)

DAIRY EXTENSION DIVISION

ICAR-NATIONAL DAIRY RESEARCH INSTITUTE

(DEEMED UNIVERSITY)

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This is to certify that the thesis entitled, **"EXPLORATORY ANALYSIS OF INTEGRATED FARMING SYSTEMS OF KERALA"** submitted by **Ms. VANI CHANDRAN** in partial fulfilment of the requirement for award of the degree of **DOCTOR OF PHILOSOPHY IN AGRICULTURAL EXTENSION EDUCATION** of the **ICAR-National Dairy Research Institute (Deemed University)**, Karnal (Haryana), India, is a bonafide research work carried out under my supervision and guidance, and no part of the thesis has been submitted for any other degree or diploma.

Dated : 26/08/2022

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Date: 26/08/2022 **(Vani Chandran)**

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LIST OF ABBREVIATIONS

AEU	:	Agro Ecological Unit
ATMA	:	Agriculture Technology Management Agency
D + C	:	Dairy + Crop
D + C +Ap	:	Dairy + Crop + Apiary
D + C +F	:	Dairy + Crop + Fisheries
D + C +P	:	Dairy + Crop + Poultry
D + C + F+ P	:	Dairy + Crop + Fisheries +Poultry
D + C + Ap + P	:	Dairy + Crop +Apiary + Poultry
D + C + Ap + F	:	Dairy + Crop + Apiary + Fisheries
D + C + Ap + F +P	:	Dairy + Crop + Apiary + Fisheries + Poultry
Fig.	:	Figure
GOI	:	Government of India
Ha	:	Hectare
ICAR	:	Indian Council of Agricultural Research
IFS	:	Integrated Farming System
IFSRS	:	Integrated Farming System Research Station
KAU	:	Kerala Agricultural University
KSPDC	:	Kerala State Poultry Development Cooperation
KUFOS	:	Kerala University of Fisheries and Ocean Studies
KVASU	:	Kerala Veterinary and Animal Sciences University
KVK	:	Krishi Vigyan Kendra
LEADS	:	LEAD Farmer Centered Advisory Delivery and Services
MILMA	:	Kerala Co-operative Milk Marketing Federation Ltd
MGNREGS	:	Mahatma Gandhi National Rural Employment Guarantee Scheme
MS-Excel	:	Micro Soft Excel
n	:	Selected Sample Size
PCA	:	Principal Component Analysis
PRA	:	Participatory Rural Appraisal
SAU	:	State Agricultural University
VFPCK	:	Vegetable and Fruit Promotion Council Keralam

EXPLORATORY ANALYSIS OF INTEGRATED FARMING SYSTEMS OF KERALA

ABSTRACT

The present study was conducted in Kerala. Three districts were selected randomly each from Southern, Central and Northern Kerala. The respondent groups of the study were comprised of Farmers and Extension Personnel. The total sample size was 240, among that 180 were IFS farmers and 60 were officials. Data were collected through a well structured interview schedule. The collected data were analyzed by using appropriate statistical tools in order to draw meaningful conclusions. Most of the IFS farmers in Kerala belonged to old aged category and had completed education up to higher secondary. The primary occupation of the majority of the respondents were farming only and they were marginal farmers with small family size and herd size. Most of the farmers had medium level experience in IFS activities and had high mass media exposure with medium extension agency contact and extension participation. In the study area, nine IFS components were identified. Component analysis in terms of extent of adoption, integration of practices and contribution to household income revealed that, extent of adoption of identified components and contribution to annual household income varied from low to medium whereas extent of integration of available components varied from medium to low. Based on various combinations, eight different dairy based IFS systems were identified and dairy and crop were the dominant component in all systems both in terms of adoption as well as integration. The findings also pointed out that for establishing and maintaining various components in a unit, farmers were experiencing different technological needs and constraints. IFS farmers perceived the need for value addition technologies more than production technologies. In general, they preferred socially accepted low cost technologies with high income generation capacity, efficiency, flexibility, easy accessibility and permitting sustainable and maximum utilization of local resources. Lack of remunerative prices for farm produces and high cost of production were the top ranked constraints experienced by the farmers. Majority of the IFS farmers had a neutral to favourable attitude towards IFS. IFS offers multiple sources of income and guarantees supply of balanced and nutritious food to families which were the most important factors that influenced the attitude. The findings highlight the need for revamping of the existing policies, schemes, programs, to support institutional strengthening and capacity building of the farmers. This will help the farmers to expand their existing units by adding more components and technologies to their units. Further, this would overcome many constraints faced, thereby improving the productivity and profitability.

केरल की एकीकृत कृषि प्रणालियों का अन्वेषणात्मक विश्लेषण

सारांश

वर्तमान अध्ययन केरल में आयोजित किया गया था। दक्षिणी, मध्य और उत्तरी केरल से तीन-तीन जिलों को यादृच्छिक रूप से चुना गया था । अध्ययन के प्रतिवादी समूहों में किसान और विस्तार कार्मिक शामिल थे। कुल नमूना आकार 240 था, जिसमें 180 आईएफएस किसान थे और 60 अधिकारी थे । एक अच्छी तरह से संरचित साक्षात्कार अनुसूची के माध्यम से डेटा एकत्र किया गया था । सार्थक निष्कर्ष निकालने के लिए उपयुक्त सांख्यिकीय उपकरणों का उपयोग करके एकत्रित आंकड़ों का विश्लेषण किया गया था । केरल में अधिकांश आईएफएस किसान वृद्ध वर्ग के थे और उन्होंने उच्च माध्यमिक तक शिक्षा पूरी की थी । अधिकांश उत्तरदाताओं का प्राथमिक व्यवसाय केवल खेती करना था और वे छोटे परिवार के आकार और छोटे पशु समूह के आकार वाले सीमांत किसान थे । अधिकांश किसानों को आईएफएस गतिविधियों में मध्यम स्तर का अनुभव था और मध्यम विस्तार एजेंसी संपर्क और विस्तार भागीदारी के साथ उच्च जनसंपर्क माध्यम संसर्ग था। अध्ययन क्षेत्र में नौ आईएफएस घटकों की पहचान की गई । अंगीकरण की सीमा, प्रथाओं के एकीकरण और घरेलू आय में योगदान के संदर्भ में घटक विश्लेषण से पता चला कि, पहचाने गए घटकों को अपनाने की सीमा और वार्षिक घरेलू आय में योगदान निम्न से मध्यम तक भिन्न था जबकि उपलब्ध घटकों के एकीकरण की सीमा मध्यम से निम्न तक भिन्न थी। विभिन्न संयोजनों के आधार पर आठ अलग-अलग डेयरी आधारित आईएफएस प्रणालियों की पहचान की गई और अभिग्रहण के साथ-साथ एकीकरण दोनों के मामले में डेयरी और फसल सभी प्रणालियों में प्रमुख घटक थे । निष्कर्षों ने यह भी बताया कि एक इकाई में विभिन्न घटकों को स्थापित करने और बनाए रखने के लिए, किसानों को विभिन्न तकनीकी आवश्यकताओं और बाधाओं का सामना करना पड़ रहा था । आईएफएस किसानों ने उत्पादन प्रौद्योगिकियों की तुलना में मूल्यवर्धन प्रौद्योगिकियों की आवश्यकता को अधिक महसूस किया । सामान्य तौर पर, उन्होंने उच्च आय सृजन क्षमता, दक्षता, लचीलेपन, आसान पहुंच के साथ सामाजिक रूप से स्वीकृत कम लागत वाली प्रौद्योगिकियों को प्राथमिकता दी और स्थानीय संसाधनों के स्थायी और अधिकतम उपयोग की अनुमति दी । कृषि उत्पादों के लिए लाभकारी कीमतों की कमी और उत्पादन की उच्च लागत किसानों द्वारा अनुभव की जाने वाली शीर्ष श्रेणी की बाधाएं थीं । आईएफएस के अधिकांश किसानों का आईएफएस के प्रति तटस्थ से अनुकूल रवैया था । आईएफएस आय के कई स्रोत प्रदान करता है और परिवारों को संतुलित और पौष्टिक भोजन की आपूर्ति की गारंटी देता है जो कि दृष्टिकोण को प्रभावित करने वाले सबसे महत्वपूर्ण कारक थे । निष्कर्ष किसानों की संस्थागत मजबूती और क्षमता निर्माण का समर्थन करने के लिए मौजूदा नीतियों, योजनाओं, कार्यक्रमों में सुधार की आवश्यकता पर प्रकाश डालते हैं । इससे किसानों को अपनी इकाइयों में अधिक घटकों और प्रौद्योगिकियों को जोड़कर अपनी मौजूदा इकाइयों का विस्तार करने में मदद मिलेगी । इसके अलावा, यह कई बाधाओं को दूर करेगा, जिससे उत्पादकता और लाभप्रदता में सुधार होगा ।

CHAPTER –1

Introduction

INTRODUCTION

Kerala is known for its richness of and biodiversity. The varied agro ecosystems have enabled Kerala to host large number of crops and allied enterprises. However, unfortunately, the conventional agricultural systems are currently facing tremendous pressure in terms of new agrarian structure, land reforms and increasing impacts of climate change. This has adversely affected the food security and generic resource base of the state compelling the households to increase their dependence on markets for their everyday needs. This scenario points towards an urgent need for a planned policy framework and development in the agriculture sector to meet the nutritional requirements of the state. Farmers in Kerala are either marginal and small or even landless with fragmented land holdings. Attaining self-sufficiency in food production in this peculiar condition is indeed a challenge and it can be achieved only through a noble, sustainable approach and Integrated Farming Systems (IFS) shows a way forward. IFS is broadly defined as a system comprising of several mutually cohesive and complementary agro based enterprises. Along with the benefits of sustainability and livelihood security, IFS also helps to mitigate the risks associated with mono cropping system by integrating livestock rearing and other enterprises which have a stable market. Livestock is a vital aspect of IFS which provides income on a daily/weekly basis, whereas, seasonal income is also obtained through the crop components. Attaining minimum dependence on external resources and efficient recycling of farm waste are the major objectives of IFS. Therefore, Integrated Farming System is a strong bet which could help the farmer to improve the overall productivity and thereby maximizing the profitability from a unit area.

1.1. Farming Systems of Kerala

A farming system is an effective fusion of several agro-based enterprises such as crops, aquaculture, animal husbandry and so on. It ensures maximum productivity from unit area and enables to reap maximum profit, without disturbing the ecological and socio economic balance. The selection of different components in a unit is primarily based on its complementarity to each other and the ability to meet the diverse needs of the growers. Integrated Farming System Research Station (IFSRS, Karamana) functioning under Kerala Agricultural University has developed many IFS models and it has also won national recognition for its activities. These models have also been included in the State plan for popularization at the *panchayat* level. IFSRS, Karamana has developed four IFS models of 0.20 ha each, *viz.*, homestead based, coconut based, rice based and banana based, suited to marginal land holding size of Kerala. Among these, Kerala homestead gardens are the most prominent and viable IFS model in the state (Jacob, 2015).

The predominant farming systems in Kerala

- **Homestead based farming system**

Homesteads or home gardens are remarkably prevalent in Kerala and they can be considered as a feasible way of making the best utilization of available land in the state where the average size of holdings is very modest. The homesteads can be best utilized for various agricultural activities as they are known to give higher yields per unit area and it assumes great importance for conservation as well as cultivation. Thus, it is the best way to achieve nutritional as well as financial security to the farm families via the effective use of various natural resources. Based on the principle components, different types of systems like coconut based systems, rubber based systems, banana based systems, cashew based system, dairy based systems etc. can be seen in homesteads of Kerala.

- **Coconut based system**

Coconut is an important cash crop in Kerala. Farming systems based on coconut, are quite popular in Kerala. The interspace available in the coconut gardens can be best utilized for intercropping with different crops such as green manure crops, fodder crops, spices, vegetables and so on. It can be considered as a feasible alternative for making the best use of available agricultural land.

- **Rice based system**

This type of system is predominant in the low land areas of Kerala. Along with rice, some other enterprises like fisheries, poultry, livestock is added, which helps the farmers to earn more profit from their field. In Pokkali and Kuttanad areas, different rice based models are also being implemented successfully in order to boost the profits of marginal and small rice farmers in Kerala.

1.2. Background of the study

Kerala is a part of Western Ghats and it is characterized by the occurrence of diversified ecosystems, capable of supporting various types of agriculture and allied activities, even though the economic situation of the state has been confronted with numerous hurdles in past years. Kerala is highly prone to various natural disasters like cyclones, drought, flood and landslides. Cyclone Ockhi in 2017 and severe floods during 2018 and 2019 are the recent examples. The unexpected crisis due to Covid - 19 pandemic has also hit the State very hard. The financial recession in the Gulf countries also made a negative impact on Kerala's economy, as many emigrant employees returned (Anon., 2020).

The agricultural sector in Kerala has undergone significant structural changes in the form of decline in share of Gross State Domestic Product indicating a shift from the agrarian economy (Anon., 2017a). The natural disasters that hit the State in the form of floods and landslide wreaked havoc, affecting agricultural sector the most. Crops were most heavily affected (88% of the total loss). The growth in agriculture and allied sector has plummeted from 1.7 per cent in 2017-18 to 0.5 per cent in 2018-19 (Anon., 2020). Therefore, the aim of Govt. is to leverage different domains like agriculture, animal husbandry, tourism, transportation etc in order to attain a ten per cent rate of growth (Anon., 2017a).

Recent trends in land use pattern

Kerala has witnessed major changes in its land use pattern over the years. The population density of the state is relatively high, yet average size of holding is very modest (0.02 ha - 1 ha) (Nair and Krishnankutty, 1984). A common trend seen in Kerala for the last few years is to utilize existing farmland for non-agricultural activities like urbanization. In this context, expanding net area sown is practically very difficult in Kerala.

Changes in operational holding

According to the Tenth Agriculture Census 2015-16 of Kerala, the area of the holdings in all the size classes showed a decreasing tendency during the period from 2010-11 to 2015-16. The average size of holding has declined to 0.18 hectare in 2015-16 as compared to 0.22 in 2010-11, which is quite modest when related to other states. The official figures show that 96.7 per cent of the total number of landholdings belong to marginal farmers (< 1 ha) and the area encased by these holdings accounts for 61.4 per cent of the entire collective area of holdings. The number of holdings increased (11.02%) in the marginal size class during the period from 2010-11 to 2015-16. Small, semi-medium and medium operational holdings (1.00 – 10.00 ha) in the current census were only 3.28

per cent with 31.83 per cent operated area. In 2010-11, the corresponding figures were 3.65 per cent and 33.45 per cent (Anon., 2019a).

Changes in cropping pattern

According to the statistical data, revenue of the state from agriculture sector has dipped after a consistent growth in seventies and exhibited a fluctuating trend in 1980s. This swing in agricultural income can be ascribed as the transition in land use pattern from seasonal annual crops to high-yielding perennial crops. Thus, with this transition in cropping pattern, by the end of the 1980s, the economy again gained momentum and generated higher income to the farmers. The proportion of perennial crops has grown over time. As a result, the latest data shows that, in 2018 – 19 the percent of area under food crops such as rice, pulses, tuber crops in Kerala is reduced to 10.15 per cent of total cultivated area where as the cash crops like coffee, tea, cashew, spices, rubber, coconut etc. accounts for more than half of the total cultivated area (62.1 %) (Anon., 2020).

Thus, Kerala remains a food deficit region and the gap between the requirement and internal production of food crops is on the increase year after year. Achieving self sufficiency in production is vital at this time, as excessive amounts of chemicals have been reported in commodities imported from other states, posing a health risk to humans. (Balakrishnan, 2015). In this peculiar context of limited cultivable area, integrated farming is a best alternative available to farmers seeking to improve overall production and profitability in a sustainable way. IFS meets the criteria for long term application by being efficient, environmentally sound, sustainable, financially feasible and socially desirable.

Apart from land scarcity, considerable production risk is also noticed in Kerala, as climate change related difficulties have intensified along with fluctuating price for the commodities. The increased incidence of pest and diseases and degradation of soil health also resulted in continuous crop failure. Recently occurred flood has also added to the problem. In this context, IFS offers some hope. An IFS unit composed of different enterprises which are complementary to other and aid in the effective utilization of land, other available resources and farm waste. It ensures maximum productivity from unit area which leads to high profitability and standard of living.

1.3. Justification of the study

IFS have been shown to be an important way to improve the intake of safe and micro nutrient rich foods, particularly for households. An integration of multiple components in a unit area can help to meet the nutritional requirement of the farm family. Based on the differences in components present in a unit, several IFS models can be seen in Kerala. Even though these systems are made up of integration of various components, which are complementary to each other, in terms of adoption and profitability of various crops and components, area wise variations can be noted among each unit, so no common model can be suitable for all the conditions. This focuses on the need for location specific designs of IFS model.

An IFS unit is said to be ideal, only when the integration of all the selected components are effectively balanced. If the components are not supporting or compactable to one another, that system will not succeed. That means optimization of individual components in an IFS is also very important for increasing the overall productivity. So, the primary attention should be given to the effective integration of various elements in a unit, as far as concerned with recycling wastes and maintaining soil health and production. The disparity that exists between ideal and actual condition can be bridged by choosing the best combination of components and ensuring maximum usage of existing resources. Further, while selecting and maintaining different components, it must be ensured that the interactions among them are as compatible as possible with minimum competition. Hence, for designing an IFS unit in a profitable and sustainable way, analysis of the available components is a prerequisite. Understanding the interconnections and dependences among existing components, will aid in the development of a unit, as it gives a clear idea about how the output from one component is more productively utilised as an input in another.

Keeping this in view, a thorough analysis should be carried out among the existing Integrated Farming System units to identify the extent of adoption and integration of various components, their contribution to annual household income and to understand the technological needs for improving the productivity and profitability which will be helpful for the designing and improvement of the existing IFS units. It will explore the possibilities for developing new models and examine whether existing models could be scaled up. This further reflects into the structural and functional dynamics of IFS which enables the research and extension systems to set or modify their priorities and select proper and specific delivery mechanisms.

Although the numbers of farmers who adopt IFS are increasing, it still represents only a meagre portion of the whole farming population. Hence, there is a need to understand the attitude of farmers towards IFS for implementing new policies in order to increase the acceptance among farmers. Efforts need to be made to ensure that the technologies meant for the cultivation practices get disseminated at large scale throughout the length and breadth of the State leading to high rate of adoption of these technologies for eradicating adoption gap, if existing. In the changing socio - techno and climatic conditions, more focus should be given to development of compatible technologies. For that, analyzing the existing technological needs and institutional framework for disseminating these technologies is essential.

The study will also provide information about the constraints faced by the farmers and the extension gaps that exist in the study area. It would help the extension workers to take measures for mitigating the constraints and strengthening the extension support to farmers. Thus, the findings of the study could act as a stimulant to bring changes in the existing integrated farming units in a sustainable way, by ensuring maximum utilization of resources and assuring nutritional and financial security to the farm families. As impact of climate change increased, knowledge progressed and new technology developed, the existing systems should go through an evolution in order to cope up with the changing conditions for maintaining its productivity. Nowadays, the IFS concept is getting more acceptance among the people in Kerala, however in the recent times not many studies have been conducted to evaluate the performance of the existing farming systems. So there is paucity of data in this regard and it is required to conduct a detailed study on above mentioned areas that can drive Kerala's agricultural sector on the path of high growth in future.

1.4. Statement of the problem

The unique features of Kerala agriculture are homestead system of cultivation, shrinkage of area, prevalence of cash crops and dominance of marginal holders. A large percentage of Kerala's population depend for its livelihood on cash crops, mainly, coconut and rubber. Any agricultural production becomes sustainable only when it fetches due economic benefits to the farmer. According to the Situation Assessment Survey of the NSSO, the share of agricultural households within all rural households in Kerala was 27.3 per cent in 2012-13 (which was the lowest among all States). Among that, 77.7 per cent of the agricultural households are in indebted condition (Anon., 2017b). Due to the prevalence of cash crops in Kerala's present farming systems, farm families in the state receive a higher income per month. During 2012 -2013, average monthly income (Rs) per agricultural household in Kerala was Rs. 11888.The corresponding figure was Rs 6426 for

India (Sudevan, 2020). But a sharp rise in cost of cultivation, lack of progress in mechanisation and high cost of living have contributed to a decline in profitability in farming. Moreover, an interesting feature existing in agricultural households in rural Kerala is the multiplicity of sources of income. Sixty one per cent of agricultural households earned a major share of their income from non-agricultural sources. This underlined that higher value of production in agriculture in the State does not convert into higher net income per household.

This implies that, most of the farmers in the state are unable to achieve a sustainable livelihood from their marginal holding with existing systems. Considering the need to increase the production of agriculture commodities by all possible means with the challenge of attaining self-sufficiency in agriculture production in Kerala's peculiar situation of limited cultivable area and predominance of cash crops can be achieved through promotion of IFS. A number of programmes have been introduced in Kerala by various formal institutions to promote IFS concept thereby enhancing the productivity and profitability of farmers. As a result of these initiatives, the number of farmers who have shifted from mono cropping system to IFS have increased to a certain extent in last few years. However, some fluctuations especially in terms of economic returns are being noticed year by year among these IFS (Anon., 2017c). As the agrarian conditions changes, the existing system should be modified in such a way that its scope expands and its focus is sharpened in accordance with newly acquired conditions. So research studies on the structural and functional diversities and various technological aspects of existing farming systems would help in formulating strategies to ensure effective and meaningful programmes for the holistic development of existing systems on a long term sustainable basis. The above mentioned facts necessitate the need to explore following questions

1) What are the various components prevalent for establishing an IFS unit in the study area? Further, to what extent those components are being utilized by the farmers and what is its contribution on household annual income?

2) What are the technological needs being perceived by the farmers and the officials for maintaining IFS?

3) What are the different constraints faced by the farmers for establishing and maintaining an IFS?

4) Whether the respondents are having positive attitude towards IFS and what are the factors influencing their attitude?

5) What could be the effective strategies for addressing the constraints and refining the existing policies for improving the productivity and financial stability from IFS unit?

In order to seek answers to the above researchable issues, the specific objectives of the present study entitled **"Exploratory Analysis of Integrated Farming Systems of Kerala"** were formulated as:

i. To study the extent of adoption of various components of the IFS and their contribution towards annual household income

ii. To assess the technological needs of the farmers and the constraints faced by them for adopting IFS

iii. To measure the attitude of farmers towards IFS

1.5. Scope of the study

The present investigation was formulated to reveal the facts about extent of adoption of available components of IFS, component wise contribution on annual income, farmer's attitude, constraints faced and technological needs among the famers. It will also suggest some measures in order to overcome the constraints in the study area and research as well as extension gap, if exists.

✓ Component analysis in terms of extent of adoption, integration of practices and its contribution towards household annual income facilitates effective integration of various enterprises and development of more income generating activities among IFS units.

✓ Technology forecasting is essential for any planning process due to the quick advancement of technology and the escalating rate of technological depreciation. Technology need refers to a probabilistic prognosis of technical advancements based on prospective features of useful equipment, systems or procedures and customer's needs. Conducting a comprehensive technological need assessment with the help of Department of Agriculture, other associated institutions and its linkages and collaboration with other organizations gave an idea about the existing systems, capacities, processes, programs, resources and needs at the organizational level as well as the individual level for planning, decision making, implementation, co-ordination, convergence and monitoring functions.

- ✓ Despite the fact that several programmes have been launched, still IFS farmers confront with numerous challenges for establishing and maintaining a unit. It is important to identify the key felt constraints by the farmers in order to expedite the adoption of IFS. Constant feedback is crucial for refining existing policies and programmes in order to bring additional advantages to IFS farmers. This study will provide details about the problems faced by the farmers. Elucidation of problems and solutions given by the farmers gave a deeper insight for the policy makers for developing better strategies in future programs and plans.
- ✓ Attitude of farmers towards any developmental activity is a priceless resource to policy makers when formulating strategies to lessen vulnerabilities of farmers. Farmers' attitudes toward IFS units have a significant impact on its upkeep. The decision to establish and maintain an IFS unit directly depends on the attitude of farmers. Therefore, by analyzing the attitude of farmers, better strategy could be formulated for increasing its adoption among the farmers.
- ✓ Identification and assessment of the needs, constraints and concerns related to effective and efficient functioning of the IFS systems helped to provide recommendations for revamping of the existing policies, schemes, programs to support institutional strengthening and capacity building of the farmers.
- ✓ The findings would give information to scientists of KAU, subject matter specialists of KVK, officials of Agriculture, Animal Husbandry and Fisheries department, Development Organizations as well as other change agencies to implement plans, policies and programs for the benefit of farmers.

1.6. Limitations of the study

Due attention has been given to make this study is as realistic and comprehensive as possible. However, it is subject to the following limitations as inherent in a single student research project:

1. Being a single student research project, it was not possible to cover large sample. So the study was restricted to three districts of Kerala, owing to the paucity of funds, time and resources.

2. The findings of the study were based on a small sample size and may not be comprehensively generalized in other districts due to variations in agro -climatic, socio economic conditions and cropping pattern.

3. The collected information was mostly reliant on the expressed responses and perception of the respondents as well as their ability to recall, as no records were retained by them. Hence, complete freedom from individual bias and prejudice cannot be claimed.

4. Even though care was taken to incorporate all the relevant variables for the study, exclusion of important variables still cannot be ruled out.

1.7. Presentation of the thesis

The thesis has been organised into five chapters. The first chapter deals with a brief ***Introduction,*** which includes background of the study, statement of problems, objectives and scope of the investigation as well as its limitation. The second chapter provides the ***Review of Literature***, which aids in better understanding of the past works and experiences, associated with the study. The third chapter, ***Research Methodology*** explains the locale of the study, sampling plan, selection of variables and their measurement, collection of data and statistical tools used for data analysis. The findings of the study along with detailed discussion in accordance with the objectives of the study are presented in the fourth chapter, *i.e.* ***Results and Discussion***. Finally, the summary of the findings and their implications are presented in the fifth chapter, the ***Summary and Conclusions.*** At the end, ***Bibliography*** section followed by ***Appendices*** are also presented.

CHAPTER –2

Review of Literature

REVIEW OF LITERATURE

Comprehensive reviewing of literature is a pre-requisite in any research process, as it provides a foundation for undertaking a scientific investigation. Literature reviewing brings forth the findings of previous and recent research works that have been conducted in different parts of the world for better understanding of selected field of investigation. It assists the researcher in becoming acquainted with available knowledge base in the field of interest and also aids in the improvement of research methodology. Keeping in view the objectives of the study, brief review of the earlier research work done has been presented under the following subheadings:

2.1.1. Extent of adoption of various components in IFS

2.1.2. Contribution of components towards annual household income

2.2.1. Technology needs assessment among IFS

2.2.2. Constraints faced by the farmers related to IFS

2.3. Attitude of farmers towards IFS

2.4. Conclusion from reviews

2.1.1. Extent of adoption of various components in IFS

Farming system refers to the collection of interconnected components which are interacting with one another in a particular environment. Hence, the selection of components influences the overall productivity of the system. Thus, the effective integration of suitable complementary components gives higher returns and ensures maximum utilization of various resources than a monocropping system. It is therefore necessary to identify the extent of utilization of various components in a farming system, for further development and improvisation of the system.

Kerala state is characterized with high density population, with size of the farm holding ranging from 0.02 to 1 ha, most commonly called as homesteads (home gardens). Thomas (2004) conducted a technology assessment in the home garden systems in four districts of Kerala. The research showed that crop + animal husbandry combination was a predominant type in home gardens from the sampled populations, where livestock and crop interaction was noticed in less than half of (44.23%) the total sampled respondents followed by (28.36 %) crop + poultry interaction of which crop + hen was the dominant type of interaction system. Hence, it was concluded that the home garden not only had primary home garden structure but also possessed through inclusion of various components. District wise analysis also showed similar results. The results revealed about the crop + livestock interaction in home gardens of all the districts. But it was different in terms of occurrence of specialized components. Aquaculture units (11.54%) followed by sericulture (5.77%) was dominating in the home gardens of Alappuzha. In Thiruvananthapuram and Kollam district floriculture and apiculture components were also noticed along with crop + dairy.

Similarly, Jacob (2015) conducted a study to analyze farmer's preferences and technological needs for various crop components in homestead based farming system. The preference of crops was worked out for 10 dimensions i.e., cost effectiveness, sustainability, family need, less management, cost of cultivation, nutrient recycling, resource utilization, soil conservation, availability of inputs and guaranteed market. Different crops were preferred by homestead farmers for varied reasons. Cost-effectiveness was the prime reason for preference of coconut, tapioca, pepper, colocasia and yam. Guaranteed market was the second best reason for preparing coconut and pepper. Family needs and availability of inputs were the major contributing factors for selecting cowpea and banana in home gardens. Addition of livestock component into the homestead system was practiced by farmers because of nutrient recycling and resource utilization followed by their contribution to sustainability. Similar studies were also reported in different part of India. Mohanty *et al.* (2010) studied integrated farming systems in Gajapati district of Orissa. In their view, the IFS models in the study area comprised of various components such as field crops (rice, ground nut, maize, pigeon pea and ragi), horticultural crops (banana and vegetables), tubers (yam and tapioca), vermicomposting and poultry.

In IFS, the integration of various components is in such a manner that the outcome of an enterprise is an input for another with high degree of complementarity effect on each other. While analyzing the IFS units in Karnataka state (Chickballapur district) the linkages existing among different enterprises or components in integrated farming systems has been emphasized by Apsara (2018). In the study area the major farm enterprises identified were sericulture, dairy, agriculture, horticulture, sheep rearing, goat farming and poultry farming. Accordingly, in majority (76.67 %) of the IFS units the linkages among agriculture, dairy, sheep and goat farming were prevalent. According to the results, the integrated farming system with the highest number of components has the highest linkages among the components. Another study was carried out in Uttar Kannada district which highlighted the importance of livestock component in IFS. The livestock component, pointed out as a crucial facet of IFS which acted as a supplementary enterprise with crop enterprise and enhanced the income level of the farmer and provided resource base like FYM to crop enterprises. The by products of agricultural crops were used as fodder for dairy animals, while the dung of dairy animals was used as manures for agriculture purposes. When this component was studied under different agro eco systems considerable variation was noticed within the number of animals possessed. From this it could be inferred that, farmers under identified farming system had assigned differential weightage to the number of dairy animals based on their farm resource position. Further, all farmers had combined this component with agriculture and horticulture components as supplementary activity by which the farmers realized additional income and ensured effective utilization of unused farm byproducts (Shruthi, 2015).

Another study was conducted in the IFS units in Central Dry zone of Karnataka by Noorain (2010) to get an idea about the economical sustainability of IFS. The prominent components identified in the study area were crop, dairy, small ruminants and poultry. He also noticed that the extent of adoption of each component shows some variation. About 49 per cent of the farmers practiced crop + dairy system followed by crop + dairy + small ruminants (13%). The extent of adoption of combinations such as; crop + dairy + poultry combination and crop + dairy + small ruminants + poultry were 2 per cent each in contrast to 34 per cent who took up various crops alone.

Sreelakshmi (2018) made an attempt to study the technology needs and risk associated with farmers who are adopting homestead based farming systems in Thiruvananthapuram district of Kerala. She worked out the dominance index to bring out empirically the dominant crops (structurally, economically and numerically) in home gardens, which will give a better understanding of the cropping system and type of home gardens. The numerical dominance for the crop component in specialized home gardens was worked out on a seven-point scale and the study revealed that the maximum numeric dominance was observed for coconut (1.89) followed by banana (1.94), rubber (2.32), tapioca (3.45), vegetables (3.67), yams and colocassia (4.22) and arecanut (4.60) respectively in order of their mean scale values. Almost 20 crops were identified as dominant ones when rated on a 7 point scale for numeric dominance of which only top 7 have been selected. The results are in line with Meerabhai *et al.* (1991), Thomas (2004) and Jacob (2015). According to them, mostly coconut based farming is being followed in the state especially coastal and mid land Kerala, where other dominant crops were more included as intercrops, thus reiterating the existing of horizontal diversification in specialized home gardens.

In 2012, a comparative analysis was conducted in the integrated farming systems in Mandya district by Swetha. The study indicated that in irrigated condition, about 35 per cent of small farmers practiced agriculture along with sericulture, while 30 per cent of them practiced agriculture and dairy. About 25 per cent of medium farmers were engaged in agriculture + poultry +sericulture + livestock followed by 20 per cent of them who practiced agriculture +dairy +sericulture. In the case of big farmers 35 per cent of them practiced, agriculture + sericulture + dairy followed by 25 per cent of them who practiced agriculture + sericulture + dairy + poultry farming + vermicomposting. In dryland situation, about 30 per cent of small farmers practiced horticulture + dairy followed by 20 per cent of them who practiced horticulture + dairy + forestry. About 30 per cent of medium farmers were engaged in horti + livestock + forestry next to that 20 per cent of them practiced horticulture + dairy + goat rearing +forestry. Among big farmers about 35 per cent of practiced agriculture + horticulture + dairy + forestry followed by 25 per cent of them who practiced horticulture +dairy +forestry.

According to Nath and Barik (2013), who analyzed the integrated farming systems in Deogarh district of Odisha for understanding the ways to increase the income of farmers, there were 13 rice based farming systems in the district. Each system was different from the other for its components. Among all the farming systems, rice + pulses farming system was the most prevalent one adopted by 18.60 per cent of farmers. Rice + pulses + livestock was the second most popular farming system (11.3%) followed by rice + pulses + oilseeds + horticulture crops + livestock and rice + livestock (9.3% each). Rice + pulses + oilseeds + horticultural crops + livestock and rice + pulses + horticulture crops (8% each); rice pulses + oil seeds (6.7%); Rice + oilseeds + livestock (5.3%); Rice + horticultural crops + livestock (4.7%); Rice + horticultural crops (4%) and Rice + oilseeds + horticultural crops (2.7%).

Rajeshwari (2013) made an attempt to investigate the economics of IFS units of Karnataka. Four different systems practiced in the study area were identified, namely crop only system (70 %), crop + livestock (43%), crop + livestock + sericulture (18%) and crops + livestock + horticulture (17%). In the case of marginal farmers, major components identified in their farming systems were crops and livestock, whereas in the fields of small and medium farmer's containing all the four components. The main components identified in the large farmer's field were crop, livestock, sericulture and vermicomposting system. Rathod *et al.* (2013) studied integrated farming systems in Wardha district of Vidarbha region of Maharashtra state. It was reported that all the farmer respondents had adopted agriculture and dairy farming system followed by vegetable cultivation (83.33%), horticulture/fruit crops (65%), forage crops (45%), vermicomposting (30.83%), goat rearing (22.50%), poultry (29.17%), sericulture and apiculture systems (18.33 % each). A similar research carried out by Kumara *et al.* (2015) in Bhadra command of Davanagere district (Karnataka) reported that almost all the farmers had adopted agriculture (100%) followed by dairy farming (83.33%), fodder crops (45%), vermicomposting (30.83%), poultry (29.17%), goat rearing (22.50%), sheep rearing (18.33 %), banana (15%) and vegetables (12.50%).

Thus, from the previous research studies, it could be concluded that different combination of crops, animals, fish, birds were identified in different model. The components and its extent of utilization varies according to agro ecological zones, interest of the farmers, economic returns etc. In majority of the identified farming systems crop + dairy component combination was a predominant type. The linkage among these components were prevalent due to high degree of complementarity effect on each other (Rathod *et al*., 2013; Noorain, 2010; Kumara *et al*., 2015; Apsara, 2018; Thomas, 2004).

2.1.2. Contribution of components towards annual household income

Integrated Farming System approach aims at reducing the cost of production by recycling of crop residues and by products within the farm itself, increasing income by growing more number of crops and including different enterprises. Moreover, it helps to create employment throughout the year from diversified enterprises which also helps to provide assured income for farmers.

Poorani *et al*. (2011) conducted a study on integrated farming systems in Palladam district of Tamil Nadu. The result showed that the integrated farming system increased the productivity, profitability and employment generation by 48, 40 and 45 per cent, respectively than the existing conventional farming system. After reviewing the farming situation in the dry land integrated farming, Mynavathi and Jayanthi (2015) also got similar results. In their opinion IFS approach was profitable and more sustainable than the conventional sole cropping system. Rahman *et al.* (2020) through his study in Purba Barddhaman District of West Bengal, identified a model with Crop+ fish + poultry farming, which had proven more remunerative **(**Benefit-Cost ratio 2.40) with an earning around Rs. 1,50,000 per annum.Tarai *et al. (*2016) conducted a research on integrated farming system for enhancing income, profitability and employment opportunities, through KVK, Kalahandi, Odisha. Results revealed that integrated farming system involving crop and non crop component are economically more viable than the traditional cropping system. The farmers who adopted integrated farming system have received high net income as compared to mono cropping.

Mohanty *et al*. (2010) reported about a successful tribal integrated farmer in Orissa who was getting enhanced productivity as well as the profitability and sustainability after adopting the IFS as compared to the conventional farming system and earned seven times higher net monetary return as compared to traditional method of farming. In 2008, Rathore and Bhatt made an attempt to find out the suitable combination of crops and livestock in an experiment in Jhum field in Peren district of Nagaland. Nearly seven different farming systems were tested. It was found that except piggery all livestock components like dairy, poultry, duckery and fishery had a significant contribution in their annual income.

Another study was conducted during 2009-2012 in villages of Barabanki and Raebareli districts of Uttar Pradesh, in the World Bank Funded National Agricultural Innovation Project of Indian Council of Agricultural Research (ICAR). Out of a total of 5250 families associated in the project, 42 families were selected for evaluation and they practiced traditional IFS or adopted Specialized IFS (SIFS) for their livelihood. The families practicing either mono cropping pattern or traditional farming were taken as control for comparison. The study pointed out that the average net return from traditional farming (control) was Rs. 96,000 whereas, in integrated farming system practicing additional ventures of rural poultry and vegetables, was Rs. 2,71,000/-. The input cost in traditional farming was more or less constant while it decreased by 25-35% in subsequent years in IFS models. Thus they concluded that SIFS model is profitable in the present scenario of decreasing landholding especially for the marginal farmers due to reduced input cost in subsequent years of initial investment (Dhama *et al.*, 2013).

For finding the contribution of total income to the livelihood of farmers who practice integrated farming system, Ponnusamy and Devi (2017) conducted a study in Tiruvallur and Thanjavur districts of Tamil Nadu. By using proportionate random sampling, they identified 150 farmers practicing dairy-based enterprise combinations from both the districts. The income from each combination was computed from the yield of the component enterprises and price realized by the sample respondents. The total income obtained from all the enterprises owned by the respondents for the past one year was computed as annual gross income of family. From the study, it was found that Crop+Dairy+Poultry+Fishery, Crop+Dairy+Poultry+ Horticulture and Crop + Dairy+ Poultry + Sheep and Goat + Horticulture systems were found to contribute a higher net income to the farm families. It was concluded that despite their small or medium holdings and small livestock holding, the farmers in study area earned a good income from such enterprises due to their intensive management, including the use of family labour. Channabasavanna *et al.* (2009) developed the profitable integrated farming system model for small and medium farmers of Tungabhadra project area of Karnataka. The total cost incurred on various components was Rs.18225 per hectare and the net return obtained from all the components was Rs. 22887 per hectare.

A study was conducted by Singh *et al*. (2012) on integrated farming systems comprising the components like crop, dairy, fishery, horticulture and apiary rearing at Modipuram and Meerut District of Uttar Pradesh. It was found that the integrated farming system approach recorded higher productivity, profitability and employment generation in the study area. Among the components, highest share of profit was obtained from dairy (48%) followed by crop (41%) then horticulture (6%), fish (3%) and apiary (2%). Among various components goat rearing was found to be the most profitable enterprise followed by vegetable cultivation. The contribution of Poultry in annual income was found to be the lowest. Ugwumba *et al.* (2010) studied integrated farming system and its effect on profitability of IFS and farm cash income in Nigeria. Data obtained were analyzed by means of gross margin and net farm income, profit function and multiple regression methods. The highest net farm income was recorded by crop –livestock – fish partial integration which is closest to the full integration of crops-livestock – fish – processing- biogas. It was also reported that the farm cash income was significantly influenced by level of farmer's education, years of experience, type of integration and cost of farm inputs.

Deshmukh *et al.* (2013) studied about the role of integrated farming system in strengthening rural livelihood in the disadvantaged area of Bidar district. The result of the study revealed that among the crops under the integrated farming system red gram and bengal gram gave high income as compared to mono cropping and also revealed that among various components intervened, production of earthworms was recorded the highest B:C ratio followed by milk yield. Ravisankar *et al.* (2007) studied integrated farming system in upland areas of Bay Islands, South Andaman. It was noted that among all the components evaluated, the highest net return was obtained from crop (81.09%) followed by livestock (14.30%), poultry (4.38%) and fish (0.38%) and employment generation was 346 man /days/ha/ year under integrated farming system. Rathod *et al.* (2013) studied IFS in Wardha district of Vidarbha region of Maharashtra state to analyse the economics of different farming systems. It was found that among all the farming systems evaluated, vermicomposting had given maximum net profit with the B:C ratio of 4.89 followed by backyard poultry (3.34), apiculture (2.82), forage crops (2.71), sericulture (2.42), agriculture (2.28), goat rearing (2.21), fruit crops (1.76), vegetable crops (1.56) and dairy farming (1.38).

The above studies indicated that IFS provides higher income compared to the conventional sole cropping system and it also generates better employment opportunities to the farmers. Integration of livestock components with a crop is suggested by various researches as it helps in improving nutritional standards and socio economic conditions of the farmers (Singh *et al*., (2012); Channabasavanna *et al.,* (2009); Rathore and Bhatt (2008); Ravisankar *et al.,* (2007)).

2.2.1. Technology needs assessment among IFS

Technology is described as an organized body of knowledge and practice, typically applied to industrial practices but can be applied to any recurring action (Mc Graw, 1982). It enables man to live more comfortably and securely by putting scientific knowledge in to direct application (Hoda, 1979). Raju (1982) defined new technology as, any new item in the farming system, including different commodities, farm operations, equipment and other services. According to Rao (1998), technology forecasting is required for any planning process due to rapid technological innovation and the increased rate of depreciation of available technologies. A technology forecast is a stochastic projection of future technical advancements in forms of beneficial machine, method or trial and customer needs.

According to Truong and Yamada (2002), farmers prefer technologies with low input but with high benefit and which ensure high productivity. Usually, farmers perceive technology as fairly good but application of technology seemingly is a problem. Altieri and Anderson (1986) revealed that for accelerating moderate to high level food production, indigenous technology should be integrated with technology development for resource poor families. To understand the way in which a technology influences the development of capacity and pliability, a thorough examination of those technologies is important (Clements *et al.,* 2011). The technology assessment as a whole can provide significant feedback to the operating system, which helps in generating technologies beneficial to the small and marginal farmers (Thomas *et al*., 2013). In the area of technology adaptation, it may entail identifying and evaluating various practises and technologies that enhance overall performance, ensure nutrition security and are adaptable to various agro-ecosystems, (Anon, 2014). In order to analyze the technological needs in an area, various dimensions are available. By following the mean relevancy score method, Rajendran (1992) identified 14 characteristics connected to technology and its viability. These were the initial cost, regularity of returns, potential for income generation, time utilisation pattern, viability, rapidity of returns, simplicity, physical compatibility, efficiency, profitability availability, suitability, social acceptability and availability of raw materials and supplies and services. Adaptability, productivity, continuity, identity and security were the five dimensions proposed by Anon., (2002) for technology assessment.

In 2004, Thomas conducted a technology assessment in the home garden systems of Kerala. By conducting focus group discussion with specialists and through pilot study, certain specifications about different technological practices were pointed out and the technology need of the respondents were calculated by examining these specifications. In order of assessing the district wise discrepancies in technological needs, Kruskal-Wallis test was used. After analyzing technology need in three districts, it was concluded that the greatest technology needs or limited technology availability were recorded in unexplored horticultural crops, which were in line with that of fruit crops (mango and jackfruit) and beverages. Rubber had the lowest technological need which was in line with that of spices. The decreasing orders of technological need for remaining crops were cashew, fruits (banana and pineapple), tuber, vegetable and coconut. Also for various categories of crops, it was seen that farmers required more technologies for processing, value addition and storage irrespective of the crop categories. In terms of technological need of the farmers, the result implies that, a drastic shift had been taken place from traditional to more scientific technologies. This might be attributed to the high socio economic conditions of homestead growers. Similar findings were also reported by Thomas and Kishorekumar (2015) and Ravikishore *et al.* (2017). Another common aspect required was market analysis and support. Crops of home gardens are mostly horticulture or cash crops, so that market intelligence, organizational support and advices were highly required. The study found that un exploited and under exploited horticultural tree crops with immense export potential exists in the home gardens. It was one of the most important areas requiring vital attention.

Jacob (2015) worked out the technology needs in the homestead based farming system in Thiruvananthapuram district of Kerala, according to various scientific production technologies, after the pilot survey done on a non sampled population. The scoring procedure used by Thomas (2004) for technology need assessment was used. Technology needs were calculated for all economically dominant crops with reference to 9 parameters. From the result, it could be inferred that the highest technology need of home garden farmers was for drainage technology followed by home garden machinery and soil amendments. The results of technology needs with special reference to the need of home garden suited implements was in line with the findings of Thomas (2004). Majority of the technology available to the farmers are for commercial crops but home garden farmers are of strong opinion that they require home garden friendly technologies as it can directly reduce the labour problems experienced and increase economic returns.

In the same year another study was conducted in the home gardens of Thiruvananthapuram district of Kerala by Sebastian (2015), in order to find out the technological needs in horizontal and vertical diversifications. Technology need was assessed based on mean score. The results of technology need assessment on vertical diversification revealed that storage technology score (7.45) was the most needed technology followed by harvesting technology (7.05), processing technologies (6.95) and packaging technologies (4.95). This showcased 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 home gardens. Further the study emphasized that, 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 home garden. This also proved that the farmers felt that they needed more technologies for home garden vertical diversification than that of horizontal diversification.

Availability of irrigation facilities, transportation and market facilities, innovations in high productive seeds, agriculture equipment, modern technology, use of chemical fertilizers and hybrid seeds etc. and nonphysical factors play a crucial role in the field of agriculture. Without increasing the land area, the production of home gardens may be increased considerably by using management technology of horticulture and agroforestry under multi storied cropping system (Saqui and Ruhul, 2001). It is also important to note that once the agricultural productivity improves in a specific area due to the adoption of high yielding varieties, its producers and their community benefit socially and economically (Awotide, 2012).

Trilochan (1994) conducted a multidimensional analysis in dairy farming system in western dry region of Rajasthan. In this study an attempt was made to identify the technological gap that exists in the study area, for that an index was also developed. Technology gap identification could be considered as a first step towards technology need assessment. He identified mainly three dairy farming systems in the area *viz*; bovine, crop + bovine, crop + bovine + ovine followed by the cattle owners. It was observed that the respondents were having higher level of technological gap in high potential zone than the lower potential zone in all the three systems in breeding practices and management practices. The difference of mean technological gaps between high potential and low potential zones in case of bovine system was comparatively lesser than the difference of other two systems that is crop + bovine and crop + bovine + ovine. However, in case of health care practices, higher technology gap was noticed in lower potential zone than high potential zone. Further system wise analysis revealed the higher level of technological gap of the respondents in bovine system than crop + bovine and crop + bovine + ovine. The research provided sufficient base to project the situation of dairy in the dry land areas. As it is known fact that to improve the dairy farming conditions, it was inevitable to improve the breed of the animals, and provide them with good fodder and maintain them in good health. The study suggested that the authority should take necessary actions in order to reduce this gap. The results also pointed out that the dairy farmers in dry land area need to be educated regarding scientific breeding and health care practices and veterinary staff must extend all possible help at the doorsteps of the dairy farmers till they understand the significance of these practices.

Sahadev (2011) conducted a study in Udaipur district of Rajasthan, which dealt with the existing technological need of the farm women in relation to wheat production technology. Technological needs of farm women were studied for each of the farming operation under wheat crop, starting from field operation to storage of wheat. On this ground, it was found that respondents possessed maximum technological needs about the land preparation which were used in preparatory tillage. It was quite discouraging that respondents give second and third rank to technological needs of the importance of tillage practices and implements used. These findings are similar to the findings of Cherian *et al.* (2001), who reported that the respondents required high training needs in seed treatment, nursery management, manure application, plant protection measures & harvesting. He further noted that the respondent had low technological needs about the method of sowing with a percentage of 79.74 and ranked last in the rank in hierarchy of seed and seed practices of wheat crop.

Sreelakshmi (2018) analyzed the technology needs of specialized home gardens of Kerala. The technology needs of farmers may differ depending on the specializations that they have added in their units. In that study the technology need was assessed for each specialization viz. dominant crops, animal husbandry components, aquaculture and other specializations separately. The scores assigned being in ordinal scale, the non-parametric test of analysis of variance (chi-square test) was administered to assess the need disparities. The data subjected to chi square test revealed that ($\chi2=0.284$) home garden respondents were having adequate availability of technology towards the production aspects in dominant crops. The chi square test revealed that ($\chi2=0.594$) home garden respondents possess necessary technology related to protection process. This was because of the "safe to eat food" concept has taken away the minds of farmers to draw attention towards the protection related aspects. The result was in conformity to the findings of Sujitha (2015) who stated that adoption of technologies of farmers related to coconut based farming system was focusing on safe practices with a lean towards safe and sustainable practices. For value addition technologies majority of respondents (32%) were having adequate technology needs but availability was a major concern expressed by fifteen specialized home garden farmers. In case of dairy component, it was found that even though technology was available, it was not sustainable. The result pointed out that, in a specialized home garden farmer requires technology that is of cost effective, low input oriented and high productive in nature. It also suggested that the policy makers and implementers should focus on incentivizing the home garden farmers who would prefer to do value addition of the products derived from the crop and livestock components in the specialized home garden.

The results from the previous studies threw light in to the extent of contribution/ dissemination of technology, proved that the technology needs vary from one farmer to another. This may be due to the different managerial practices adopted by farmers, demand and supply of inputs, and other crop demands. Marginal farmers, especially those working with limited resources have reaped only far fewer benefits from the latest technologies developed in agriculture. It can be inferred that most of the farmers prefer technologies which needs low input and can provide high productivity (Truong and Yamada, 2002; Thomas, 2004; Jacob, 2015; Sreelakshmi, 2018).

2.2.2. Constraints faced by the farmers related to IFS

Agriculture depends on various factors. Whenever we try to grow food, something unforeseeable goes wrong. The farmers may face many constraints. These types of constraints are familiar to anyone who has ever tried to grow food responsibly and successfully. Constraints can be classified in to different types like production related constraints, marketing related constraints, economic constraints and so on. Apsara (2018) analyzed the production constraints faced by sample farmers practicing olericulture based farming systems, using Garrett’s ranking techniques. Based on Garrett’s score, among the production constraints, high cost of production was the major constraint felt next to that timely supply of credit, water scarcity, inadequate availability of labour, lack of adequate knowledge about IFS and limited power supply. Vegetable cultivation involves relatively higher costs when compared to field crops results in more production cost. Among the constraints related to marketing, price volatility was ranked first then lack of storage facility, transportation issues, lack of market information, and untimely payment for the produce. Singh *et al*. (2013) conducted a survey during 2010-11 in Southern Rajasthan. They reported that, 91 per cent of the farmers in Chittorgarh and Rajsamand district identified non availability of quality seed as a major constraint and lack of cross breed and exotic breed animals resulting in low productivity of animals.

About 87.5 per cent of farmers suggested the need for making available good quality planting material for horticultural crops.

Dadabhau (2014) reported that the important constraints of farmers while practicing different IFS in Backward Districts of Maharashtra were difficulty in managing nutritional insecurity and crop residue recycling, difficulty in practicing intercultural operations, competition for resources, effect of shade and defoliation on yield, long transition period, risk involvement, high initial capital investment, need for special infrastructure, polluting house and difficulty in animal care during peak agriculture season, high water requirement and damaging of crops by animals. Lightfoot (1997) proposed four important challenges prevalent in Philippines and Ghana, related to implementation of IFS. Requirement of prolonged transitional phase, that generally happens when establishing IFS, was the first one. It takes minimum 3-10 years. The second most important constraint was labour issues, followed by an absence of guaranteed land ownership rights and financial condition to establish a unit.

Thamrongwarangkul (2001) noted that while in Northeast Thailand, farmers those who lack sufficient infrastructure, were unable to cross the transitional phase very easily. Farmers need a regular income for meeting various expenditure of their family. So that during transitional period also farmers want to meet the nutritional and financial security of their family. Same results were reported on a research conducted by the Anon. (2000). In contrast, Tokrishna (1992) stated that in Thailand, the major problems felt by the progressive farmers, who wish to increase the area of their farm, were inadequate water supply, lack of marketing facilities and availability of feed for cattle.

In Kerala also some studies have been conducted in the various farming systems to get an idea about major constraints faced by the farmers. Krishnan (2013) made an attempt to study the techno socio-economic characterization of specialized home gardens in three districts of Kerala through a dominance-diversity approach. The main impediment that homestead growers confront was they usually do not get accurate payment for their products, even though it is home garden product and organic. Moreover, homesteads face some unique problems of over production for home use and lower production for selling which when combined with inadequate storage facilities, results in squandering. It also affected economic returns from the unit. These results also support the findings of Thomas (2004). Next important constraint faced by many of the home garden growers were lack of time for engaging in other activities because their unit consists of more specializations. Another key element that limits the productivity was the insufficient supply of inputs and their high price rate. Labour shortage combined with some other reasons in Kerala, led to high labour cost. The socio-political situations in terms of job ethos were also added in to these problems. Despite the fact that, family labour utilization was practised in many homegardens, the less number of family members due to nuclear family pattern could not help to overcome the labour shortage. Some cultural operations such as harvesting of tree crops, ploughing etc required trained persons, as a result, growers were pushed to hire labours from outside in high rate. The findings were supported by that of Geethakutty (1993) and Aravind *et al.* (2004).

Sreelakshmi (2018) conducted a study to assess the technology needs and risks factors associated with the specialized home gardens in Thiruvananthapuram district of Kerala. Various constraints were ranked based on the priority of the respondents. Among these, lack of timely and skill based extension service, poor harvest and lack of storage facilities, lack of marketing facilities were the primary constraints which needed immediate attention. Whereas non availability of credit, inadequate employment opportunities, lack of technology were considered to be of least important among the farmers. The lacuna of adequate extension services was reported to be a serious issue. The study also suggested that, small scale farmers should be brought into limelight and appropriate strategies should be framed for meeting their constraints. Frequent meetings and follow up could definitely improve the small scale farms or specialized home gardens to a large extent. Similarly, in case of specialized home gardens, lack of post harvest technology was adequately found and which was a major constraint with reference to vertical diversification. According to Sebastian, (2015), who has conducted a study to assess the technological need on horizontal and vertical diversifications for the economically dominant crops in home gardens of Kerala, farmers felt more constraints on vertical diversification rather than horizontal diversification. The major constraint experienced by home garden farmers was lack of availability of low cost storage facilities. In her view, there is an urgent need for implementing latest measures which emphasizes more on vertical diversification in order to increase the profitability of home gardens.

Wadear (2003) carried out a socio economic assessment study in an animal based farming system for long term sustainability in northern Karnataka. The study highlighted the significant issues encountered by respondents in the chosen areas of northern

Karnataka. Price fluctuations, a shortage of warehouse space and the occurrence of pests and diseases were cited as major difficulties under first farming system of region I. The significant limits in sunflower cultivation region II were a paucity of data regarding the supply and accessibility of seeds as well as the occurrence infections in case of Bengal gram, lack of timely supply of seeds was the major issue in both regions. In milk production, farmers faced problems of lack of bank loans, inadequate fodder area, accessibility to AI, lack of market, high price for feed etc. In sericulture based farming systems of eastern Karnataka, the major constraints felt were the lengthy procedures for getting bank loan (91.66%) followed by pest and disease incidence (88.33%) and inadequate awareness regarding its management (86.33%). Eighty five percent felt lack of extension support. More than three fourth (78.33 %) of the sample were unaware about handling temperature and humidity in cattle yards (Malathesh, 2004).

In the same year, another study was conducted by Rajeswari (2004) in the Tumkur district in the same state. All the farmers who were following coconut based systems reported mite infestation as the major constraint that prevalent in the study area. Following that, labour shortage, marketing issues, shrinkage of agricultural land and financial insecurity were also reported. Other problems included inconsistent global market for their produces, production constraints due to lack of quality planning material and lack of support price for the farm products. In 2005 a study was conducted in the Northern part of Karnataka by Udagatti. The major constraints felt by the farmers in that area were lack of quality planting materials, high price for farm inputs, lengthy procedures for getting loans, financial issues, inadequate storage facilities and not getting much price for their produces etc. The study also stressed the importance of government intervention in to this filed in order to support farmers for getting loans easily and for designing farmer friendly policies.

Sharma *et al*. (2008) reported the constraints faced by farmers of Rajasthan. In Dausa district, improper communication services followed by financial crisis and low price for the farm product were the major constraints. High cost of cultivation and water scarcity due to insufficient rain were also added to it. The study suggested that, to mitigate the effect of these constraints, the government should take steps to establish new communication channels. More extension activities should be organised to encourage farmer participation and increase technology adoption. Immediate involvement of cooperative society was essential in that area to ensure quality chemicals to farmers. It further reported that the procedures for getting bank loans should be simplified to enable farmers to take loans and along with this, a hike in support price was also needed. In Mandya district among paddy based farming systems less than half of the farmers faced shortage of quality seeds. Nearly half of them had felt marketing issues (43.3%) followed by lack of availability of improved breeds. One third experienced insufficient extension support followed by difficulties in transporation (30 %) (Chitra, 2010). In the same year Pushpa (2010) conducted a study in IFS of two districts of Tamil Nadu, lack of extension support was the major constraint identified to the tune of 86.19 per cent. Nearly eighty per cent respondents had difficulties in getting demonstrations on IFS. About eight constraints had been identified as important in dairy farming and among those the most important constraints were lack of good quality planting materials (95.83%) and low awareness about fodder production (91.67%). There were seven constraints reported by the respondents in sericulture based systems also, of these unstable price for cocoons and inefficiency in identifying disease symptoms, inadequate trainings were the top ranked constraints faced by nearly three fourth of the sample size.

Singh, *et al.* (2016) investigated the farming systems of southern part of Rajasthan the selected districts were Chittorgarh and Banswara. Among the constraints, inadequate supply of quality planting material was ranked first followed by labour shortage and high cost of cultivation and low price for products. In case of dairy, low productivity of cattle was the major issue faced which was followed by lack of sufficient quantity of fodder. Some farmers had difficulties for getting adequate veterinary services. Horticulture farmers in the study area were facing productivity issues, labour shortage, shortage of quality planting materials and lack of proper value addition facilities. During the year 2015-16, Bhutia, *et al.* (2017) carried out a study and highlighted the different constraints faced by the farmers in crop livestock production system in Bihar. The study revealed that the major problems in crop production were non availability of quality seeds or planting material (88.99%) followed by high price for farm inputs, high incidence of disease infestations, smaller and fragmented land holdings and scarcity of farm credit. In case of livestock production, infertility problems in cattle was ranked first (85.40%) followed by ignorance about scientific management practices, lack of improved breeds, insufficient quantity of green fodder and lack of knowledge on balanced feeding.

Thus from the detailed account of the studies reviewed, it can be concluded that the price variance, in adequate storage facility, incidence of pest and diseases, non availability of quality planting materials, lack of timely credit, lack of marketing facilities, high cost of production, low price of produce, labour shortage , were the most common constraints felt by majority of the farming population (Wadear, 2003;Thomas, 2004;Malathesh, 2004; Udagatti, 2005; Chitra, 2010; Singh *et al.*, 2013; Bhutia *et al*., 2017; Sreelakshmi, 2018).

2.3. Attitude of farmers towards IFS

The study of one's attitude toward something provides a snapshot of how encouraged or depressed they are about that subject, as attitude influences ones behaviour, mode of thinking and acting. Attitude of growers is very important for the adoption of any new agricultural technology. If the growers have positive attitude or positive behaviour about any new concept they can easily adopt it or use that concept in an effective manner.

The final choice to establish or continue with an integrated farming system is heavily dependent on the farmer's attitude towards IFS. Dhadabhau (2014) tried to understand the farmer's perspective on the extent of vulnerability reduction in traditional farming as a result of IFS in Maharashtra. Most of the IFS farmers (34.17 %) believed that farmers could reduce the vulnerability in traditional method through the IFS in a high rate followed by one fourth in medium rate. It was a very good sign that most of the farmers respondents felt that, it could be easy to reduce their threats from high to very high through the adoption of IFS. It also pointed that farmers had a perception that, adding more components in an IFS unit helps to reduce the risk associated with crop failure and thereby leads to a sustainable income to their families. That implied, IFS farmers with larger combination of components were perceived to have a low level of risk than others with less components or still practising traditional farming. IFS is a well tried-and-true method in Kuttanad area of Allapuzha district of Kerala. A study conducted by Mamatha (2017) in that area reported that, most of the farmers who adopted Integrated farming systems in their field, had a positive perception towards the utility of IFS. Through the study, the perception for both marginal and small farmers were also analyzed and found that most of them belonged to medium category of perception utility. Thus she concluded that regardless of the type of farmers majority of the adopters were reaping the benefits of IFS.

An attempt has been made by Chandulal (2013) to understand the attitude of growers in Anand district of Gujarat about organic farming. The attitude of the cultivators was worked out by using attitude scale developed by Patel (2005) with slight modification. Based on the measurement of attitude, the respondents were categorized into five groups. It was evident from the study that most of the farmers possess favourable attitude towards organic farming. The study also tried to find out the factors influencing farmer's attitude. By analysing the results, it was evident that most of the respondents possessed higher secondary education, good extension participation, high social participation, this might be the influencing factors for the positive attitude. From the study, it was clear that majority (96%) of the farmers who adopted mixed farming strongly agreed that mixed farming is valuable concept to gain higher income by mixing crop production and livestock enterprises. An overwhelming majority, 92 per cent of the respondents have an opinion that mixed farming makes best use of crop residues. This implied that majority (90%) of the farmers who adopted mixed farming had positive to highly positive attitude towards it. Mixed farming being a sustainable, practical, adoptable, economic and prospective farming system, most of the farmers might have shown positive and highly positive attitude towards it. Moreover, the farmers are already availing the benefits from mixed farming system and thus developed a positive attitude towards mixed farming. Her results are similar to that of Vaidya (2011) and Patel (2013).

A study conducted by Sreelakshmi (2018) in the homesteads of Thiruvananthapuram district of Kerala found that all the respondents have a positive attitude for adding more components to the existing crop production system. It is because of the additional economic and social benefits. In Kerala home gardens have the unique nature of growing multiple crops such as trees, shrubs, bushes and with the incorporation of farming components utilizing the available area in home gardens. Similarly, the assured economic gain from the specializations was another major factor resulting in increased number of specializations. In some of the selected home gardens, horizontal diversification up to six levels were noticed. This was a clear indication that the farmers have a positive attitude for transforming home gardens with more inclusions leading to horizontal diversification for making home gardens more remunerative. Through the study, an attempt to understand whether there was any difference of attitude among specialized home garden farmers of different AEU's were also made. Kendall's rank correlation coefficient analysis was used for measuring it. It was found that there exists a significant relationship between attitude of farmers and different agro ecological units. The attitude towards specializations may vary according to the difference in agro ecological units as the type and extent of utilization of different specializations may also vary with regards to AEUs. Hence, it was natural that respondents of different AEU's possess significant difference in attitude towards specializations.

Sarjeet (2019) conducted an assessment of farming systems practiced by the farmers of Sriganganagar District of Rajasthan. In that study researcher made an attempt to analyzed the attitude of farmers towards different farming systems and the factors influencing their attitude. The results showed that majority of the respondents (74.17 %) had a positive attitude about different farming systems. It might be due to the reason that, the respondents perceived the spectrum of advantages of different farming systems. This finding was supported by Dhaka *et al.* (2017) and Haque *et al.* (2017). The study also analyzed the relationship between selected personal variables with their attitude by conducting a correlation analysis. Education, landholding, social participation, source of information and annual income were positively significant with attitude. Bhoir *et al.* (2020) made an attempt to identify the attitude of farmers towards different integrated farming system components. The study was carried out in twelve *tehsils* of Kolhapur district of Maharashtra. Frequency, percentage, mean and standard deviation were the statistical tools used to analyze the data. The findings revealed that more than three fourth (76.67 per cent) of the respondents had medium level of attitude towards IFS, followed by high level (18.00 per cent) and low level (5.3 per cent) of attitude towards IFS. Majority (85.17 per cent) of the respondents expressed that poultry farming creates employment opportunities for rural people. More than three - fourth (80.67 per cent) of the farmers had an opinion that there were no difficulties for adopting dairy component in to their units even without Govt. aid. More than half of the respondents had a negative attitude towards sericulture and agro processing activities. In case of aquaculture, only progressive farmers had shown a positive attitude. From that study it can be concluded that there is a need of conducting trainings/workshop for IFS from line departments and more support should be provided from Govt. in order to change the attitude of farmers towards IFS.

Thus, it could be inferred from the above reviews that, even though, all the studies were reported that the respondents had a more favourable positive attitude towards various farming systems, still there exists some variation in the attitude of respondents towards the objects in question. The personal and socio-psychological characteristics of the farmers play a dominant role in determining their attitude towards various farming systems (Sarjeet, 2019; Sreelakshmi, 2018; Chandulal, 2013).

2.4. Conclusion from reviews

The summary of the review of literature reveals that:

a) Based on the components, different types of integrated farming systems are seen in India. The extent of utilization of those components in each system may vary according to the AEZ, farmer’s interest and profitability etc.

b) Generally, IFS provides higher income compared to the conventional sole cropping system and it also generate better employment opportunities to the farmers.

c) Irrespective of the type of farming systems, majority of the farmers are facing different types of constraints, but the intensity of those constraints perceived by the farmers vary according to person.

d) Technology need assessment will give a clear picture of technology gap that exists in an area. Adoption of a technology in the field level by a farmer is highly influenced by the need of the farmer. The technological need perceived by the farmers may vary according to their socio-economic- psychological factors. Most of the farmers prefer technologies which need low input and can provide high productivity.

e) While considering the farmers’ attitude towards various farming systems, majority of them have a positive attitude, however, that does not mean that all the farmers have positive attitude. It will vary according to socio -psychological factors.

f) Even though so many strategies have been implemented by the authorities to reduce the difficulties faced by the farmers and thereby creating a positive attitude towards integrated farming, the results of the reviews shows that still there is a need for implementing better strategies in every area, in order to reduce the constraints, meet the technological needs and create a positive attitude among farmers.

CHAPTER –3

Research Methodology

RESEARCH METHODOLOGY

Research methodology is the systematic, theoretical analysis of the procedures applied to a field of study (Kerlinger, 1973). It is the blueprint of any research, that provides a framework for the research exertion and further describe the methods and practices for accomplishing the research objectives. It is merely a guide to research, tells how it is executed and aids the researcher in steering the work in right direction. This chapter deals with the design and methodological plan to study objectives set forth. The various aspects of this chapter have been presented under the following subheads:

3.1 Research design

3.2 Locale of the study

3.3 Sampling plan and mode of data collection

3.4 Selection of variables and their measurements

3.5 Data collection

3.6 Statistical analysis

3.1. Research Design

Research designs are aimed at answering research questions in the most valid, accurate and cost effective manner possible. It is the "Binding factor" for the intended research efforts that ties all of the parts of an investigation together. According to Kerlinger (1983) “Research design is the plan, structure and techniques of investigation devised to gain answers to research questions and to control variance. For the present study, the exploratory research design was used. Exploratory research aims to simply explore the research questions. It is defined as a research used to explore a problem which is not clearly defined. This study is carried out to gain better understanding or deeper knowledge about the existing integrated farming system units of Kerala.

3.2. Locale of the study

The study was purposively conducted in Kerala, India (fig. 3.1). Kerala lies in the Agro climatic Zone XII which is called as West Coast Plains and Hills Regions. There are 14 districts in Kerala (Kerala has five AEZs and twenty three AEUs). Thus, to get a complete image of Kerala three districts were selected randomly from a total of 14 districts.

Fig. 3.1: Map of Kerala

3.3 Sampling plan and mode of data collection

Kerala state was purposively selected and three districts (one district each from Southern, Central and Northern Kerala) were selected randomly. Kollam district from Southern Kerala, Thrissur district from Central Kerala and Kannur district from Northern Kerala were the selected districts for conducting the study. From each district, 2 Agro Ecological Units (AEU) were randomly selected. A list of panchayats in each AEUs of the study area was prepared and two panchayats with potentially active and operational IFS units were selected randomly from each AEU.

The respondent groups of the study comprised of Farmers and Extension Personnel. To select farmer respondents, a comprehensive list of farmers those who had adopted integrated farming system with dairying as one of the component, in each selected panchayat was prepared separately in consultation with Krishibhavans, ATMA and local influential persons of the respective panchayats. On the basis of the lists, 15 Integrated Farming System units were selected in the study area randomly from each identified panchayat, thus making the total sample size 180 IFS units. 60 officials (20 officials from each district) which include Agriculture Officers, Veterinary surgeons, officials from KVK and ATMA also were selected purposively as the respondents for the study, thus made the total sample size of 240 respondents. The sampling plan of the study (fig.3.2) and the database used are presented below:

3.3.1. Selection of State, Districts, Panchayats and Respondents

Selection of Kerala State

Kerala is characterized by resource richness and various cropping systems, which differs noticeably from that of the national scene because of its typical geographical and climatic conditions. Kerala is well known for the species diversity of western Ghats and has earned the moniker "Biodiversity Paradise." Though the state has distinct and diversified agro-climatic conditions, allowing it to produce a wide range of crops and farm-related activities, its agricultural legacy is not at a par with other states. In fact, Kerala state is known for its outstanding social and economic indicators, but has pictured a considerable fall in agriculture production and productivity over last few years.

Kerala has generally been a consumer state, relying on its neighbouring states for meeting their daily food requirement. In a land scarce state like Kerala, expanding agricultural land is very hard to envision. In this frame of reference, more advanced strategies are required to achieve self sufficiency in production. In this context, IFS can be considered as a viable option to provide food, nutrition and finanical security to people. By realizing this fact State Govt. is now giving more emphasis to the concept of Integrated Farming Systems (IFS) through various programmes (*Jaivagriham Programme*). As a result of these programmes many IFS units have been established in all districts of the state. But the establishment of IFS units is not an end, rather it is only a means for achieving self sufficiency in agricultural production. Thus, a thorough analysis is needed among the existing IFS, in order to ensure that all the units are functioning well, because the success of these systems is crucial for changing the current agricultural conditions of the State. Hence, this study on analysis of IFS in Kerala was of transcendental importance.

Selection of Districts

In order to get a complete image of IFS units in Kerala, three districts **(**one district each from Southern, Central and Northern Kerala) were selected randomly. Kollam district from Southern Kerala, Thrissur district from Central Kerala and Kannur district from Northern Kerala were the selected districts for conducting the study.

Kollam District is situated on the South west coast of Kerala. The latitudinal and longitudinal extends are 8°48′N 76°36′E and / 8°80′N 76°6′E, / 8.80; 76.6, respectively. The district is divided into 11 development blocks, 68 grama panchayats and 4 municipalities. It covers 2491 sq. km and is the seventh largest district in Kerala. According to the 2011 census, Kollam district has a population of 26.35 lakhs and a population density of 1061 inhabitant per square km. Figure.3.3. shows the map of Kollam district. Kollam district is classified into five Agro Ecological Units based on their location and climate, soil and topographical features, of these AEU 1 (Southern Coastal Plains) and AEU 3 (Onattukara Sandy Plains) were selected randomly for the study.

Thrissur is a revenue district of Kerala located in the central part of the state (10.52°N 76.21°E). It covers an area of approximately 3,032 square kilometres. The districts of Palakkad and Malappuram border it to the north and Ernakulam and Idukki border it to the south. To the west is the Arabian Sea and to the east are the Western Ghats. There are 16 development blocks, 86 panchayats and 255 villages in the district. As per the 2011 census the population of the district was 31 lakhs accounting for more than 10 per cent of total population in the state. Thrissur district is grouped into six Agro Ecological Units, of these two AEUs were chosen randomly (figure.3.4). The selected AEUs were; AEU 6 (Kole Lands) and AEU 10 (North Central laterites).

Kannur district is situated between 11° 40' and 12° 48' North latitudes and 74° 52' and 76° 07' longitudes, with an area of 2,966 square kilometres. The population, as reported by census report 2011, is 25.23 lakhs. There are 129 villages, 71 panchayats and 11 development blocks in the district and based on its location, climatological and topographical features grouped in to five Agro Ecological Units (AEUs). Two AEUs were selected randomly (fig. 3.5) from the five. The selected AEUs were; AEU 11 (Northern Laterites) and AEU 15 (Northern High Hills).

Selection of Panchayats

Elaborate list of all panchayats including the details of IFS farmers from the selected Agro Ecological Units was created through discussions with officials, local people and secondary sources. From each AEU, two panchayats with active and operational IFS units were picked at random. The details of selected panchayats were given below (Table 3.1 and Fig. 3.3 to 3.5).

Table 3.1: Details of the study area

Selected Districts	Agro Ecological Units Selected	Block	Selected Panchayat
Kollam	AEU 1	Chittumala Block	Kundara Panchayat
		Mukhathala	Elamballur Panchayat
	AEU 3	Oachira	Thazhava Panchayat
		Sasthamcotta	Mynagappally Panchayat
Thrissur	AEU 6	Cherpu	Paralam Panchayat
		Anthikkad	Chazhoor Panchayat
	AEU 10	Mala	Annamanada Panchayat
		Kodakara	Kodakara Panchayat
Kannur	AEU 11	Edakkad	Peralasseri Panchayat
		Kuthuparamba	Mangattidom Panchayat
	AEU 15	Irikkur	Eruvassi Panchayat
		Iritty	Aralam Panchayat

Selection of the Respondents

The respondent groups of the study composed of both farmers and extension personnel. Even so, the respondent categories of extension personnel were confined to the analysis of characterization of various technology dimensions in integrated farming systems.

a) *Farmers:*

To select farmer respondents, a comprehensive list of IFS farmers in each selected panchayat was prepared separately in consultation with ATMA, Krishibhavans and local influential persons of the respective panchayts. On the basis of the lists, 15 IFS units were selected randomly from each identified panchayat, thus making the total sample size of 180 IFS units.

b) *Extension Personnel*

Sixty officials (20 officials from each district) which include Agriculture Officers, Veterinary surgeons of the selected panchayats, block level and district level officials from ATMA and KVK of the respective blocks and districts, were selected purposively as the respondents for the study, thus making the total sample size 240 respondents (fig.3.2).

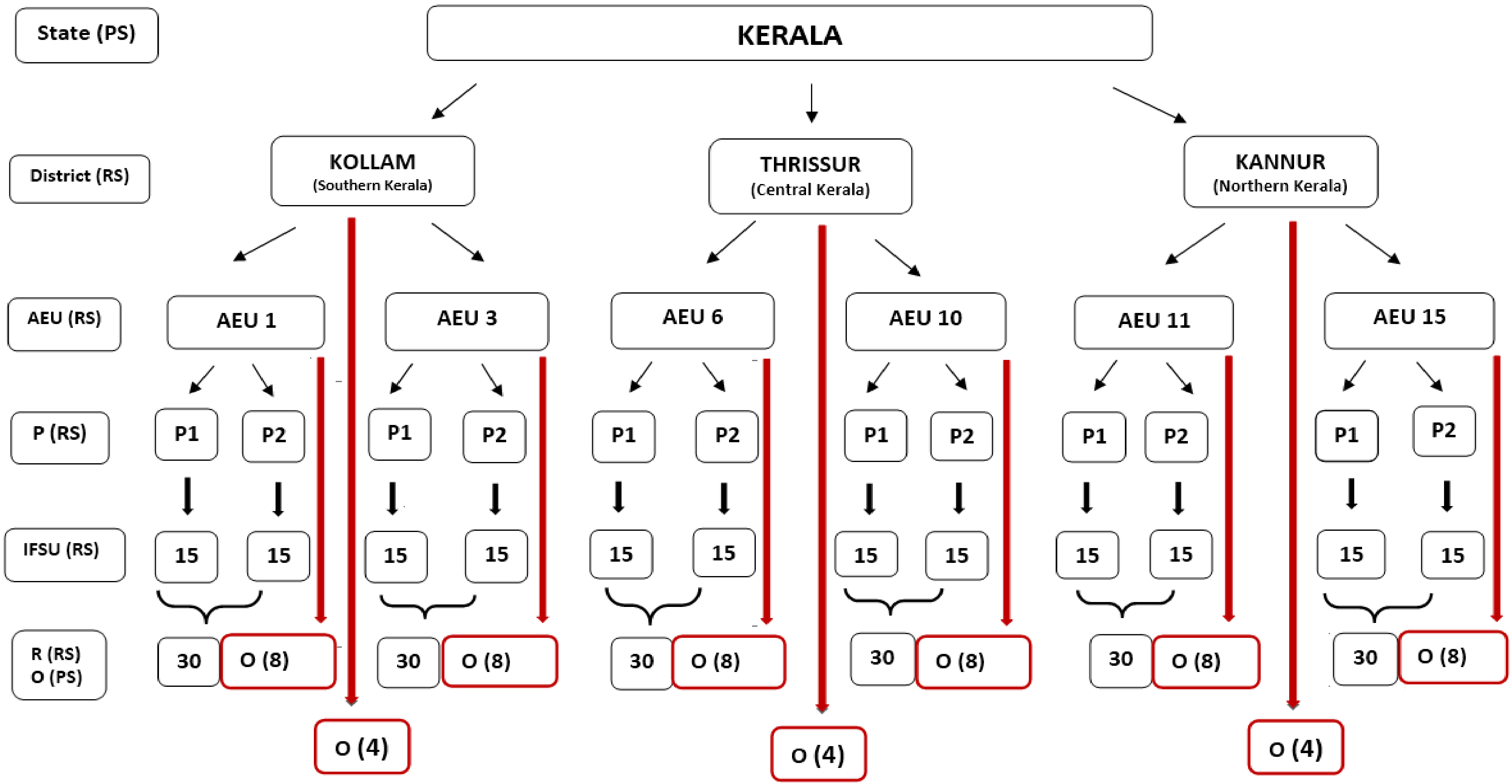


Fig. 3.2 : Sampling plan

Total respondents= 240, PS= Purposive Sampling, RS= Random Sampling, AEU = Agro Ecological Unit, P = Panchayat, IFSU = Integrated Farming System Unit, R = Respondents, O= Officials

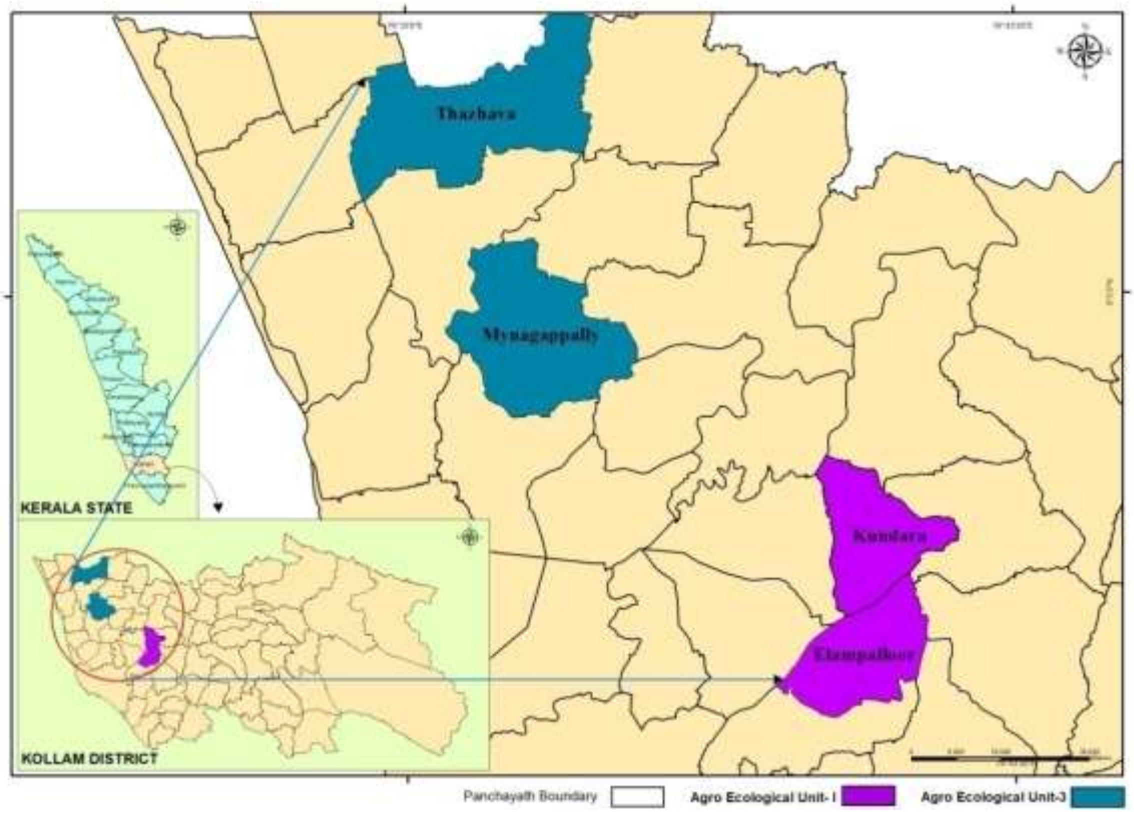


Fig.3.3 : Selected panchayats in Kollam District

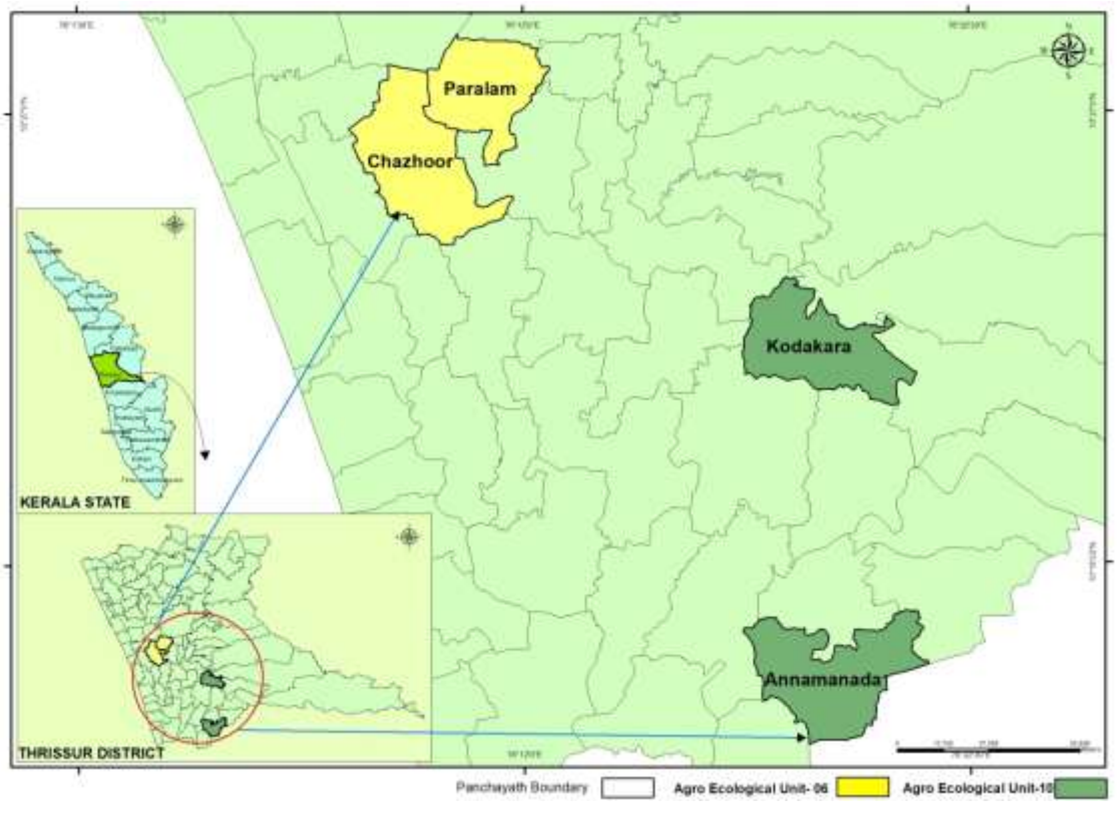


Fig 3.4 : Selected panchayats in Thrissur District

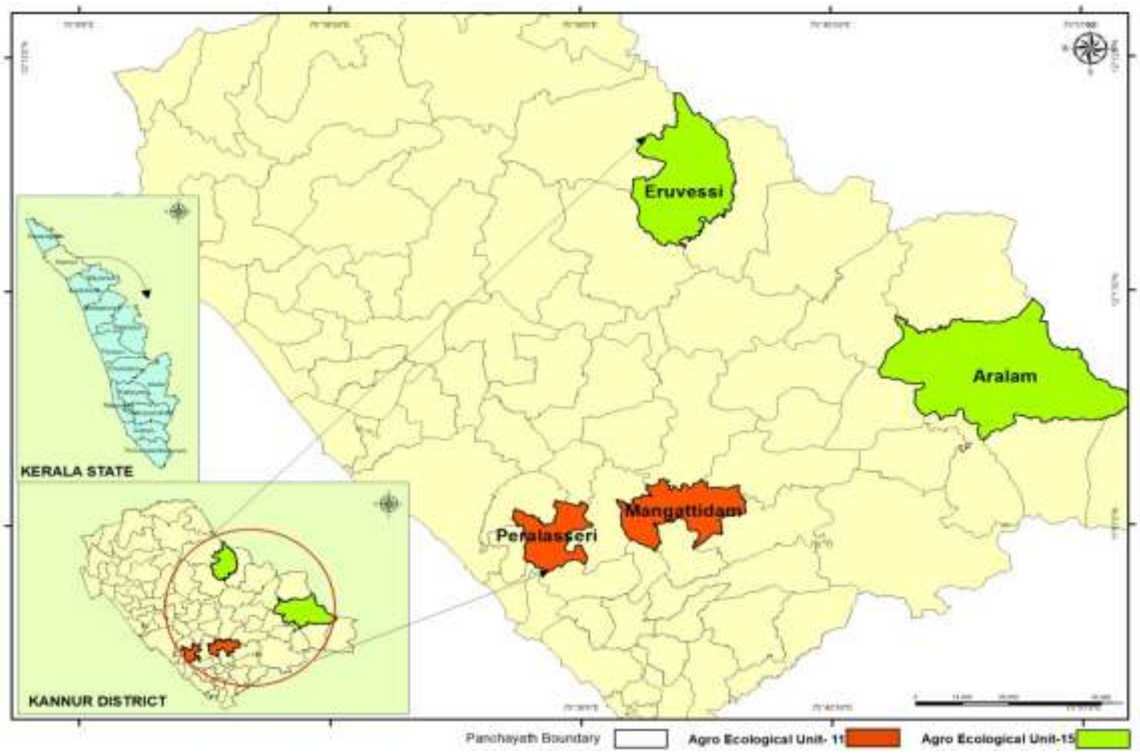


Fig 3.5: Selected panchayats in Kannur District

3.4. Selection of variables and their measurements

Taking into account the background and objectives of the study, relevant variables were chosen by following a thorough analysis of the literatures and discussion with experts in the study area. The first set of variables were related to socio economic profile characteristics of the farmers and related to their integrated farming. The selected variables, their mode of measurement and operationalization of concepts are presented as follows:

Table 3.2: List of selected variables and their measurements

Sl. No.	Variables	Measurement
I	**Socio Economic profile**	
1	Age	Direct questioning
2	Education	
3	Family size	
4	Occupation	
5	Farm size	

6	Herd size	
7	Experience in farming	Schedule was developed
8	Mass media exposure	
9	Extension Agency contact	
10	Participation in extension programmes	
11	Market orientation	
12	Irrigation potential	
13	Economic motivation	
14	Innovativeness	
15	Risk orientation	
16	Social participation	
17	Training undergone	
18	Awareness about various farm enterprises	
II	**Objective 1: Extent of Adoption of Components in IFS**	
19	Extent of adoption of available components in IFS	Adoption Index was developed
20	Annual Income	Schedule was developed
21	Extent of integration with enterprises	
III	**Objective 2: Technological needs of the farmers for adopting IFS and constraints faced**	
22	Technological needs of the farmers for adopting IFS	Modified procedure of Thomas (2004)
23	Constraints faced by the respondents	Garrett ranking technique was used
IV	**Objective 3: Attitude of farmers towards IFS**	
24	Attitude of farmers towards IFS	Attitude scale was developed

3.4.1 Age

Age was defined as the chronological age of the respondent at the time of investigation. The number of completed years of age of the respondent was considered for an individual score. According to the procedure outlined in the Population Census Report, 2011 (GOI). Respondents were grouped into three age groups as follows:

Categories of age of respondents

Age category	Years
Young	Up to 35 years
Middle aged	36- 50 years
Old aged	Above 50 years

3.4.2. Education

Education is referring to the highest academic qualification possessed by the respondent through formal and informal learning process. In view of the educational level of the respondent, they were grouped into five categories.

Categories of educational level

Sl. No.	Educational level	Score
1.	Illiterate	1
2.	Primary (Class 1-7)	2
3.	Secondary (Class 8-10)	3
4.	Higher Secondary (Class 11-12)	4
5.	Graduate and above	5

3.4.3. Family size

Family size was operationally defined as the number of members of either sex living in a household/family dependent on the head of the family. Based on the score obtained, the respondents were grouped into, small, medium and large family size.

Categories of family size

Sl No.	Category of family size	Number of family members
1	Small	Up to 5
2	Medium	6-10
3	Large	More than 10

3.4.4. Occupation

Occupation was operationalised as the primary activity in which the respondent spends major part of the time and attention for the livelihood. The IFS farmers were classified into four groups according to their occupations. The scoring procedure was described below:

Sl No.	Category of occupation	Score
1	Farming as a sole profession	4
2	Farming+ Agri. labour	3
3	Farming+ business	2
4	Farming+ service	1

3.4.5 Farm size

Farm size was operationalised as the the total land owned/cultivated by the respondent at the time of conducting survey. The grouping of IFS farmers were based on the standard classification criteria as shown below:

Sl. No.	Farm size category	Land holding (ha)
1.	Marginal	Up to 1 ha
2.	Small	1.1 to 2 ha
3.	Semi-medium	2.1 to 4 ha
4.	Medium	4.1 to 10 ha
5.	Large	More than 10 ha

3.4.6. Total Annual Income

Income refers to the total earnings of the IFS farmer's household in a year accrued from farm activities and other sources, represented generally in monetary terms. In this study, total annual household income was computed by summing up the gross income from all the on farm sources. The pattern of classification was shown below. Respondents were categorized in to three categories namely, low, medium and high income based on their cumulative square root frequency.

Categories of annual income

Sl. No.	Category	Annual income from Crop Farming (Rs.)
1.	Low	<175016
2.	Medium	175016-499903
3.	High	>499903
Sl. No.	**Category**	**Annual income from Dairy Farming (Rs.)**
1.	Low	<79232
2.	Medium	79232 -148261
3.	High	>148261
Sl. No.	**Category**	**Annual income from fish farming (Rs.)**
1.	Low	<368456
2.	Medium	368456 - 529279
3.	High	>529279
Sl. No.	**Category**	**Annual income from poultry (Rs.)**
1.	Low	<2217
2.	Medium	2217- 5571
3.	High	>5571
Sl. No.	**Category**	**Annual income from apiculture (Rs.)**
1.	Low	<43523
2.	Medium	43523-77466
3.	High	>77466
Sl. No.	**Category**	**Annual income from mushroom (Rs.)**
1.	Low	<27320
2.	Medium	27320- 31190
3.	High	>31190

Sl. No.	Category	Total Annual farm income (Rs.)
1.	Low	<361254
2.	Medium	361254 -823059
3.	High	>823059

3.4.7. Herd size

Herd size was referred to as the total number of cattle and buffaloes owned by the farmers at the time of data collection. A schedule was developed to collect the data and on the basis of Standard Animal Units for computing the herd size. Based on the score obtained, by using Cumulative Square Root Frequency Method, the respondents were further classed in to three as given below:

Sl. No.	Category of herd size	Size
1.	Small	< 4.21
2.	Medium	4.21– 7.80
3.	Large	>7.80

3.4.8. Experience in farming

Experience in farming is operationalised as the number of years the respondent has been engaged in various farming activities related to IFS. By following cumulative square root frequency method, the respondents were categorized in to three groups as low, medium and high.

Category of experience	No. of years
Low	< 8 years
Medium	8– 12 years
High	>12 years

3.4.9. Mass media exposure

It referred as the degree to which the respondents of the study were exposed to different mass media sources with respect to acquiring information regarding IFS. The responses were graded on a three-point continuum of regular, occasional and never, with a score of 3, 2, 1 respectively. Further the respondents were grouped in to low, medium and high mass media exposure categories based on Cumulative Square Root Frequency Method.

Category of mass media exposure	Score Range
Low	<15.36
Medium	15.36 – 18.90
High	>18.90

3.4.10. Extension Agency contact

It referred to the degree to which the respondent meets the extension agents for information related to various aspects of IFS Units. The responses were graded on a three-point continuum of regular, occasional and never, with a score of 3, 2, and 1 respectively.

Category of extension agency contact	Score Range
Low	<25.84
Medium	25.84 – 29.58
High	>29.58

3.4.11. Participation in extension programmes

It referred as the extent of farmer participation in various programmes organised by governmental and non-governmental organizations. To measure this variable, a schedule was developed. The frequency of participation was assessed on 3 point continuum as regular, occasionally and never with respective scores of 3, 2 and 1. The total score of each respondent was computed by adding their individual scores together. Then, using the cumulative square root of frequency method, the respondents were classified into low, medium and high extension participation group.

Category	Score Range
Low	<11.74
Medium	11.74 – 14.70
High	>14.70

3.4.12. Market orientation

Market orientation was operationalized as the extent to which a farmer is oriented towards scientific farm management activities, comprising of planning, production and marketing functions/activities of his farm enterprises. A schedule was developed, which consists of six statements (Interview Schedule –Appendix VI) in which the responses were collected on a two point continuum, "Agree" and "Disagree", with scores two and one for the positive statements and reverse scoring for the negative statements. The maximum and minimum score that could be obtained by the respondent were 'twelve' and 'six' respectively. Based on the score obtained through cumulative square root of frequency method, the respondents were further categorized into three groups such as low, medium and high.

3.4.13. Irrigation potential

It referred to the extent to which irrigation water was available or scarce in the holding. It was gauged based on the availability/ lack of irrigation water for each unit. The following was the scoring pattern set for this study:

Scoring pattern of irrigation potential

Irrigation potential category	Score
Physical water scarcity	1
Economic water scarcity	2
Little or no water scarcity	3

Through this procedure a respondent could get a maximum score of 'three' and minimum of 'one,' for this variable. Physical water scarcity was mentioned as the perception of respondent that the water available in their unit was insufficient for irrigation purpose. Whereas Economic water scarcity denoted as the perception of respondents that the water available in IFS unit should be utilized judiciously for meeting their irrigation needs in each unit. Little or no water scarcity implied that water was plentiful in their units.

3.4.14. Economic motivation

It was defined as the extent to which respondent is oriented to obtain profit and the relative value placed on economic ends so that, it influences further adoption or its sustenance related to agriculture. A suitable schedule was developed for measuring this variable, which consists of six items (Interview Schedule – Appendix VI) that range from 'Strongly Agree' to 'Strongly Disagree' on a five-point scale. The following were the scores ascribed to positive statements. For the negative statements, the scoring pattern was overturned.

Scoring pattern of Economic Motivation

Response	Score
Strongly Agree	5
Agree	4
Undecided	3
Disagree	2
Strongly Disagree	1

Thus, the overall score of a respondent on this variable was obtained by summing up the scores on each of the statements. The maximum and minimum score that could be obtained by a respondent through this method were ‘thirty’ and ‘six’, respectively.

3.4.15. Innovativeness

It was operationalized as the extent to which the individual adopts new ideas relatively earlier than other members of the social system. The respondents were asked to when he/she would like to adopt some improved practices in their IFS unit and the responses were scored as follows:

Categories of Innovativeness

Categories of innovativeness	Statements	Score
Highly innovative	As soon as it is brought to knowledge	3
Somewhat innovative	After I have seen other farmers tried successfully in the farm	2
Less innovative	I prefer to wait and take my own time.	1

3.4.16. Risk orientation

It was defined as the ability of the respondents to encounter risks and uncertainty in adopting IFS practices. The schedule comprises six statements, two of which were negative (Interview Schedule – Appendix VI). The statements were rated on a five-point scale: 'strongly agree' to ‘strongly disagree.' The following was the scoring pattern set for this study. The overall score on risk orientation was determined by adding the scores on each statement.

Scoring pattern of risk orientation

Response	Score
Strongly Agree	5
Agree	4
Undecided	3
Disagree	2
Strongly Disagree	1

3.4.17. Social participation

Social participation was operationally defined as the extent of involvement of IFS farmers in various formal and informal organizations, either as a member or as an office bearer. It was measured in two dimensions namely nature and frequency of participation in various organizational activities. The scoring pattern used has been described below:

For membership in organization:

Scoring pattern of for membership in organization

No membership in organization	1
Membership in each organization	2
Office bearer in each organization	3

For frequency in participation:

Scoring pattern of frequency in participation

Never attended any meeting	1
Sometimes attended meeting	2
Regularly attended meeting	3

The scores obtained on the aforementioned two dimensions were multiplied across each item for all organizations to calculate his overall social participation score.

3.4.18. Training undergone

Training undergone refers to the number of trainings undergone by the farmer in various activities related to IFS by different agricultural institutions during the last three years in Kerala.

The surveyed respondents were divided into four groups based on the number of training sessions that they had attended in last three years. The scoring method was as follows:

Scoring pattern for Training undergone

Sl. No.	Training undergone (Number)	Score
1	No training	1
2	1-5	2
3	6-10	3
4	>10	4

3.4.19. Awareness about various farm enterprises

Awareness refers to the firsthand knowledge regarding the existence of a technology, practice or process. In this study awareness was operationally defined as the general information level of a respondent with respect to different dimensions of Integrated Farming System. A schedule consisting of 10 statements were developed for measuring this variable. The respondent got a score of 2 if they were aware of the IFS, and a score of 1 if they were not. Thus, the total score was computed by summing up the scores for all the statements and then the respondents were categorized into three viz., low, medium and high categories by following cumulative square root frequency method.

3.4.20. Extent of integration with enterprises

The extent of integration was described as the degree to which the output of one component is being used as an input to other with an intention to use resources more efficiently and ensure effective recycling of residue waste within the unit itself. In IFS, integration denoted the linkage between various components available in a unit. Through pilot study and by consulting with the experts in the study area, possible integration practices for each selected component were enlisted and based on that a schedule was developed. For each practice of integration that existed in different dairy based systems, a score of two was given and for non existing practices a score of one was given. The final score was calculated by summing up the scores of each practice. Integration index developed by Pushpa (1996) was used to find out the integration index score for this investigation.

$$\text{Integration Index} = \frac{I}{P} X\ 100$$

Where,

I = Integration score obtained by the respondent

P = Possible maximum score for all the integration practices

Based on the index score, through cumulative square root frequency method, The IFS units were grouped in to low, medium and high integration.

3.4.21. Extent of adoption of available components in IFS

Extent of adoption referred to the extent to which a new technology or practice was used in a long term basis by the respondent, who was fully informed about the technology and its potential. IFS is broadly defined as a system comprising of several mutually cohesive and complementary agro based enterprises. The optimization of each component is crucial for increasing overall productivity of the unit. To get an idea about the structure and functioning of the existing unit, various components available in each unit should be analyzed thoroughly. For that a component analysis in terms of extent of adoption was carried out. Through reviewing the literatures and discussion with experts in the study area, various components prevailing in the study area were enlisted. In order to ascertain the extent of adoption of these enlisted components, a composite index was developed for the study. The procedure followed in construction of adoption index has been given as below:

3.4.21.1. Selection of major indicators:

To study the extent of adoption of various components of IFS units, an index was developed with help of selected indicators. Since, an IFS unit includes many complementary components, under each selected components appropriate indicators were chosen by referring relevant literatures and expert's opinion (Appendix IV).

3.4.21.2. Relevancy test

The indicators chosen under each dimension were thought to make a significant contribution in measuring the adoption of various components in the Integrated Farming System units. The development of a valid and reliable index necessitates careful examination of each indicator. It is plausible that not all of the indicators are equally important in evaluating the rate of adoption among IFS farmers. As a result, these selected indicators must be thoroughly examined before being included in the final index. Thus, these indicators were distributed to scientists and experts via Google forms as well as direct methods and they were requested to rate the relevancy of each indicator on a three-point scale, i.e. 'Most relevant,' 'Relevant,' and 'Least relevant,' with scores of 3, 2, and 1 respectively. The relevancy weightage (RW) was calculated for each indicator by using the following formula:

Relevancy weightage =

$$\frac{\text{Most Relevant Responses}*3+\text{Relevant Responses}*2+\text{Least Relevant Responses}*1}{\text{Maximum Possible Score}}$$

By using the above formula, the indicators with Relevancy Weightage (RW) of > 0.75 were considered for inclusion in developing the final index for measuring the extent of adoption of available components in the study area. Finally, a total of 25 indicators were retained for the data collection. To bring the values of indicators to a comparable range, normalization was done through Microsoft Excel programme using maxi- min methodology suggested by UNDP (2006) as follows:

Indicators having positive functional relationship with adoption:

$$\text{Normalized value of Xij} = \frac{Xij-Min\ Xi}{Max\ Xi-Min\ Xi}$$

Indicators having negative functional relationship with adoption:

$$\text{Normalized value of Xij} = \frac{Min\ Xi - Xij}{Max\ X1 - Min\ Xi}$$

Where, Xij is the value of indicator j corresponding to IFS unit i.

A final Composite Index was developed using the indicators for measuring rate of adoption. The data obtained through data collection were normalized and the values of 25 indicators under each component were loaded into SPSS to perform PCA for the indicators.

Principal Component Analysis (PCA) method was used to construct indices for the selected indicators. Post normalization, separate Principal Component Analysis (PCA), as suggested by Dunteman (1989), was done considering 25 selected indicators and using IBM SPSS 26 version software. Principal componets were described as the part of multivariate procedures wherein linear combinations of correlated indicators are involved to maximize the variance accounted for in the original set of indicators (Chakravarty, 2017). The followed steps of PCA are given below:

1. The normalized data were loaded to SPSS.
2. PCA was run to obtain factor loadings and Eigen values.
3. The final indicators retained after PCA with Eigen values above one was identified and the values of first principal component in the rotational component matrix were taken as final weightage.
4. The normalized values of each indicator were multiplied with its respective weightage. The multiplied values of indicators were summated for each respondent to obtain the final composite index.

Based on the obtained composite index score, through cumulative square root frequency method, the IFS farmers were grouped in to three categories, as low, medium and high adoption categories.

3.4.22. Technological needs of the farmers for adopting IFS

3.4.22.1. Technological needs in integrated farming systems

The technology needs assessment were carried out by following the score/ranking procedure used by Thomas, 2004 with slight modification.

Score/Rank Criteria

4	-	Technology not available for adoption
3	-	Technology available but not applicable
2	-	Technology available but not sustainable
1	-	Technology available, applicable and sustainable

A farmer may have different technology needs, depending on how various components are integrated and how the field is managed and the shortfalls in availability and requirement for the specialized components. In light of this, the technology needs of IFS farmers were examined and on the basis of that, they were categorized into the aforementioned groups. The technology needs of each component in a unit were evaluated separately. Hence, the scores of technology needs for all components in the selected IFS units were compiled and statistically analyzed. A mean technology need score was also calculated on different aspects of technologies for each component. The category with the highest score was considered to be the most needed technology in each component.

3.4.22.2. Characterization of IFS farmers and officials in terms of technological, social and economic dimensions.

Various dimensions that seemed to be connected with IFS were enlisted by following review of literatures and discussions with experts. The selected attributes/dimensions were examined by all the IFS farmers as well as the selected experts in this field such as agricultural officers, veterinary surgeons, officials from ATMA and KVK. They were requested to closely analyze these dimensions and, if necessary, add new dimensions or modify existing ones. The judges were asked to rate the relevance of each dimension on a 3-point scale ranging from most relevant to least relevant, with weightages ranging from "3'" to "1". Responses were gathered from all IFS farmers as well as 60 officials, thus total two hundred and forty responses were collected. The total score of each dimension and mean total were computed for both farmer and official respondents. The dimensions that exceeded the mean total were considered as important for each category. Ranking method had been used to evaluate relevance of each dimension separately for all respondents. Based on the mean score value, Venn diagram was plotted for representing those dimensions which perceived to be important by IFS farmers as well as officials. Besides that, the relevance of selected dimensions were analyzed district wise on the basis of mean and ranking method.

3.4.23. Constraints faced by respondents

In order to assess the constraints experienced by the respondents in establishing and maintaining an IFS unit, a suitable schedule was devised. A list of all possible constraints, that would be experienced by IFS farmers, was compiled after consulting with experts in the field and reviewing data collected from various literatures. The listed constraints were ranked by using Garrett ranking technique.

Garret's ranking technique was adopted to analyze the constraints faced by the stakeholders in the study area. The respondents were asked to rank the given factors in the schedule. The order of merit thus given by the respondents was converted into ranks by using the following formula:

$$\text{Percent position} = \frac{100(Rij - 0.5)}{Nij}$$

Where:

Rij = Rank given for the ith variable by jth respondents

Nij = Number of variable ranked by jth respondents

With the help of Garrett's Table, the percent position estimated was converted into scores by referring to the table given by Garret and Woodworth (1969). Then for each factor, the scores of each individual are added and then total value of scores and mean values of score is calculated. The factors having highest mean value is considered to be the most important factor.

3.4.24. Attitude of farmers towards Integrated Farming System

Attitude of a person refers to their positive or negative feelings towards something. It has the ability to affect our actions positively or negatively. In the present study an attitude scale was constructed for studying the attitude of respondents towards Integrated Farming Systems. The summated rating method was used to construct the scale (Likert,1932). The following steps were taken to construct the scale:

(a) **Collection of items:** The first step in developing an attitude scale was to gather statements or items pertaining to the objective. Based on review of relevant literatures and by discussing with experts in the field, eighty statements related to attitude of farmers towards IFS concept were prepared keeping in view the suitability of statements to the study area. The list consisted of both positive and negative statements.

(b) **Editing the statements:** The selected statements were edited in accordance with 14 criteria for developing statements stated by Edward (1957). The statements were edited carefully to ensure that they accurately measured what was intended. Finally, seventy statements were chosen for further analysis.

(c) **Experts response to raw statements:** All the statements gathered might not be equally relevant for assessing attitudes towards IFS. In order to find out the relevance and screening for inclusion in the final scale the enlisted statements were sent by post, through mail and handed over personally to a panel of judges in the field of agricultural extension comprised of experts from ICAR institutes, SAUs, and Research Scholars. The statements were placed on a three-point scale ranging from most relevant to least relevant. For each statement, the judges were requested to provide their responses as most relevant, relevant and least relevant with respective scores of 3, 2, and 1. Fifty six of the sixty five judges provided complete responses. After analysis, some statements were rewritten again in light of criticism and comments of the experts. The relevancy weightage (RW) was calculated for each statements by using the following formula:

Relevancy weightage =

$$\frac{Most\ Relevant\ Responses * 3 + Relevant\ Responses * 2 + Least\ Relevant\ Responses * 1}{Maximum\ Possible\ Score}$$

The statements having relevancy weightage more than 0.70 were considered for the final selection of statements. At this point, a total of 48 statements were chosen based on weightage score.

(d) **Item analysis:** A schedule of 48 statements was developed and responses were gathered from 60 farmers in the non sampling area through personal interview. The farmers were requested to rate their level of agreement on a five point scale namely strongly agree, agree, undecided, disagree and strongly disagree with scores of 5, 4, 3, 2 & 1 for each positive statements and reverse scoring for negative statements, respectively. The total attitude score of a respondent was computed by adding the individual scores of all items.

(e) **Calculation of 't' values:** Respondents were sorted in descending order based on their total score. The top 25 per cent of the respondents with their total scores were considered as high group and the bottom 25 per cent as the low group so that these two groups provide criterion groups in terms of evaluating the individual statements. Thus, out of 60 respondents to whom the statements were administered for the item analysis, 15 respondents with highest and 15 respondents with lowest scores were used as criterion groups in terms of which to evaluate the individual statements. The 't' values were calculated in order to differentiate the responses of high and low groups for the individual statements by using the under mentioned formula (Edward, 1957).

$$t = \frac{\bar{X}_H - \bar{X}_L}{\sqrt{\dfrac{\sum(X_H - \bar{X}_H)^2 + \sum(X_L - \bar{X}_L)^2}{n(n-1)}}}$$

t = t value of particular statement (The extent to which a given statement differentiates between the high and low group).

X_H = The mean score on given statement of high group

X_L = The mean score on given statement of low group

N = Number of respondents in each group

Σ = Summation

As a general rule, a 't' value of 1.75 or greater indicates that the average response of the high and low groups to a statement differs significantly. Based on this, 22 statements with 't' values greater than 1.75 were retained (Appendix V). Thirteen of the 22 statements chosen for the study were positive, while nine were negative.

(f) **Standardization of the Scale:** For the standardization of the scale, the validity and reliability were examined. The split half method and content validity were used to examine reliability and validity respectively.

a) **Reliability of the scale:** A scale is considered to be reliable, if it consistently generates the same results, when applied to the same sample. The attitude scale so designed for the study was pre tested for its reliability by using the split half method. The twenty two selected attitude items were divided into two halves by odd even method. It was administered to 60 respondents from non sample area and who were not covered in the actual sample size of the research. The responses were collected on five point scale *viz.* Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (DA) and Strongly Disagree (SDA) having scores 5,4,3,2 and 1 respectively. Two sets of scores were obtained and these scores were correlated with each other. The correlation coefficient (rhh) between scores of two halves of statements was 0.761. The positive and significant correlation between the two sets of scores indicated that the scale was reliable. The reliability coefficient of whole scale was calculated by the formula given by Spearman (1910) and Brown (1910) as follows;

Reliability Coefficient (rSB) = $\frac{2 * rhh}{1 + rhh}$

Where, rhh = Reliability coefficient of the whole scale

Here, Correlation coefficient of the half-scale, found experimentally i. e. 0.761

Reliability Coefficient (rSB) = $\frac{2 * 0.761}{1 + 0.761}$ = 0.864

The reliability coefficient of whole scale was 0.864 which found significant and positive indicated that the whole scale was reliable.

b) **Validity of scale:** The content validity of statements was assessed by juries (experts) opinion through relevancy test. As the content of the attitude scale was thoroughly covered, the entire universe of IFS through literature consultation and experts opinion, it was assumed that the attitude scale measured what it was intended to measure. Furthermore, calculation of ‘t’ values assured high discriminatory values of the statements. Thus, the scale was taken as a valid measure of the desired dimension. Finally, 22 statements were selected to determine attitude of farmers towards Integrated Farming Systems and arranged in such a way that positive and negative statements appear randomly to avoid biased response.

g) **Administration of the Scale:** The final scale consisting of 22 statements was administered to the selected sample. The statements were rated in a five-point continuum ranging from 'Strongly Agree' to 'Strongly Disagree'. The positive statements were weighted with 5, 4, 3, 2, and 1, respectively whereas reverse scoring was done for negative statements. The total score of a respondent was computed by adding the score obtained for each items. Thus, the maximum score that could be obtained by a respondent was 110 and minimum was 22. The respondents of the study were further grouped in to three unfavourable, neutral and favourable group based on mean and standard deviation method. Further, factors influencing farmer attitudes were also examined based on the mean score obtained for each statement.

3.5. Data collection

The quality of a research work is determined by the veracity and truthfulness of the data gathered from relevant and reliable sources. Taking that into consideration, the tools and techniques used to carry out this research were chosen with extreme care. Data can be collected through both primary and secondary sources. Primary data refers to information that has been collected directly by the researcher, whereas secondary data are those that have already been gathered by another person, but can be used for completion of the research work. Collection of primary data was done with help of personal interviews, participatory rural appraisal (PRA), observation method and focused group discussion method using interview schedule (Appendix VI). On the basis of pertinent reviews, a semi structured interview schedule was framed in order to thoroughly examine the various objectives of the study. While choosing various statistical tools, due consideration was given to variables, objectives and nature of respondents. A pilot study was carried out in a non sample area, through which a draft schedule had been pretested and appropriately modified, before directly administering to the IFS farmers of the study area. Officials were also included as respondent categories in the study, only for the purpose of collecting data to assess the significant techno-socio-economic dimensions. To reach valid conclusions, the collected data were statistically analyzed and interpreted appropriately.

3.6 Statistical analysis

Collected data were compiled, tabulated and analyzed using a different statistical tools and techniques, includes: mean and standard deviation, frequencies, percentages, cumulative square root frequency, relevancy test, Principal Component Analysis, Integration index, reliability coefficient, Karl Pearson correlation coefficients. Data analysis were done using Microsoft excel and IBM SPSS 26 version software. Following statistical tests were applied for interpretation of data:

Frequency : It was calculated to know the number of respondents in a particular category

Percentage Analysis : Simple comparisons were made on the basis of percentage distribution of the farmers.

Mean Score: It was obtained by dividing total scores of each statement by total number of respondents.

$$\text{Mean Score} = \frac{\text{Total score of a practice}}{\text{Total number of respondents}}$$

Cumulative square root frequency: This measure was applied to group the respondents in to different stratum *viz.* low, medium and high categories.

Reliability Coefficient: The reliability coefficient of attitude scale was calculated by the formula given by Spearman (1910) and Brown (1910) as follows;

$$\text{Reliability Coefficient } (rSB) = \frac{2 * rhh}{1 + rhh}$$

Correlation analysis: It was applied to determine the degree of relationship between the independent variables and dependent variables.

Principal Component Analysis: Principal Component Analysis (PCA) method was used to construct indices for the selected indicators.

Integration index: Integration index was developed by Pushpa (1996) was used to find out the integration index score for this investigation.

$$\text{Integration Index} = \frac{\text{Integration score obtained by the respondent}}{\text{Possible maximum score for all the integration practicess}} \text{X } 100$$

Relevancy weightage: The relevancy weightage (RW) was calculated for selecting relevant statements by using the following formula:

$$\frac{\text{Most Relevant Responses}*3+\text{Relevant Responses}*2+\text{Least Relevant Responses}*1}{\text{Maximum Possible Score}}$$

CHAPTER –4

Results and Discussion

RESULTS AND DISCUSSION

The highly diversified agro ecosystems in Kerala support a multitude of crops and allied enterprises. Integrated Farming Systems have been shown to be an important way to improve the intake of safe and micro nutrient rich foods, particularly for households in Kerala. The present study sought to explore IFS units in Kerala. A thorough analysis carried out among the existing Integrated Farming System units will be helpful for the designing and improvement of the existing IFS units. It will explore the possibilities for developing new models and examine whether existing models could be scaled up. In this backdrop, it was critical to conduct a scientific and objective investigation into the existing IFS units in Kerala. Keeping in view of the objectives of the study, the empirical evidences gathered in terms of factual data were exposed to suitable statistical and analytical tests and the findings were analyzed and discussed in this chapter. The findings are organized as follows:

4.1. Profile characteristics of the IFS farmers

4.2. The extent of adoption of various components of the IFS and their contribution towards annual household income.

4.3. The technological needs of the farmers and the constraints faced by them for adopting IFS.

4.4. Measurement of attitude of farmers towards IFS

4.1. Profile characteristics of IFS farmers

The profile characteristics depict the socio- economic conditions of the respondents, which are thought to have an impact on one's subsistence. The data on the selected variables were gathered in order to understand the socio economic status of IFS farmers. The following sections discuss the categorization and distribution of respondents in relation to their profile characteristics.

4.1.1. Age

Age was defined as the chronological age of the respondent at the time of investigation. Table 4.1 and Fig. 4.1 revealed that most of the IFS farmers in Kerala belonged to old aged category, that means age above 50 (48.33 %) followed by middle aged group with a percentage of 43.89 per cent. Meanwhile, the percentage of youngsters in the state were very less (7.78 %) as compared to other two categories.

While going through district wise data, nearly half of the respondents belonged to old aged category in Kollam (53.33%) and Thrissur (50%) district, whereas, in Kannur districts most of the farmers fell in to middle aged group (46.67%). The lowest representation of youth, which was very low as compared to other categories, was a common trend that could be seen in all districts.

Table 4.1: Distribution of respondents according to their age

Categories (Year)	Kollam (n =60)		Thrissur (n =60)		Kannur (n =60)		Total (n=180)	
	f	%	f	%	f	%	f	%
Young (<36)	3	5.00	4	6.67	7	11.67	14	7.78
Middle (36 -50)	25	41.67	26	43.33	28	46.67	79	43.89
Old (>50)	32	53.33	30	50.00	25	41.66	87	48.33
Total	60	100	60	100	60	100	180	100

Age can be considered as a key factor, which indicates ones maturity in various activities. The findings revealed that, in totality more than ninety percentage of the respondents belonged to middle and old aged categories, whereas the percentage of young farmers were less than ten per cent. In Kerala majority of the youngsters were educated and they perceive agriculture profession as a labor-intensive and non profitable one. As a result, most young people were not interested in this line of work. Their greater urge towards Govt jobs and other white collar job is also a reason for this trend.

In case of middle and old aged group, majority of them undertook agriculture as an inherited occupation from their forefathers and they were interested in IFS because, it offers a steady income to the family and greater employment opportunity by integrating more components. The results were in line with that of Suraj (2021), who conducted a study in Kerala to analyse the entrepreneurial behaviours of dairy farmers and found that majority of the dairy farmers were having age above fifty, followed by middle aged group and young group respectively and that of Krishnapriya (2011), who conducted a study in homesteads of Kerala and found that nearly three fourth of the farmers were old aged followed by middle (26.67%) and young age (2.22%).

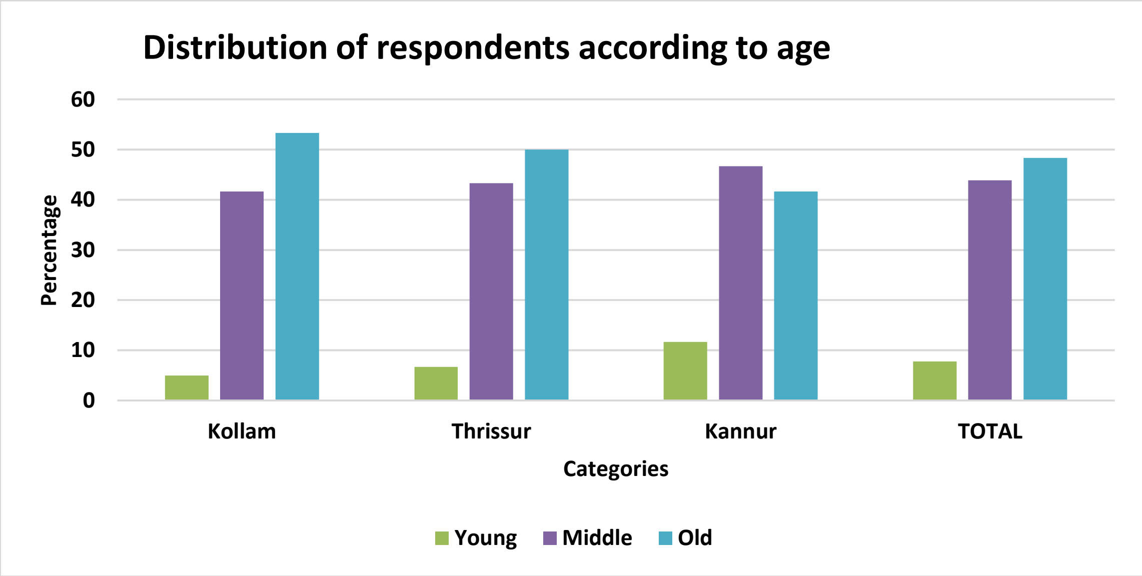


Fig. 4.1: Distribution of respondents according to age

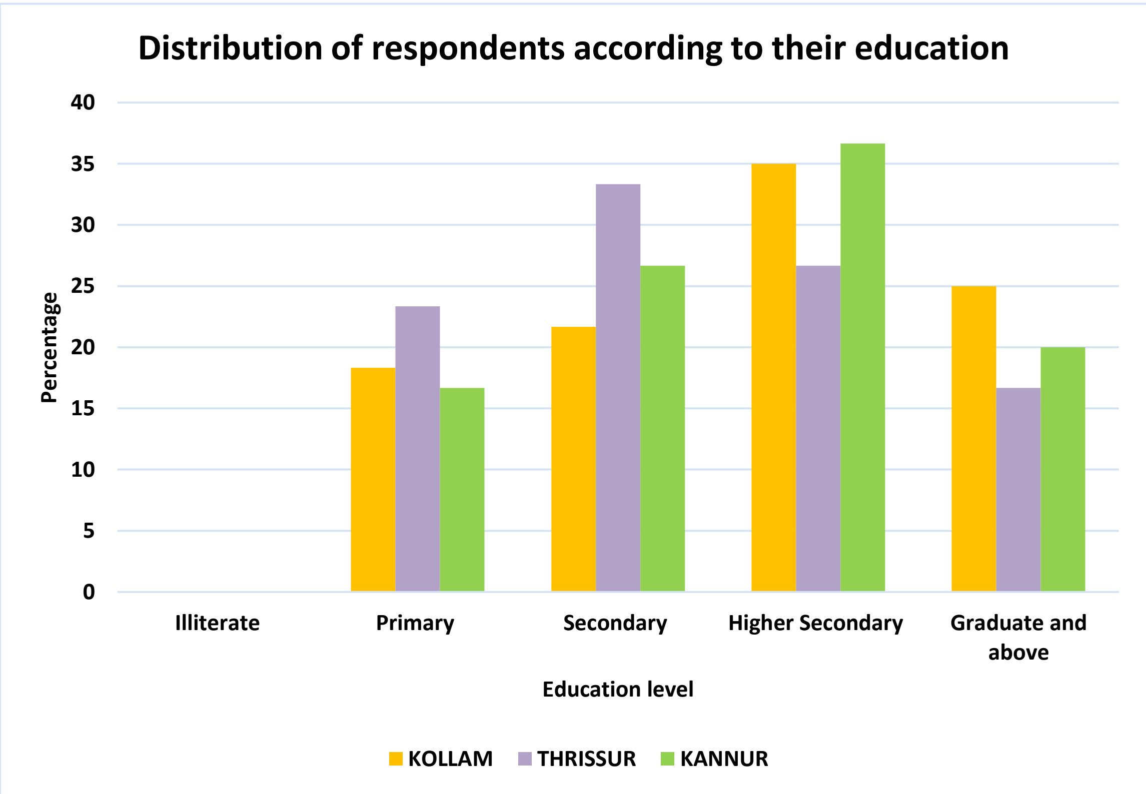


Fig. 4.2: Distribution of respondents according to their education

4.1.2. Education

Education clearly plays a significant role in the diffusion, acceptance, rejection and adoption of knowledge to peer groups. According to the findings of education level of IFS farmers, (Table 4.2 and Fig. 4.2) nearly one third of the respondents had completed education up to higher secondary (32.78 %) just near to that, 27.22 per cent had completed their secondary class. The next higher category was graduates and above (20.56 %) followed by farmers having education up to primary school education (19.44%).

Table 4.2: Distribution of respondents according to their education

Categories (Educational level)	Kollam (n =60)		Thrissur (n =60)		Kannur (n =60)		Total (n =180)	
	f	%	f	%	f	%	f	%
Illiterate	0	0	0	0	0	0	0	0
Primary (1 -7)	11	18.33	14	23.33	10	16.67	35	19.44
Secondary (8-10)	13	21.67	20	33.33	16	26.67	49	27.22
Higher Secondary (11-12)	21	35	16	26.67	22	36.66	59	32.78
Graduate and above	15	25	10	16.67	12	20	37	20.56
Total	60	100	60	100	60	100	180	100

Viewing district wise data, it is worth noting that none of the respondents were illiterate in any of the selected districts. Above one third (35%) of the respondents from Kollam district had higher secondary education. One fourth were qualified up to graduation and above degree and 21.67 per cent completed up to secondary class. As compared to other two district, in Thrissur district, higher percentage was reported in secondary level with percentages 33.33 per cent followed by higher secondary education (26.67%). In Kannur district, more than one third of the respondents (36.66 %) had completed higher secondary education followed by education up to secondary level (26.67%). The percentage of graduates and above reported in Kollam, Thrissur, Kannur district were 25 per cent, 16.67 per cent and 20 per cent, respectively.

Despite the fact that majority of the farmers were middle or old aged, the results show that they recognized the need of education. The aforementioned data were a clear indication of literacy status of Kerala. The higher level of education possessed by the respondents can be attributed to the well established educational system prevalent in the state. Educated IFS farmers could analyze the situations more efficiently and take decision about the integration of more components to increase profit accordingly. Similar results were reported by Mamatha (2017), who conducted a study among the IFS farmers of Kuttanad. It revealed that more than one third (36.67%) of the small farmers had high school education followed by less than one fourth (23.33 %) having middle school education. Another study conducted by Sebastian (2015) in the homestead farming systems of Thiruvananthapuram district of Kerala also reported a similar finding that majority (54%) of the homestead farmers had higher secondary education.

4.1.3. Family Size

Family size was operationally defined as the number of members of either sex living in a household/family dependent on the head of the family.Table 4.3 shows the allocation of respondents based on their family size in the study area.

According to the data presented (fig. 4.3), majority of the respondents (72.22 %) had small family size followed by medium size (25 %). A careful analysis of Table also depicted that same trend was visible in all districts. Respective percentages of small categories of respondents in Kollam, Thrissur and Kannur districts were 73.33 per cent, 76.67 per cent and 66.67 per cent, where as in case of medium category the percentages were 25 per cent, 18.33 per cent, 31.66 per cent respectively. Highest percentage in larger family size was reported in Thrissur district (5 %).

Table 4.3: Distribution of respondents according to family size

Categories (Number of members)	Kollam (n =60)		Thrissur (n =60)		Kannur (n =60)		Total (n=180)	
	f	%	f	%	f	%	f	%
Small (up to 5)	44	73.33	46	76.67	40	66.67	130	72.22
Medium (6-10)	15	25.00	11	18.33	19	31.66	45	25.00
Large (>10)	1	1.67	3	5.00	1	1.67	5	2.78
Total	60	100	60	100	60	100	180	100

From the aforementioned data (Table 4.3) it can be concluded that majority of the IFS farmers had small family size. The result emphasis the predilection for the nuclear family approach of Keralites. Furthermore, the fragmentation of land units visible in Kerala caused reduction of available agricultural land which led to the formation of homesteads with nuclear family types. Similar findings were reported in a study conducted among homesteads of Kerala by Sebastian (2015) that the family size of 83 per cent of the total homestead respondents were in between 2 - 4 members. In 2018, another study conducted by Sreelakshmi in five Agro Ecological Units of Thiruvananthapuram district also got similar result that nearly three fourth (70 %) of the homesteads were having small family size with 2-4 members.

4.1.4. Occupation

Based on the occupation, the IFS farmers were grouped in to four categories. Their distribution on the basis of their occupation was shown below (Table 4.4 and Fig 4.4). The occupation of more than half of the respondents (61.67%) was farming alone. One fourth (25 %) of the sample size were involved in other business along with farming. The percentages of respondents employed in government sector and as labour in addition to agriculture were 6. 11 per cent and 7.22 per cent respectively.

The detailed district wise analysis also showed the same trend. In all districts farming was the sole profession for the majority of the respondents followed by farming along with business. Highest percentage of farming as a sole profession was found in Kannur district (66.67%) and least in Thrissur district (55%). The percentage of IFS farmers who were involved in business in addition to farming was highest in Thrissur district (33.33%).

Table 4.4: Distribution of respondents according to their occupation.

Categories of occupation	Kollam (n =60)		Thrissur (n =60)		Kannur (n =60)		Total (n =180)	
	f	%	f	%	f	%	f	%
Farming as a sole profession	38	63.33	33	55	40	66.67	111	61.67
Farming+Agri. Labour	4	6.67	3	5.00	6	10.00	13	7.22
Farming + business	13	21.67	20	33.33	12	20.00	45	25.00
Farming+ service	5	8.33	4	6.67	2	3.33	11	6.11
Total	60	100	60	100	60	100	180	100

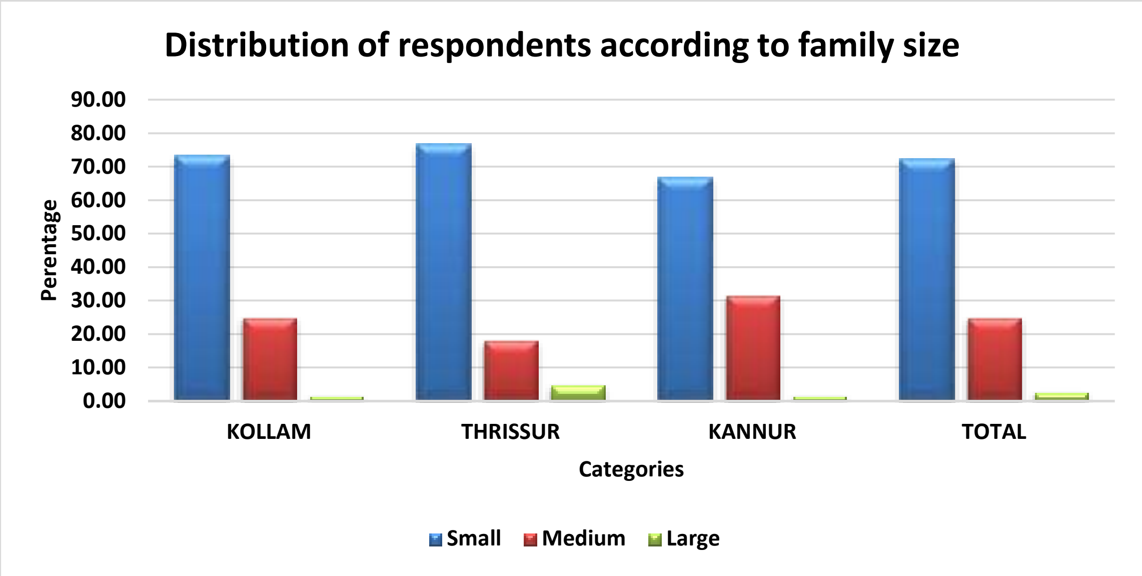


Fig. 4.3: Distribution of respondents according to family size

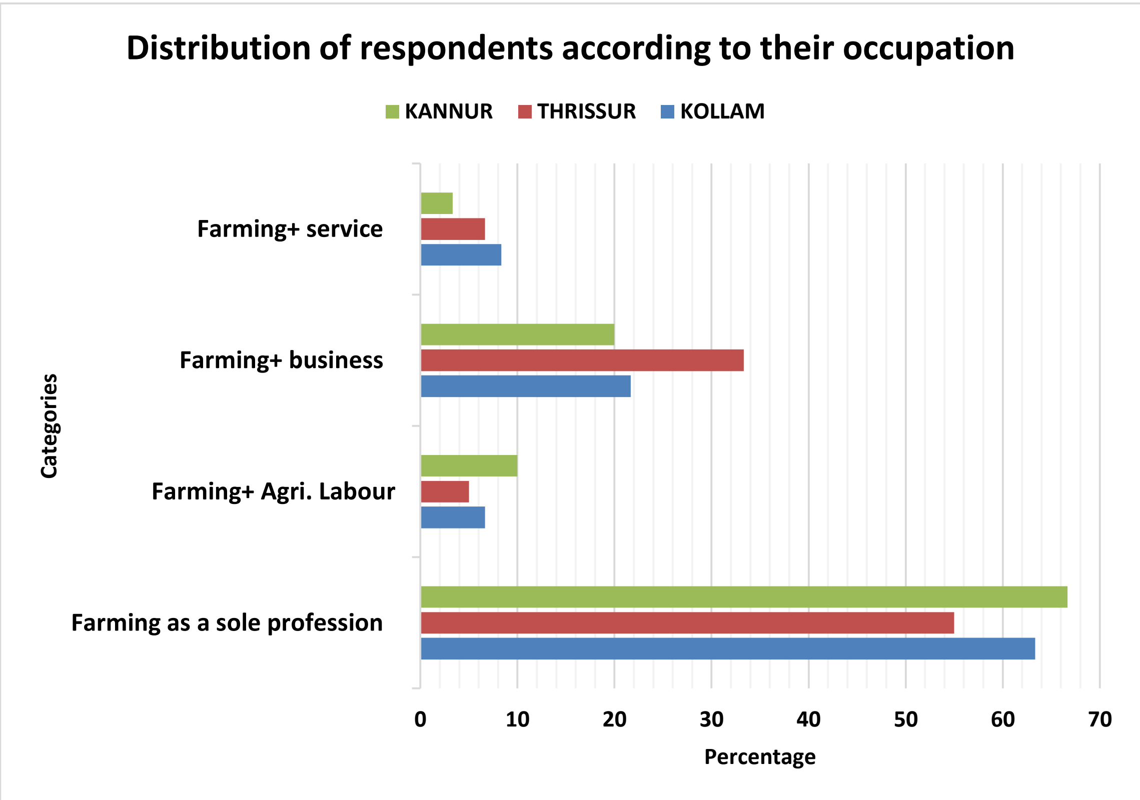


Fig. 4.4 : Distribution of respondents according to their occupation

From the Table 4.4, it can be concluded that, agriculture remains the primary occupation for majority (61.67%), albeit with slight variations between districts. This was primarily due to the fact that majority of the respondents were old aged people and agriculture was an inherited occupation from their forefathers. The limited scope of permanent employment in the non-agricultural sector also added to the situation. Another plausible explanation is that IFS consist of many components and in order to improve the profitability of those components, farmers who predominantly engaged IFS farming had to spend more time and effort into it. In the study area majority of the farmers were giving their full attention in to IFS only, which prevented them from engaging in to other jobs. The findings are consistent with those of Krishnan (2013), who found that more than half (60%) of the homestead growers of Kerala rely entirely on agriculture for earnings.

4.1.5. Farm Size

Farm size plays a dominant role in farming, because of its influence on the adoption of various technologies and addition of more components in the units, which influences total output. Table 4.5 and Fig 4.5 highlighted that eighty percentages of the total IFS farmers were marginal farmers with farm size of one hectare or less, followed by small farmers (19.44 %) with farm size in between 1.1 to 2 hectare. The percentage of farmers in other categories were negligible or nil. In Kollam district, three-quarters of the respondents were marginal farmers, compared to 80 per cent and 85 per cent in Thrissur and Kannur districts. The percentage of small farmers were high in Kollam district (25%) followed by Thrissur (20%) and Kannur district (13.33%).

Table 4.5: Distribution of respondents according to farm size

Categories of farm size	Kollam (n =60)		Thrissur (n =60)		Kannur (n =60)		Total (n =180)	
	f	%	f	%	f	%	f	%
Marginal (up to 1 ha)	45	75.00	48	80.00	51	85.00	144	80.00
Small (1.1 – 2 ha)	15	25.00	12	20.00	8	13.33	35	19.44
Semi Medium (2.1 - 4 ha)	0	0	0	0	1	1.67	1	0.56
Medium (4.1 – 10 ha)	0	0	0	0	0	0	0	0
Large (>10 ha)	0	0	0	0	0	0	0	0
Total	60	100	60	100	60	100	180	100

The high population density and nuclear family system exist among Keralites, led to the fragmentation of area and homestead based farming. Along with that use cultivable area for other non agricultural activities also resulted in shrinkage of cultivable area.These findings affirmed the data provided in the Tenth Agriculture Census 2015-16 of Kerala. According to the Tenth Agriculture Census 2015-16 of Kerala, the area of the holdings in all the size classes showed a decreasing tendency during the period from 2010-11 to 2015-16. According to official figures, majority (96.7 %) of the farming population were marginal farmers.The number of holdings increased (11.02%) in the marginal size class during the period from 2010-11 to 2015-16. Small, semi-medium and medium operational holdings (1.00 – 10.00 ha) in the current census were only 3.28% with 31.83% operated area. In 2010-11, the corresponding figures were 3.65% and 33.45% (Anon., 2019a). The findings of Basheer (2016) about the farm size of bittergourd farmers in Thiruvananthapuram district were in line with the above results, who reported that more than half (51.12%) of the bittergourd growers had possessed farm size less than 2 acres and less than one fourth (14.44 percent) were having farm size above 2 acres.

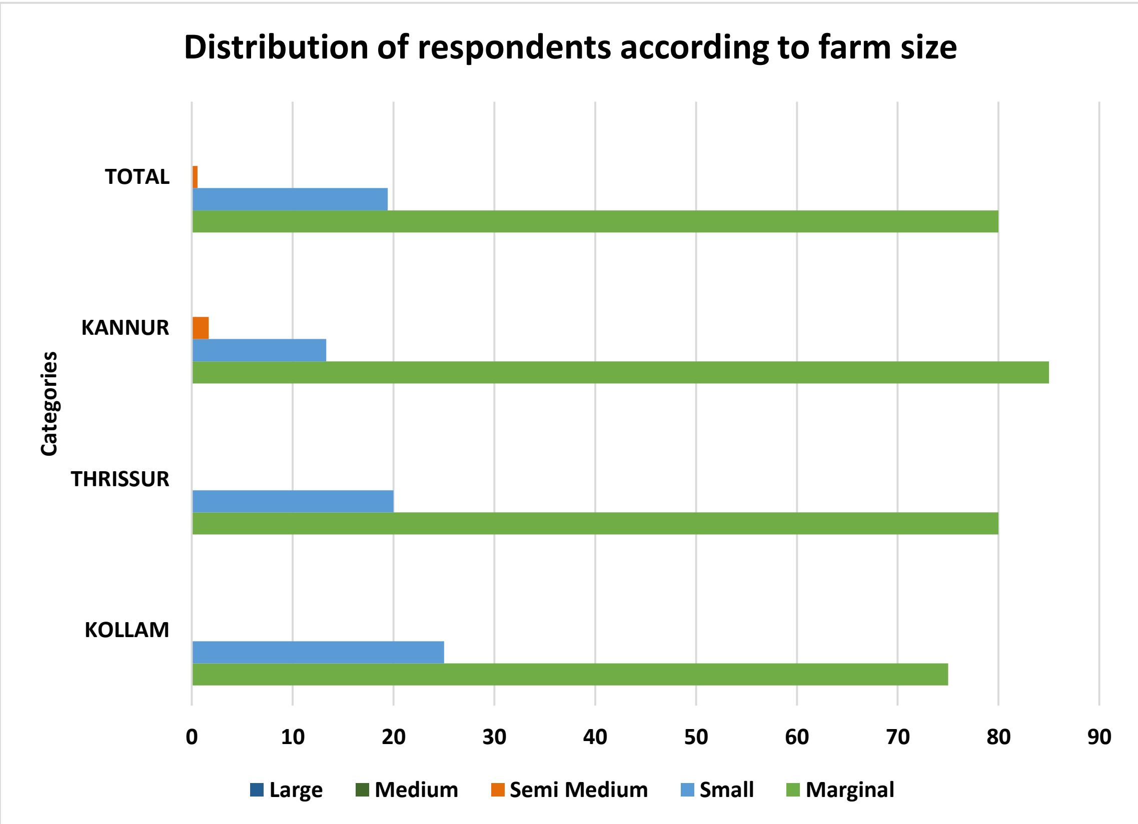


Fig. 4.5: Distribution of respondents according to farm size

4.1.6. Herd size

Herd size is generally influenced by resource availability such as land, labor and cropping system etc. Based on the Standard Animal Unit score (SAU score), IFS farmers in the study area were grouped in to small, medium and large category.

Table 4.6: Distribution of respondents according to herd size

Categories (SAU Score)	Kollam (n =60)		Thrissur (n =60)		Kannur (n=60)		Total (n =180)	
	f	%	f	%	f	%	f	%
Small (<4.21)	35	58.34	36	60.00	34	56.67	105	58.34
Medium (4.21 – 7.80)	17	28.33	19	31.67	17	28.33	53	29.44
Large (>7.80)	8	13.33	5	8.33	9	15.00	22	12.22
Total	60	100	60	100	60	100	180	100

From the Table 4.6, it was evident that majority of the farmers had small herd size (58.34 %) followed by medium (29.44 %) and large (12.22 %). The detailed district wise analysis also showed the same pattern. More than half of IFS farmers in all districts had a small herd size. In small category highest per cent was reported in Thrissur district (60 %) followed by Kollam (58.34 %) and Kannur district (56.67 %). Nearly one third of the respondents (31.67 %) in Thrissur district and more than one fourth in Kollam and Kannur district (28.33 % each) had medium herd size. In comparison to the small and medium categories, the percentage of IFS farmers with a large herd size was found to be very low (Kannur (15 %), Kollam (13.33 %) and Thrissur (8.33 %). While analysing the herd composition in the IFS units (Fig. 4.6), more than half of the total cattle population were cross breeds (56.90 %) followed by goat (31.88%), buffalo (7.87 %) and indigenous cows (3.35 %).

Dairy farming demands significant financial outlays. Land, buildings, equipment and cost of cows are more than that of goats. Furthermore, farmers found it challenging to expand their dairy farms due to high maintenance costs, high feed costs, and low milk prices. The findings were in line with that of Sreeram (2017), who conducted a study in four districts of Kerala, found that most of the dairy farmers (47.74 %) had small livestock holding (less than 4.70). According to him, land constraint was a serious issue in Kerala, made it difficult for farmers to keep more cattle.

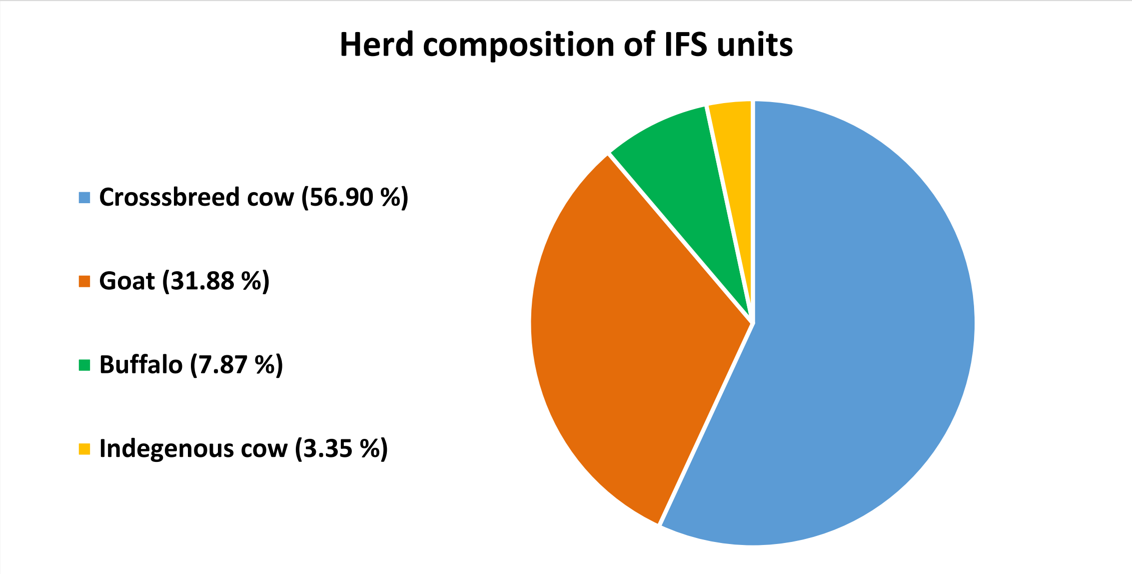


Fig. 4.6: Herd composition of IFS units

4.1.7. Experience in Integrated Farming System

An analysis of the data provided in table 4.7 and fig. 4.7, on experience of farmers in IFS revealed that most of the respondents (47.22 %) medium level experience (8 -12 years), followed by more than three fourth (38.34 %) had an experience less than 8 years in various IFS related activities. The same trend could be seen in district wise data also.

Table 4.7: Distribution of respondents according to experience in IFS

Categories (Years)	Kollam (n =60)		Thrissur (n =60)		Kannur (n =60)		Total (n =180)	
	f	%	f	%	f	%	f	%
Low (< 8 years)	23	38.33	21	35.00	25	41.67	69	38.34
Medium (8 – 12 years)	30	50.00	28	46.67	27	45.00	85	47.22
High (>12 years)	7	11.67	11	18.33	8	13.33	26	14.44
Total	60	100	60	100	60	100	180	100

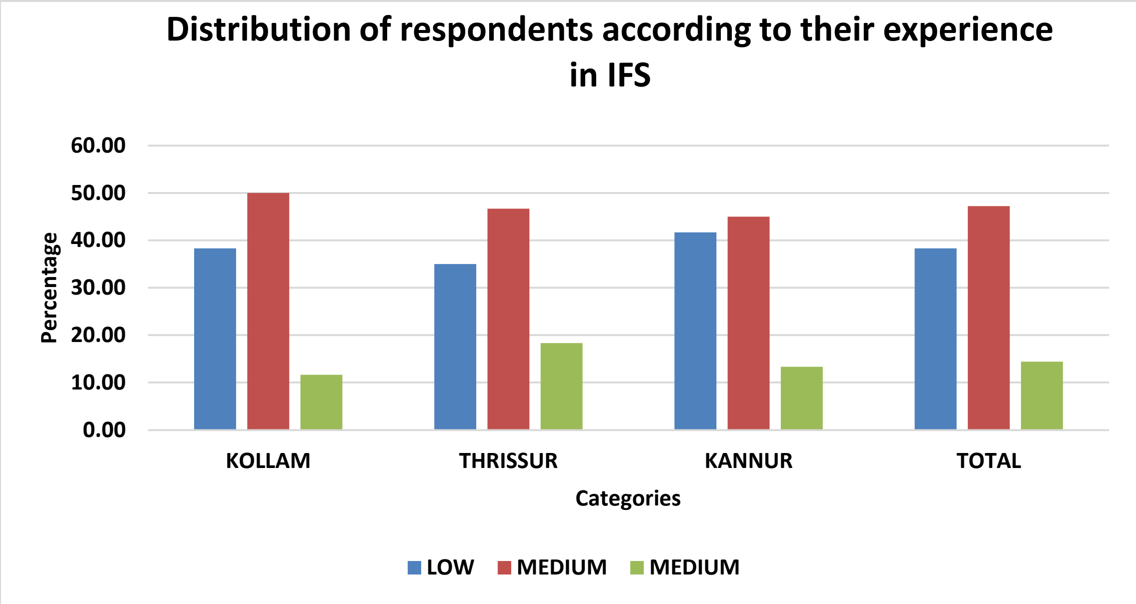


Fig. 4.7: Distribution of respondents according to their experience in IFS

Since IFS is not a new concept and mixed farming was a time-bound practice in Kerala, the majority of farmers began to integrate various components into their units years ago.The table also highlights the significant changes that had occurred in the number of IFS units in Kerala, over the last few years. This results can be attributed as an impact of various programmes implemented by Kerala Government with the support of Kerala Agricultural University (Integrated Farming System Research Station) and ATMA for increasing IFS units in the state. As part of the *Rebuild Kerala Initiatives*, a major initiative to revive the agricultural sector after flood, for the development of sustainable agriculture by integrating animal husbandry, fish, mushrooms, bee keeping, bio waste disposal and water conservation with agricultural crops, a new programme was launched in Kerala during 2020, named '*Jaivagraham*'. Financial assistance was given to farmers those who were interested in establishing new units and upgrading the existing IFS unit. As part of the programme around 40000 new IFS units established in the state within last two years, might be the reason for more than one third of the respondent belonged to low category. The findings were in accordance with that of Mamatha (2017) who found that majority of the marginal IFS farmers in Kuttanad area of Kerala had 6-10 years of experience whereas small farmers were found to have more than 10 years of experience.

4.1.8. Market orientation

Market-oriented cultivation begins with the identification of market opportunities as well as customers' demands, and it includes the selection of appropriate enterprises and procedures to meet those demands along with generating profits. A perusal of the following table 4.8, indicates that most (42.78 %) of the respondents had medium market orientation. One third (33.33 %) of the IFS farmers fell in high level category, whereas the percentage of farmers in low category were 23.89 per cent.

Table 4.8: Distribution of respondents according to their market orientation

Categories (Score)	Kollam (n =60)		Thrissur (n =60)		Kannur (n =60)		Total (n =180)	
	f	%	f	%	f	%	f	%
Low (<9.82)	16	26.67	13	21.66	14	23.33	43	23.89
Medium (9.82 -10.80)	24	40.00	28	46.67	25	41.67	77	42.78
High (> 10.80)	20	33.33	19	31.67	21	35.00	60	33.33
Total	60	100	60	100	60	100	180	100

Viewing district wise data (fig. 4.8), in all districts most of the respondents had medium level market orientation. Highest percentage was noticed in Thrissur district (46.67 %) next to that district Kannur (41.67 %) followed by Kollam district (40 %). In Kollam and Kannur district more than one third of the respondents fell in to high level with respective percentages 33.33 per cent and 35 per cent. As compared to high and medium categories, in all districts the percentage of respondents in low category was very less.

The result underlined that, in totality nearly three fourth of the IFS farmers in the study area had medium to high level market orientation. Farmers are frequently impeded by price fluctuations and as a result of this, a transition from traditional farming to more specialized farming had been occurred through IFS. The probable reason for this result might be that IFS farmers in the study area were more market oriented as well as profit driven and the market led farming activities by adding more components in the IFS units would have resulted in higher market orientation. This result is in agreement with the studies of Sakia and Khan (2012) and Maratha (2015).

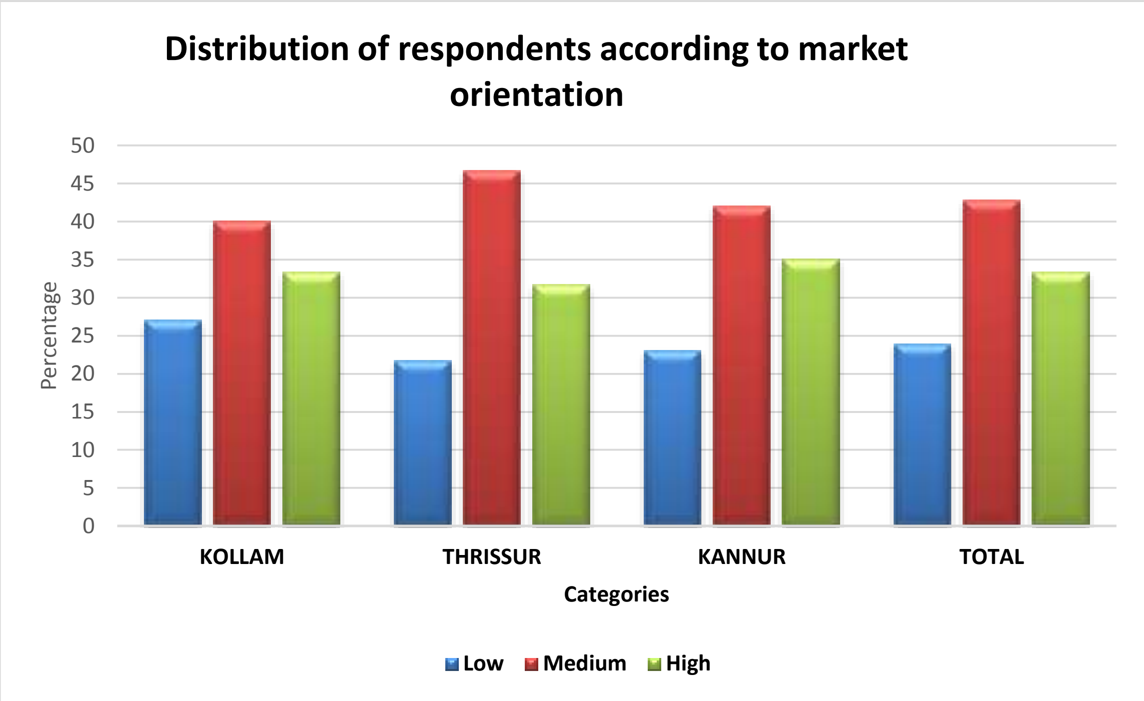


Fig. 4.8: Distribution of respondents according to market orientation

4.1.9. Mass media exposure

Exposure to mass media has a significant influence in timely availability of information as well as on knowledge level. A glance at the table 4.9 and fig. 4.9, implied that forty percentage of the respondents had high mass media exposure followed by 32. 78 per cent had medium level and 27.22 per cent had low level exposure to mass media.

Table 4.9: Distribution of respondents according to mass media exposure

Categories (Score)	Kollam (n=60)		Thrissur (n=60)		Kannur (n =60)		Total (n =180)	
	f	%	f	%	f	%	f	%
Low (<15.36)	13	21.67	16	26.67	20	33.33	49	27.22
Medium (15.36- 18.90)	22	36.67	20	33.33	17	28.34	59	32.78
High (>18.90)	25	41.66	24	40.00	23	38.33	72	40.00
Total	60	100	60	100	60	100	180	100

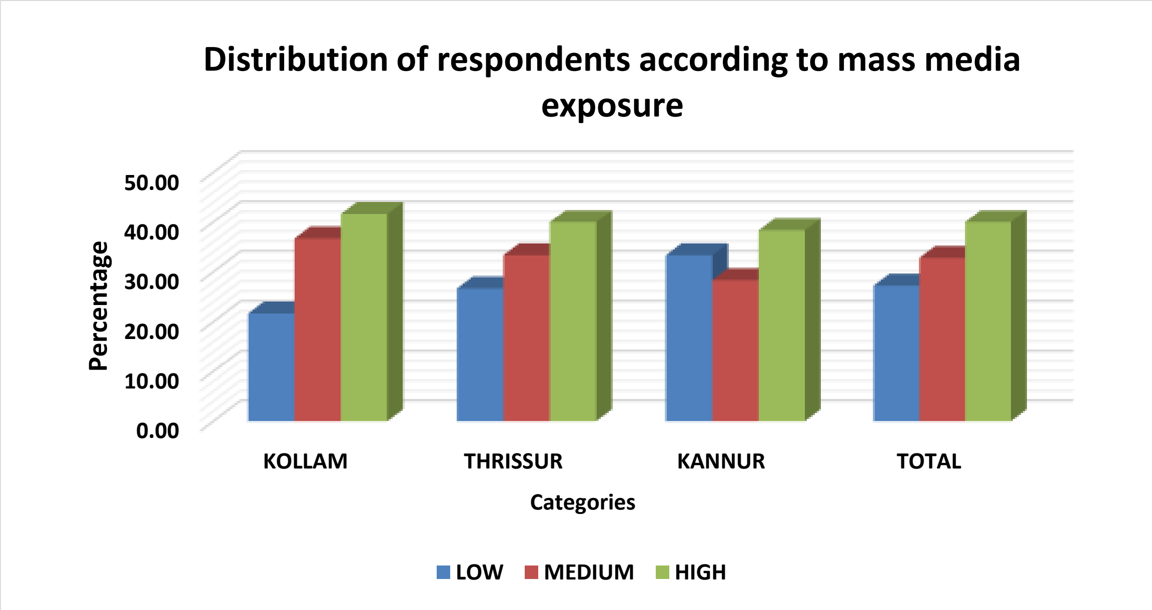


Fig. 4.9: Distribution of respondents according to mass media exposure

District wise distribution was also following the same pattern. Most (41.66 %) of the IFS farmers in Kollam district were having high mass media exposure, while more than one third (36.67 %) had medium exposure. In Thrissur district percentage of respondents in high, medium and low exposure category were 40 per cent, 33.33 per cent and 26.67 per cent respectively. More than one third (38.33 %) of the respondents in Kannur had high media exposure, followed by low exposure (33.33 %).

Table 4.10: Distribution of farmers according to use of various information sources

Information Sources	Kollam (n=60)		Thrissur (n=60)		Kannur (n=60)		Total (n=180)	
	f	%	f	%	f	%	f	%
Radio	34	56.67	31	51.67	36	60.00	101	56.11
TV	48	80.00	52	86.67	46	76.67	146	81.11
Newspapers	38	63.33	35	58.33	42	70.00	115	63.89
Magazines	29	48.33	36	60.00	33	55.00	98	54.44
Mobile phones (Internet/ Social media)	57	95.00	58	96.67	55	91.67	170	94.44

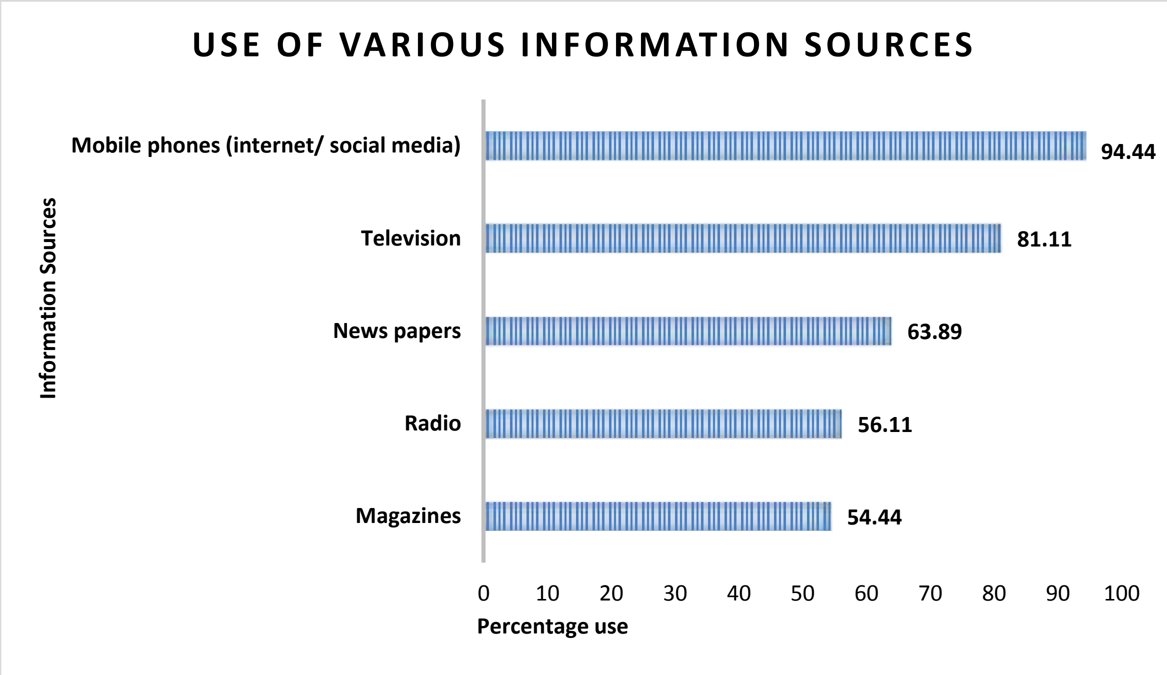


Fig. 4.10: Distribution of respondents according to use of various information sources

While considering the use of various information sources available (Table 4.10 and Fig. 4.10) mobile phones (internet/social media) were reported to be the most widely used mass media source (94.44) followed by televisions (81.11%) and newspapers (63.89%). Easy accessibility and usefulness of these media sources might be the reason for its high exposure. Due to lockdown associated with Covid 19 pandemic, majority of the farmers had moved to mass media and other online platforms for getting latest information. As an easy medium to reach at farmers door step, KISSAN Kerala mobile based agro services, has introduced several mobile based services to farmers, in the form of SMS, voice and videos etc. This might be the reason for higher mass media exposure and high use of mobile based media in the study area. Because the majority of farmers had televisions in their homes, the use of that medium was also found to be high. Since, farmers were educated and newspapers are one of the cheapest printed materials available, they use them extensively. The results support the findings of Sebastian (2015), who conducted a study in home gardens of Thiruvananthapuram district and found that among various mass media sources, television was found to be in very useful category followed by newspapers and magazines in useful category.

4.1.10 Extension Agency Contact

The extension agency contact is able to update the knowledge by providing information that will allow a farmer to understand and make decisions on a situation. Table 4.11 and fig. 4.11 depicts the distribution of IFS farmers based on their extension agency contact.

With regard to extension agency contact, most of the farmers (45.56 %) had medium level agency contact followed by high level contact (29.44 %). Among the IFS farmers, only one fourth of them had low level contact with extension agency. District wise analysis also confirms the same. Nearly half (43.33 %) of the respondents from Kollam district belonged to medium level, followed by high and low level extension agency contact (31.67 % and 25 % respectively). Majority of the farmers in Kannur and Thrissur district belonged to medium level with respective percentages, 51.67 per cent and 41.67 per cent, followed by high level contact (26.67 % and 30 % respectively).

Table 4.11: Distribution of respondents according to their extension agency contact

Categories (Scores)	Kollam (n =60)		Thrissur (n =60)		Kannur (n =60)		Total (n =180)	
	f	%	f	%	f	%	f	%
Low (<25.84)	15	25.00	17	28.33	13	21.66`	45	25.00
Medium (25.84 - 29.58)	26	43.33	25	41.67	31	51.67	82	45.56
High (>29.58)	19	31.67	18	30.00	16	26.67	53	29.44
Total	60	100	60	100	60	100	180	100

The most likely explanation for the majority of farmers in the medium and high category may be due to their desire to improve their situation as well as their curiosity in extension programs to update their knowledge and maintain contact with extension workers. In addition, as part of the recent IFS supporting programmes launched, farmers were encouraged to contact extension agencies for assistance and support.

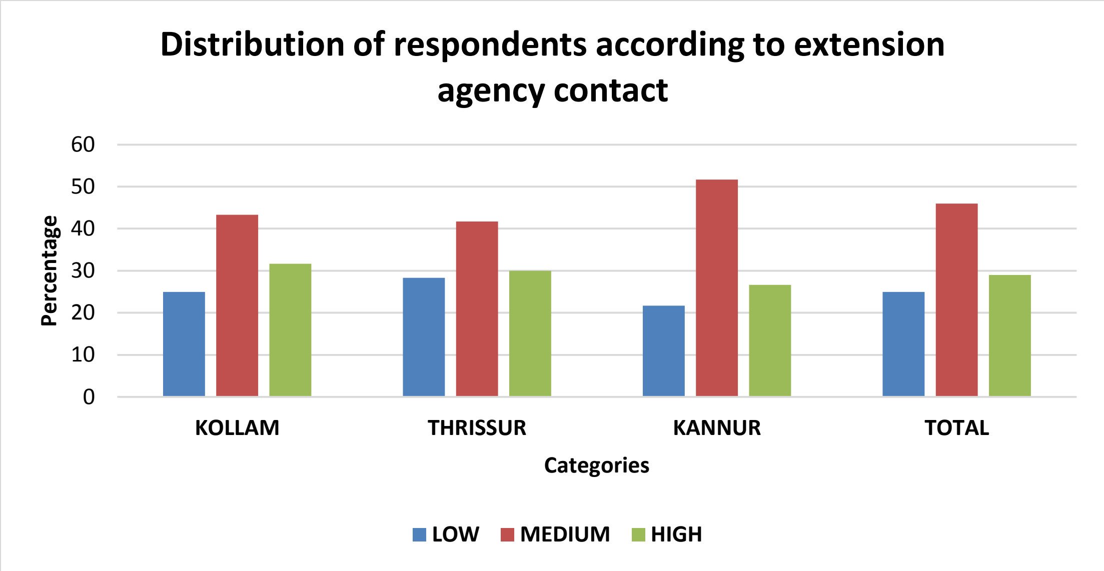


Fig. 4.11: Distribution of respondents according to extension agency contact

4.1.11 Participation in Extension Programmes

Participation of farmers in various extension programmes, serves as a platform to gain latest information, break down attitudes and practices that may be at odds with this new knowledge and persuade farmers to adopt new practices. As shown in the table (4.12.) below most (45 %) of the respondents had medium level extension participation. More than one fourth of the sample (29.44 %) had high level participation in extension activities followed by 25.56 per cent in low level participation.

Table 4.12: Distribution of respondents according to their extension participation

Categories (Scores)	Kollam (n =60)		Thrissur (n =60)		Kannur (n =60)		Total (n =180)	
	f	%	f	%	f	%	f	%
Low (< 11.74)	17	28.33	15	25.00	14	23.33	46	25.56
Medium (11.74- 14.70)	24	40.00	27	45.00	30	50.00	81	45.00
High (> 14.70)	19	31.67	18	30.00	16	26.67	53	29.44
Total	60	100	60	100	60	100	180	100

A cursory look at the district wise data showed that, in all districts extension participation of most of the respondents was in medium level. Highest percentage was reported in Kannur (50 %) followed by Thrissur district (45 %). In case of high extension participation category highest percentage was noticed in Kollam district (31.67%) followed by Thrissur district (30 %).

In terms of frequency of participation in various extension programmes (Table 4.13 and Fig. 4.12), more than half of the respondents (56.11%) were attending group farm meetings on a regular basis. Most of them were occasionally attending exhibitions (50 %), seminars (46.67 %) and demonstrations (45.56 %). More than half (59.45 %) of the respondents never attended any study tour yet (table 4.13 and fig. 4.12). The findings are keep up with the results of Sujitha (2015), who found that in Thiruvananthapuram district most of the homestead growers (52 %) occasionally participated in various extension programmes, whereas regular participation was only noted in less than one third of the respondents.

Table 4.13: Frequency of participation in extension programmes

Extension Programmes	Frequency and percentage (in bracket) of participation		
	Regular	Occasional	Never
Study tour	38 (21.11)	35 (19.44)	107 (59.45)
Seminar	60 (33.33)	84 (46.67)	36 (20.00)
Exhibition	53 (29.44)	90 (50.00)	37 (20.56)
Group farm meeting	101 (56.11)	56 (31.11)	23 (12.78)
Demonstration	56 (31.11)	82 (45.56)	42 (23.33)

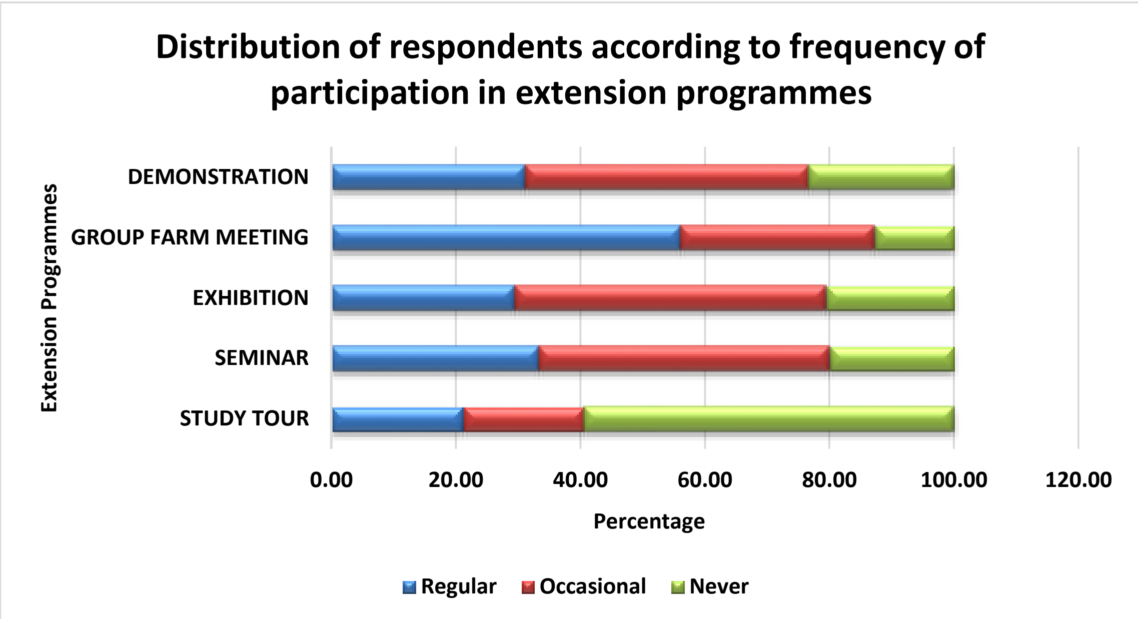


Fig. 4.12: Distribution of respondents according to frequency of participation in extension programmes

IFS comprise of many components requiring constant and equal attention. So time management is very important for balancing the functions of various components in a unit. The aforementioned data showed that majority of the respondents had medium level of participation in extension activities and regular participation was highest for group farm meetings. It might be due to the fact that majority of the farmers face difficulty in finding time for participating in other activities on a regular basis. Since several farming groups such as '*Padashekarasamithi'*, '*Agriculture Development Committee'*, '*Karshakakuttayma*', '*LEADS*' group in Kollam and Kannur district etc. were active in every panchayat, they often held meetings at the convenience of their members, which may account for their regular participation. So it can be concluded that time was the limiting factor that pulled farmers from their regular participation in various activities.

4.1.12. Irrigation potential

It refers to the extent to which irrigation water was available or scarce in the holding. A perusal of the following table 4.14 and fig. 4.13 indicated that nearly two third of the IFS farmers were grouped in the category of "little water scarcity". Less than one third of the sample size (28.89%) had felt "economic water scarcity" followed by 6.67 per cent reported to have "physical water scarcity".

This trend had not changed as we moved from district to district.More than two third (68.33%) of the respondents in Kollam district reported little or no water scarcity followed by Thrissur (65 %) and Kannur (60%). One fourth (25 %) of the respondents in Kollam district and less than one third of the IFS farmers in Thrissur (31.67 %) and Kannur (30%) district reported economic water scarcity. In all areas, percentage of farmers who face physical water scarcity was found to be less.

It was found that more than half of the respondents (64.4 %) belonged to little or no water scarcity group. It should be noted based on the results obtained on this small sample size, so it cannot be generalized for other districts, as water availability in an area is obviously dependent on topographical and climatic factors. In addition, the increased number of rainwater harvesting units in the study area also might have contributed to this result. These results were consistent with that of Krishnan (2013), who conducted a study in the homesteads of three districts of Kerala and found that, in general half of the homestead growers had no water scarcity followed by 26.67 per cent had physical water scarcity. According to the district wise data of that study, 80 per cent of the homestead growers in Ernakulam and 70 per cent in Thrissur belonged to little or no water scarcity group. However, 70 per cent of the homesteads of Palakkad district were facing physical scarcity.

Table 4.14: Distribution of the respondents according to irrigation potential

Categories	Kollam (n =60)		Thrissur (n =60)		Kannur (n =60)		Total (n =180)	
	f	%	f	%	f	%	f	%
Physical water scarcity	4	6.67	2	3.33	6	10.00	12	6.67
Economic water scarcity	15	25.00	19	31.67	18	30.00	52	28.89
Little or no water scarcity	41	68.33	39	65.00	36	60.00	116	64.44
Total	60	100	60	100	60	100	180	100

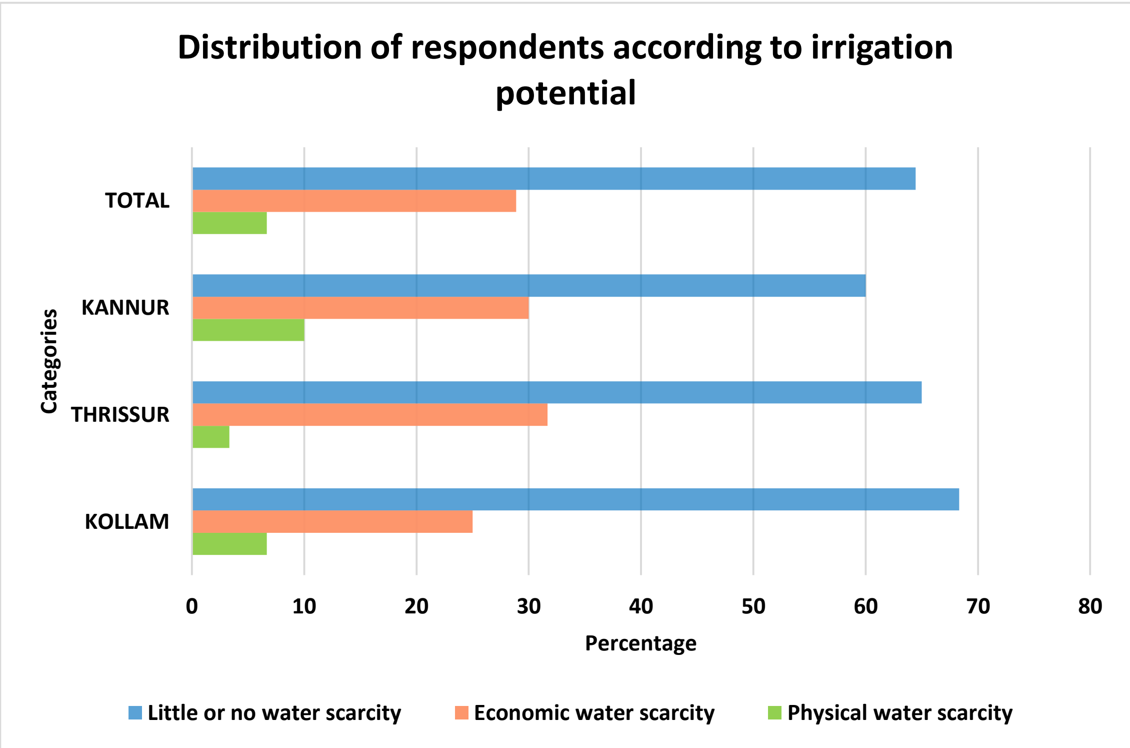


Fig. 4.13: Distribution of respondents according to irrigation potential

4.1.13. Economic Motivation

Economic motivation of a person is very important, as far as adoption of various components in an IFS unit is concerned, as it can influence the decision making process. The results (table 4.15) showed that 41.67 per cent of the total respondents belonged to group having high economic motivation. More than one third (34.44 %) of the sample size fell in medium level economic motivation followed by less than one fourth (23.89 %) in low category.

District wise interpretation (fig.4.14) pointed out that, near to or more than one third of the respondents in all districts had high and medium economic motivation. Highest per cent for higher level was noticed in Kannur (45 %) followed by Thrissur (43.33%) and Kollam (36.67%) district. In case of medium category, highest percentage was reported in Thrissur with a percent of 36.67 per cent followed by Kollam (35 %) and Kannur (31.67%).

Table 4.15: Distribution of the respondents based on their economic motivation

Categories (Score)	Kollam (n=60)		Thrissur (n =60)		Kannur (n =60)		Total (n =180)	
	f	%	f	%	f	%	f	%
Low (<19.87)	17	28.33	12	20.00	14	23.33	43	23.89
Medium (19.87 -24.85)	21	35.00	22	36.67	19	31.67	62	34.44
High (>24.85)	22	36.67	26	43.33	27	45.00	75	41.67
Total	60	100	60	100	60	100	180	100

Economic motivation is an important factor that can stimulate adoption of different components and technologies in a unit. IFS are designed to provide a stable income to the farm family thereby improving their livelihood. A glance at the table 4.15 and fig. 4.14 revealed that, nearly three fourth of the IFS farmers had medium to high level of economic motivation. It indicated the economic interest possessed by the IFS farmers. The IFS farmers of the selected area were focused more on reducing cost of cultivation by ensuring maximum utilization of the available components in the units. That means they were more profit oriented. This might be the reason for this result. The results were in line with those of Basheer (2016), who found that majority of the (95.56%) of the bitter gourd farmers in Thiruvananthapuram district had high level economic motivation.

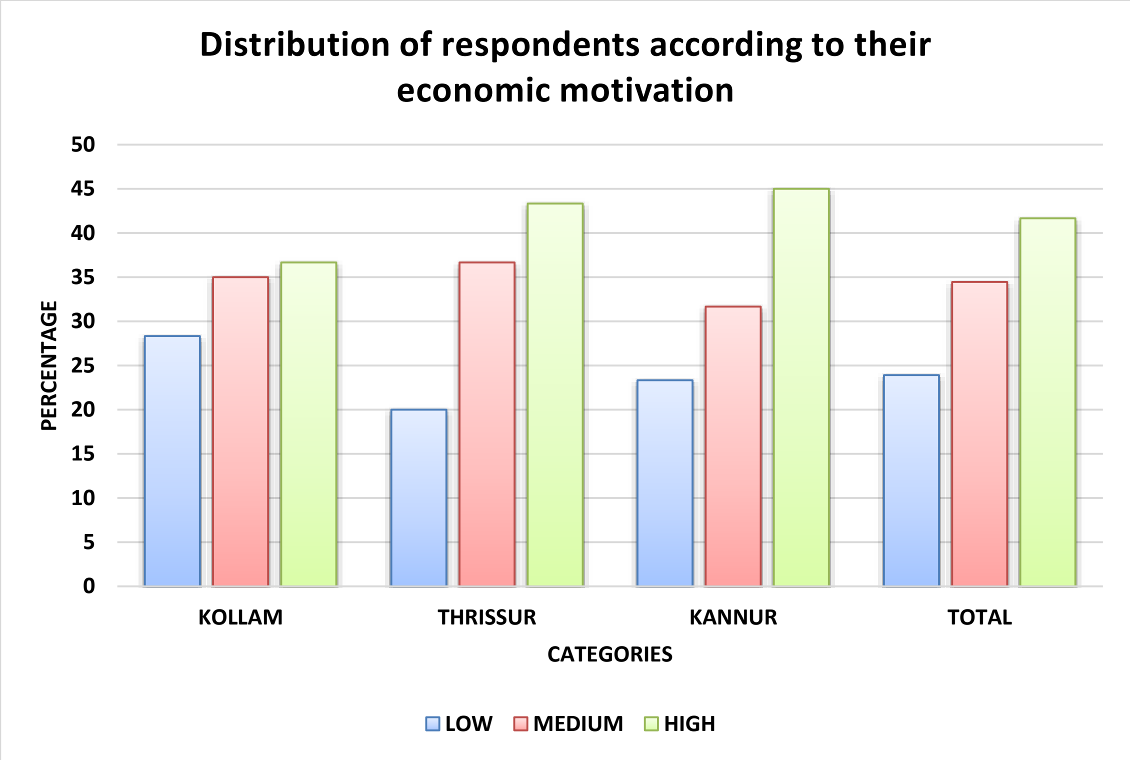


Fig.4.14: Distribution of respondents according to their economic motivation

4.1.14. Innovativeness

Innovativeness of an individual has a significant influence on adoption process. Based on the data collected, the respondents were placed in three categories and the classification was presented below (Table 4.16). Nearly two third (65 %) of the IFS farmers were somewhat innovative in nature with a score of 2. The next higher percent was noted for less innovative (21.11 %) followed by highly innovative category (13. 89 %). In Kollam and Kannur district majority (65 % in Kollam and 61.67% in Kannur) of the respondents belonged to somewhat innovative category, followed by less innovative category. One fifth (20%) of the total respondents from Kollam district and more than one fourth (26.67%) of the respondents in Kannur district had low innovativeness. In case of Thrissur district 68.33 per cent of the respondents were grouped in to somewhat innovative category followed by 16.67 per cent in less innovative category. Similar findings were reported by Basheer (2016).

Table 4.16: Distribution of the respondents according to their innovativeness

Categories	Score	Kollam (n =60)		Thrissur (n =60)		Kannur (n=60)		Total (n =180)	
		f	%	f	%	f	%	f	%
Less Innovative	1	12	20.00	10	16.67	16	26.67	38	21.11
Somewhat innovative	2	39	65.00	41	68.33	37	61.67	117	65.00
Highly innovative	3	9	15.00	9	15.00	7	11.66	25	13.89
Total		60	100	60	100	60	100	180	100

From the table 4.16 and fig. 4.15, it can be concluded that the level of innovativeness among IFS farmers was somewhat to less innovative. District wise data mirrored the overall result.

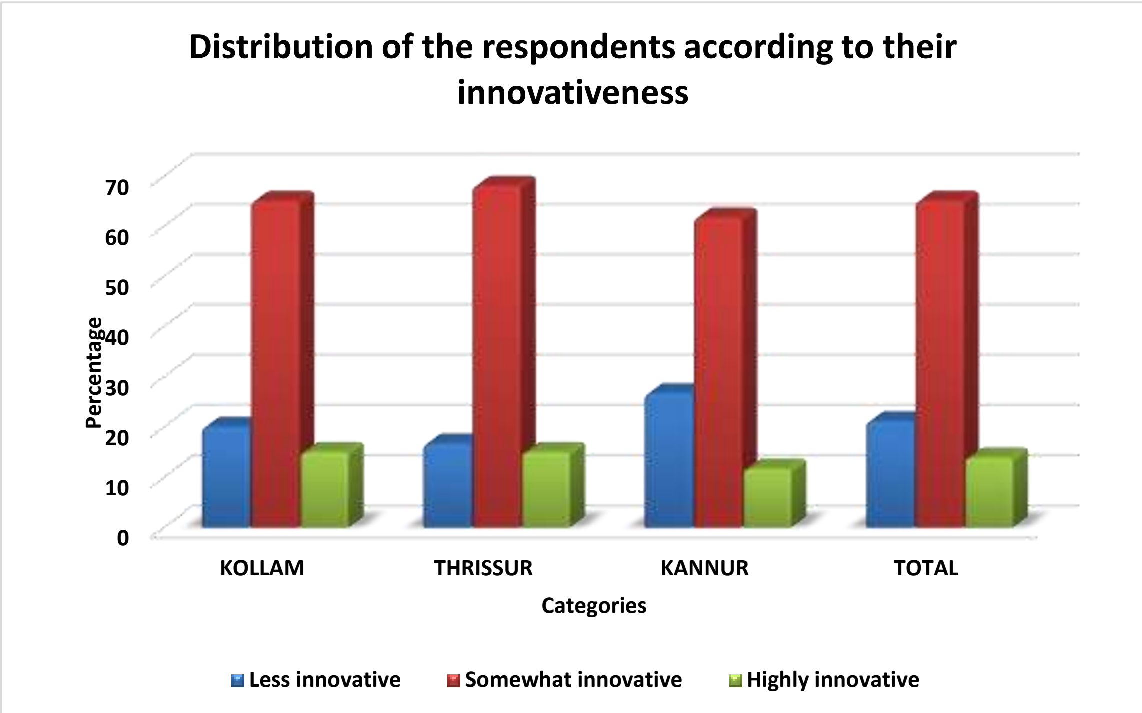


Fig. 4.15: Distribution of the respondents according to their innovativeness

Farmers, who are closely linked to the extension system, have greater access to diverse extension activities and the availability of new technologies is also higher. Age of the farmers could be an important element for showing low level of innovativeness. Majority of them belonged in middle and old aged group and they prefer to stick on traditional methods rather than experimenting new ideas. Fifteen per cent of the total respondents from Thrissur district were highly innovative. While analyzing the table 4.4 and 4.17, a higher number of farmers were noticed doing business and had high risk orientation in Thrissur. These combinations facilitate high innovativeness to those farmers.

4.1.15. Risk orientation

Agriculture is always associated with high risk (Kahan, 2013). Whenever we try to grow food, some unexpected things may happen. Risk orientation of a farmer significantly influences their decision making and adoption behaviour. It could be seen in the following table (4.17) and fig. (4.16) that majority of the IFS farmers had medium level risk orientation (40.56 %). About 34.44 per cent of the sample had high risk orientation and 25 per cent of the respondents had low risk orientation.

All the districts except Thrissur abided by the general trend. In Kollam and Kannur most of the respondents had medium level risk orientation followed by high and low level. Highest percent of medium level respondent was reported in Kollam (45 %) followed by Kannur (41.67 %). An exception was noticed in Thrissur district that, most of the respondents (38.33 %) belonged to high level risk orientation followed by 35 per cent in medium category. In terms of low risk orientation, Thrissur had the greatest percentage (26.67 %), followed by Kannur (25 %) and Kollam (23.33 %).

Risk orientation of farmers may vary according to their psychological and socio economic characteristics. From table 4.17, it could be observed that risk orientation of IFS farmers moved from medium to high. The result might be due to the contact of IFS farmers with various extension agencies and their engagement in extension programmes. These interactions might have transformed their negative thoughts and given them the confidence to adopt new component and technologies in their field to earn more. In addition, IFS farmers are subject to risk since their unit contains numerous components. So that for ensuring maximum profit and productivity, they should find out the best possibilities for combining the available components in a sustainable manner. As all components should support each other, it offers a high risk to farmers in selecting complementary components and their integration. The above observations also exhibited the same trend. These findings were in line with that of Mamatha (2017), who conducted a study in IFS in Kuttanad, reported that among the selected IFS farmers, nearly two third (73.33 %) of the small farmers and more than half of the marginal farmers (63.33%) belonged to medium level risk orientation.

Table 4.17: Distribution of the respondents according to their risk orientation

Categories (Score)	Kollam (n =60)		Thrissur (n =60)		Kannur (n=60)		Total (n =180)	
	f	%	f	%	f	%	f	%
Low (<19.16)	14	23.33	16	26.67	15	25.00	45	25.00
Medium (19.16 -23.65)	27	45.00	21	35.00	25	41.67	73	40.56
High (>23.65)	19	31.67	23	38.33	20	33.33	62	34.44
Total	60	100	60	100	60	100	180	100

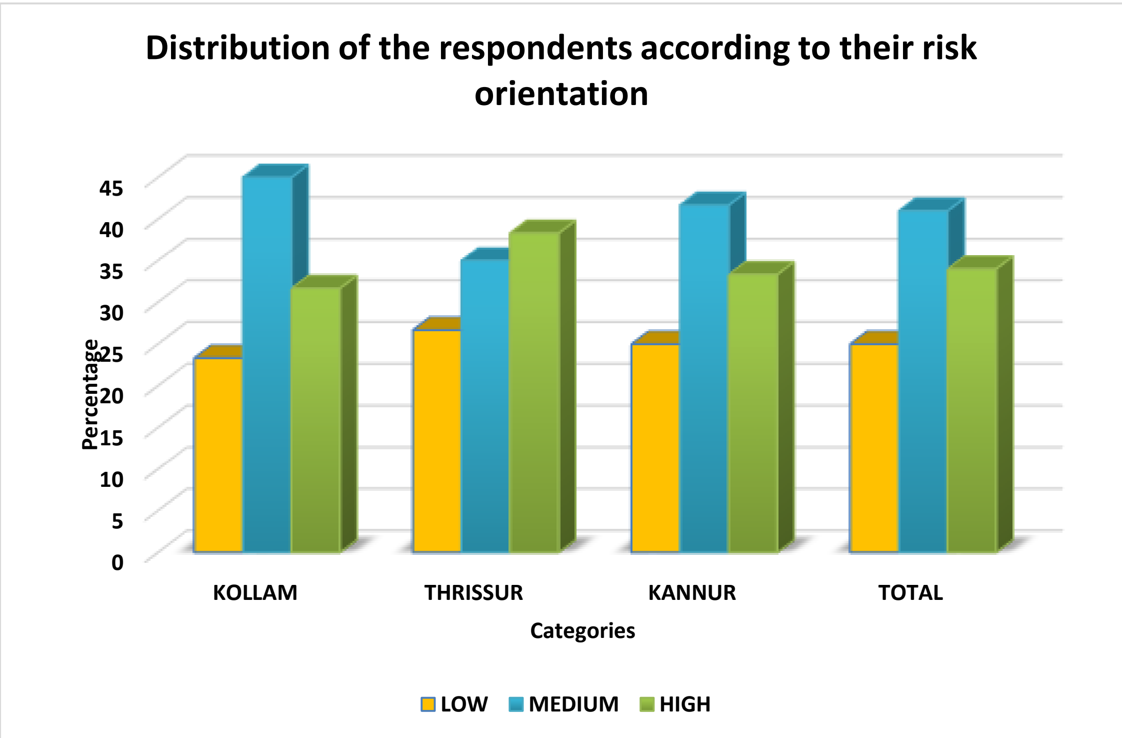


Fig. 4.16: Distribution of the respondents according to their risk orientation

4.1.16. Social Participation

Social participation refers to the extent of involvement of IFS farmers in various formal and informal organizations, either as a member or as an office bearer. The data on the level of social participation of IFS farmers was shown in the table 4.18 and fig. 4.17 below.

From the table 4.18, it was clear that most of the (46.67 %) IFS farmers had medium level social participation. Less than one third (28.89 %) and near to one fourth (24.44%) of the respondents were grouped respectively in high and low level categories. The district wise distribution also gave the same result. Majority of the farmers in all districts were having medium level social participation. Highest per cent was noted in Thrissur (51.67%) followed by, Kollam (46.67 %) and Kannur (41.67 %). The percent of high level category was highest in Kollam district and Kannur districts (30 % each) i.e., nearly one third of the respondent had high social participation, where as in Thrissur the percentage was less than one third of the sample size (26.66 %). Similarly, more than one fourth (28.33 %) of the total respondents in Kannur district had low level participation and less than one fourth of the respondents in Thrissur (21.67 %) and Kollam (23.33 %) belonged to low category. These findings were contradictory to those of Jacob (2015), who found that more than half of the (52 %) homestead growers had low level social participation.

Regarding the nature of social participation (fig. 4.18), highest participation was observed both as office bearer (12.78 %) and as a member (87.22 %) in cooperative societies like VIPANI and MILMA followed by farmers club (as office bearer (10 %) and as a member (61.11 %)

Table 4.18: Distribution of respondents according to their social participation

Categories (Score)	Kollam (n =60)		Thrissur (n=60)		Kannur (n =60)		Total (n =180)	
	f	%	f	%	f	%	f	%
Low (< 19.88)	14	23.33	13	21.67	17	28.33	44	24.44
Medium (19.88-23.50)	28	46.67	31	51.67	25	41.67	84	46.67
High (> 23.50)	18	30.00	16	26.66	18	30.00	52	28.89
Total	60	100	60	100	60	100	180	100

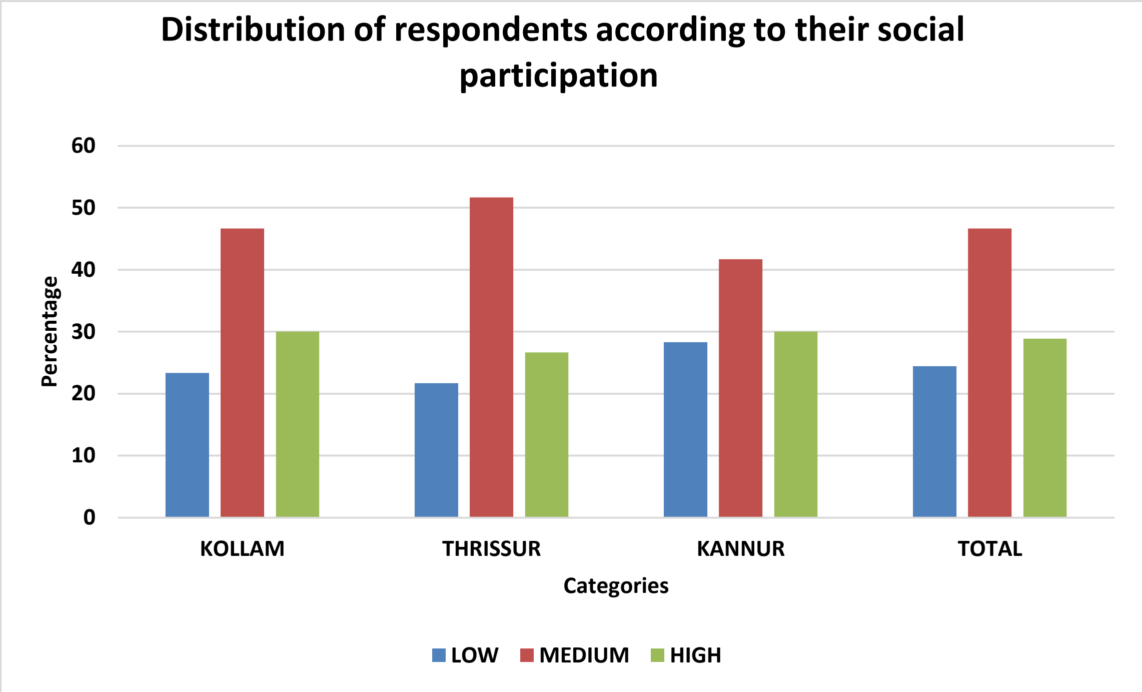


Fig. 4.17: Distribution of respondents according to their social participation

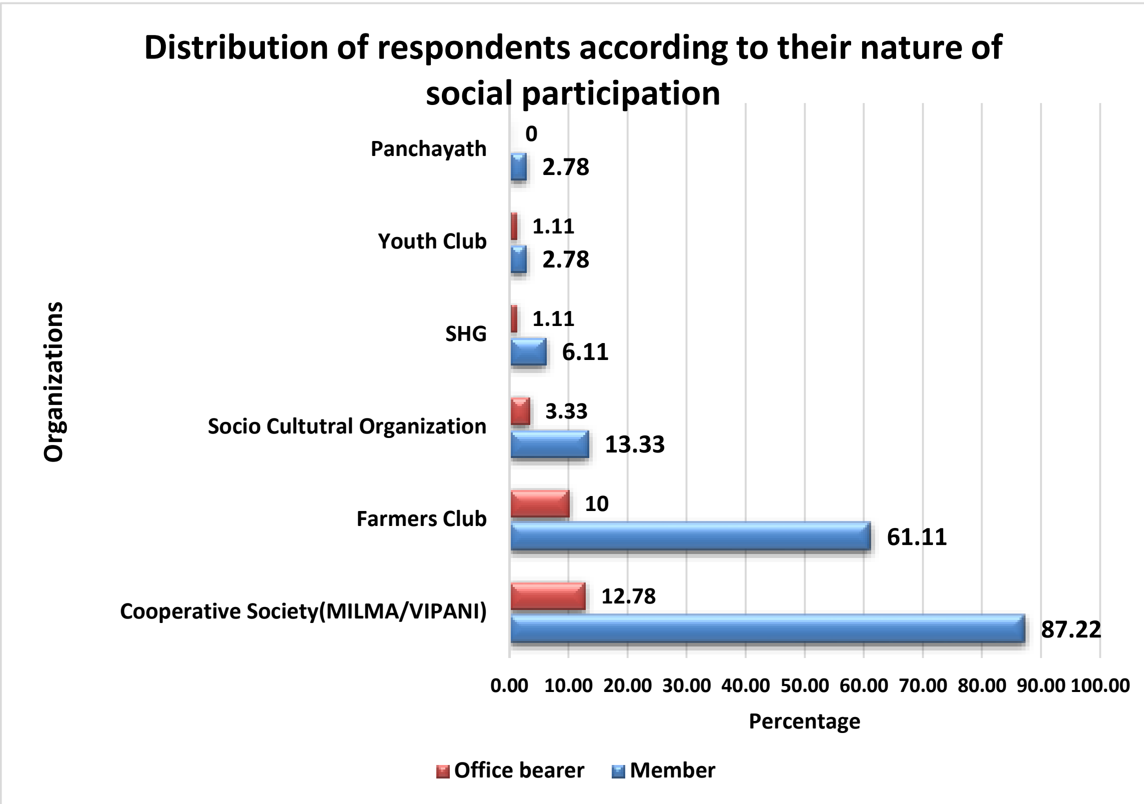


Fig. 4.18: Distribution of respondents according to their nature of social participation

Through cooperative societies farmers receive loans, supply of inputs at reasonable price occasionally, some societies such as VIPANI and MILMA also serve as a government procurement center for agricultural products and milk respectively. Since all the IFS farmers adopted crop and dairy component, majority of them were actively participating in these organization either as office bearers or as members to get more benefits from the government.

4.1.17. Training Undergone

Training helps to improve knowledge and skills. Through proper training farmers can improve their efficiency and ultimately productivity also can be enhanced. Here the IFS farmers were grouped in to four groups (Table 4.19) based on the number of training that they attended related to IFS.

Table 4.19: Distribution of respondents according to training undergone

Categories (No. of training attended)	Kollam (n =60)		Thrissur (n =60)		Kannur (n=60)		Total (n =180)	
	f	%	f	%	f	%	f	%
No Training	9	15.00	6	10.00	8	13.33	23	12.78
1- 5	28	46.67	34	56.67	30	50.00	92	51.11
6 -10	15	25.00	13	21.67	17	28.34	45	25.00
>10	8	13.33	7	11.66	5	8.33	20	11.11
Total	60	100	60	100	60	100	180	100

Table 4.19 and fig. 4.19 revealed that more than half (51.11 %) of the total respondents participated in 1 – 5 training within last three years. Only one fourth of the respondents attended 6-10 trainings over last three years. The number of categories of IFS farmers who had attended more than ten training was very less (11.11 %). The table also highlighted that 12.78 per cent of the sample had not participated in any training till date.

District wise data also mimic the same trend. More than half of the respondents in Thrissur (56.67 %) and Kannur district (50 %) had participated in 1- 5 trainings, whereas the respective percent for Kollam district was 46.67 per cent. The number of farmers who had attended 6 -10 trainings in last three years was highest in Kannur district (28.34%) followed by Kollam (25 %) and Thrissur (21.67%). The percentage of farmers those who had attended more than ten trainings and the percent who had never attended any training were high in Kollam district (13.33 % attended more than ten training and 15 % had never attended any training till date).

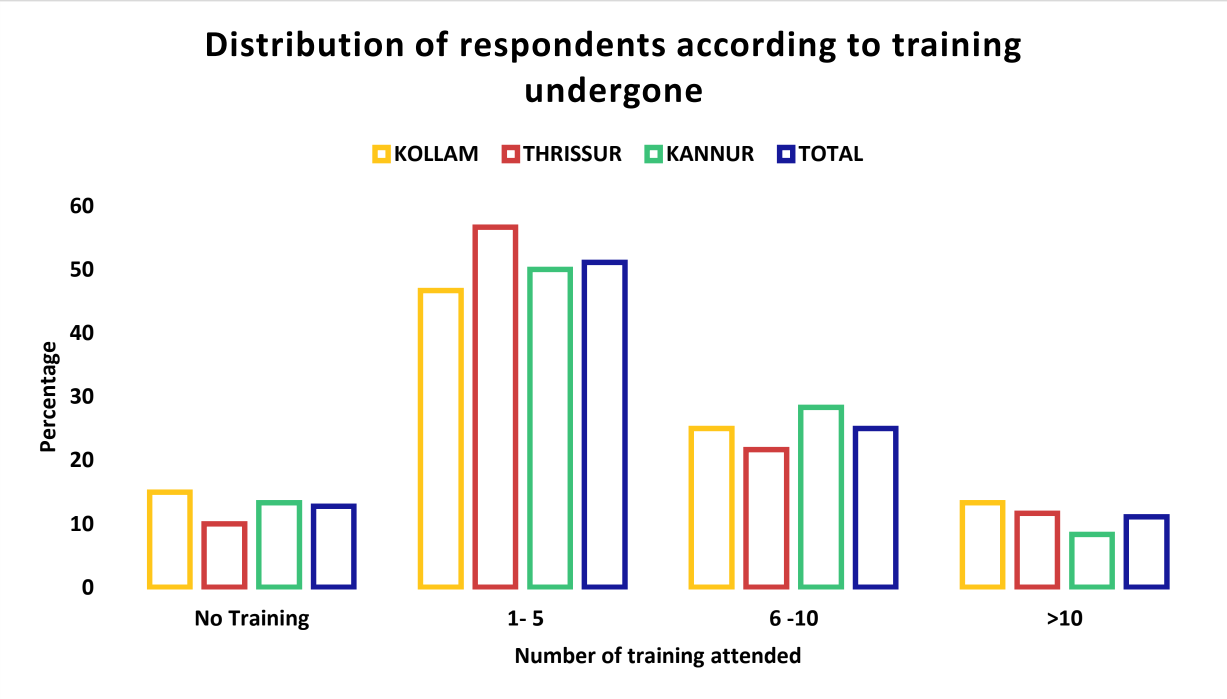


Fig. 4.19: Distribution of respondents according to training undergone

The Table 4.19 and fig. 4.19 clearly stated that majority (51.11%) of the respondents had participated in 1–5 trainings. The per cent of IFS farmers those who had attended more than six trainings in the last three years seems to be comparably less (25 %). The lockdown associated with Covid 19 affected all sectors negatively. The number of trainings conducted during lockdown time were very less as compared to previous years and gradually most of the experts and organizations had shifted their trainings, webinars etc. to online platforms such as Zoom, Google meet etc. However, majority of the respondents belonged to middle aged and old aged group, not having much proficiency in using smart phones. Due to this they were unable to take advantage of online training programmes. Besides, network issues and health issues (looking in to smart phone continuously cause strain for eyes) also prevented some of the farmers to grab these opportunities. In addition, we know that an IFS unit consist of multiple components and special attention is needed for all components. In this context, time acted as a limiting factor, which prevents farmers to engage in other activities. This also might be a reason for these results. The findings clearly show that extension professionals should motivate farmers for their active participation in various training programmes.

4.1.18. Awareness about Integrated Farming Systems

In this study awareness refers to the general information level of respondents with respect to different dimensions of Integrated Farming Systems. As seen in the following table (4.20) most of the IFS respondents (41.11 %) were highly aware about IFS. More than one third (36.67 %) of the respondents had medium level awareness whereas only less than one fourth (22.22 %) of the respondents belonged to low awareness category.

In district wise distribution (fig. 4.20), same trend was seen in Kollam and Thrissur districts. In both districts most of the respondents (46.67 % in Thrissur and 40 % in Kollam) were highly aware about different dimensions of IFS. More than one third (35 %) of the sample in Kollam and less than one third (31.66 %) of the sample in Thrissur belonged to medium category. In Kannur district, most of the respondents had medium level awareness (43.33 %) followed by more than one third (36.67 %) with high awareness. These findings were congruent with those of Krishnapriya (2011) who found that the awareness about the agrobiodiversity of homestead growers varies from medium to high level.

Table 4.20: Distribution of respondents according to awareness about IFS

Categories (Score)	**Kollam (n =60)**		**Thrissur (n =60)**		**Kannur (n =60)**		**Total (n =180)**	
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Low (<15.26)	15	25.00	13	21.67	12	20.00	40	22.22
Medium (15.26 -17.77)	21	35.00	19	31.66	26	43.33	66	36.67
High (>17.77)	24	40.00	28	46.67	22	36.67	74	41.11
Total	60	100	60	100	60	100	180	100

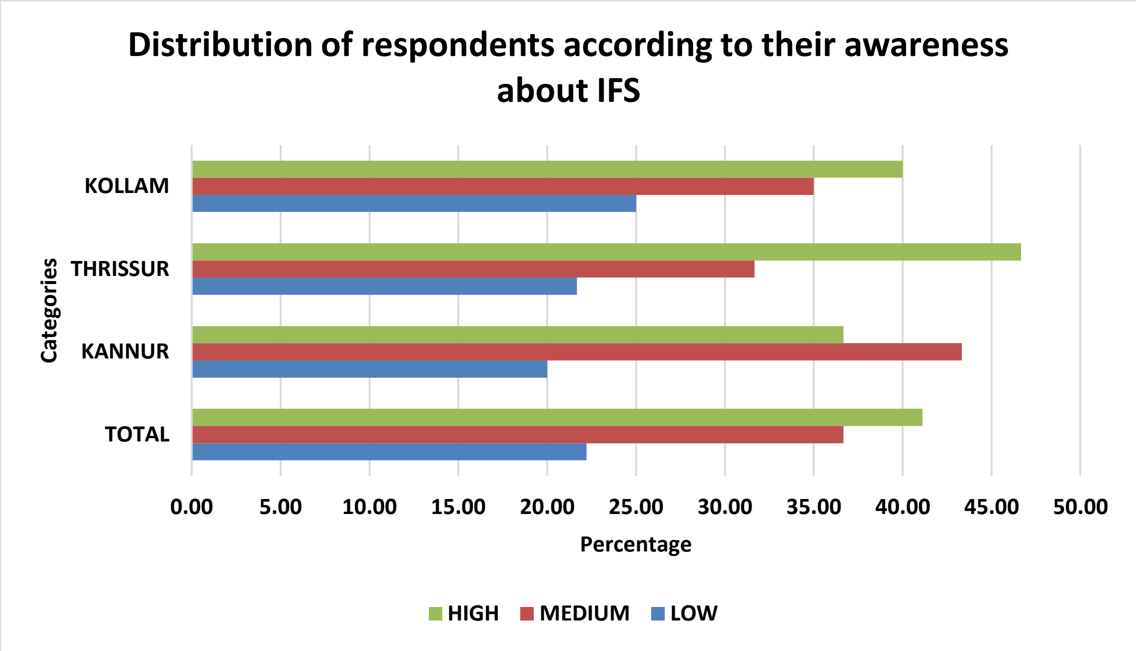


Fig. 4.20: Distribution of respondents according to their awareness about IFS

4.2. The extent of adoption of various components of the IFS and their contribution towards annual household income.

4.2.1. Identification of different components available in the study area

Numerous factors, including growing population, industrialization and agricultural transformation have contributed to the extensive exploitation of natural resources, which are essential to agriculture development. IFS is a viable option in a land hungry state like Kerala, for ensuring nutritional security, enhancing productivity and increasing income of farm families. For the upgradation of existing units, it is vital to ensure that available resources are used optimally. Hence, the selection of components has a significant role in overall productivity of the system. Thus, for designing an IFS unit in a profitable and sustainable manner, analysis of the available components is a prerequisite.

The predominant components in the study area were identified through PRA techniques such as transact walk as well as focus group discussions with experts in the relevant field and secondary data collection. Based on the availability, nine components were identified in the study area and arranged as major components and supporting components. The identified major components were: crop, dairy, poultry, fisheries, apiculture and supporting components were mushroom, composting, biogas and azolla. The component wise details were given below.

Table 4.21: Details of crop component seen in the IFS units of Kerala

Sl No	Components	Scientific Name	Varieties
I	**Cereals**		
1	Rice	*Oryza sativa*	Uma, Jyothy, Manurathna, Prathyasa, Ponmani, Kanchana, Akshaya
II	**Pulses**		
1	Cowpea	*Vigna unguiculata*	Kanakamony,Krishnamony, Sreya, Hridya, Anaswara, Pournami, Subra
2	Horse gram	*Macrotyloma uniflorum*	Pattambi Local, AK 21,AK 42
3	Black gram	*Vigna mungo*	TAU 2, TMV 1, KM 2, S1, Syama, Sumanjana
III	**Fruits**		
1	Banana	*Musa. Spp.*	Nendran, Robusta, Njalipoovan, Palayankodan, Koompillakannan, Kadali, Monthan
2	Jack	*Artocarpus heterophyllus*	Muttamvarikka, Sindhoor, Thenvarikka, Jack Vietnam,
3	Mango	*Mangifera indica*	Mallika, Alphonso, Kesar, Banganappalli, Neelam, Koottoorkonam, Priyur, Muvandan (Graft), Sindhuram, Chandrakaran
4	Pineapple	*Ananas comosus*	Amritha, Mauritius, Kannara, Kew
5	Papaya	*Carica papaya*	Red lady, CO 2, CO5

IV	**Tubers**		
1	Tapioca	*Manihot esculenta*	CTCRI and KAU varieties, Local varieties
2	Colocasia	*Colocasia esculenta*	
3	Elephant Foot Yam	*Amorphophallus paeoniifolius*	
4	Dioscorea	*Dioscorea* spp	
V	**Vegetables**		
1	Little gourd	*Coccinia grandis*	Local varieties , KAU varieties, Hybrids
2	Brinjal	*Solanum melongena*	
3	Tomato	*Solanum lycopersicum*	
4	Amaranthus	*Amaranthus spp*	
5	Bhindi	*Abelmoschus esculentus*	
6	Bitter gourd	*Momordica charantia*	
7	Ash gourd	*Benincasa hispida*	
8	Chekkurmanis	*Sauropus androgynus*	
9	Pumpkin	*Cucurbita moschata*	
10	Snake Gourd	*Trichosanthes anguina*	
11	Cucumber	*Cucumis sativus*	
12	Drumstick	*Moringa oleifera*	
13	Chilli	*Capsicum spp.*	
VI	**Oil yielding crops**		
1	Coconut	*Cocos nucifera*	T X D and D X T, Local Cultivars
2	Sesame	*Sesamum indicum*	Thilak, Thilothama, Soma, Thilathara, Thilarani, Surya Kayamkulam 1,

VII	**Spices and condiments**		
1	Pepper	*Piper nigrum*	Panniyur varieties, IISR Sakthi, IISR Thevam, Pournami, Local
2	Nutmeg	*Myristica fragrans*	IISR Viswashree, Local and Grafts
3	Clove	*Syzygium aromaticum*	Local
4	Turmeric	*Curcuma longa*	Varna, Kanthi, Suguna, Sudarshana, Suvarna, Sobha, IISR varieties
5	Ginger	*Zingiber officinale*	Athira, Aswathy, Karthika, Varada, Mahima, Rejatha, Local
VIII	**Plantation Crops**		
1	Rubber	*Hevea brasiliensis*	Budded plants, Clones
2	Arecanut	*Areca catechu*	Mangala, Sreemangala, Sumanagala, Mohitnagar,
3	Coffee	*Coffea spp.*	Arabica, Robusta
4	Cocoa	*Theobroma cacao*	CCRP Varieties
5	Betel vine	*Piper betle*	Thulasi, Karpuram, Arikodi, Amaravila, Pramuttan, Karilanchi, Perumkodi
6	Cashewnut	*Anacardium occidentale*	Anakkayam Varieties, Madakkathara Varieties, Kanaka, Dhana, Neehara, Dhanasree, Sree
IX	**Fodder crops**		
1	Guinea grass	*Panicum maximum*	Haritha, Marathakam, Makueni, Riversdale, CO(GG) 3

2	Hybrid Napier	*Pennisetum typhoides x P. purpureum*	PGN, NB Varities, IGFRI varietiesSuguna, Supriya, Susthira, CO varieties, Red Napier, Super Napier, Sampoorna (DHN -6)
3	Para grass	*Brachiaria mutica*	KAU Varieties
4	Congo signal grass	*B. ruziziensis*	
X	**Medicinal and Ornamental Crops**		
1	Jasmine	*Jasminum spp.*	Kuttimulla, CO varieties, Local
2	Orchids	*Dendrobium*	Dendrobium, Aranda, Mokara, Arachnis, Vanda,
3	Anthurium	*Anthurium spp.*	Lima White, Tropical, Nitta, Agnihotri, Liver Red
4	Neelaamari	*Indigofera tinctoria*	Local type
5	Aloe vera	*Aloe vera*	

Table 4.22: Details of livestock component seen in IFS of Kerala

Sl No.	Livestock	Breeds	Use
I	**Animal Component**		
1	Cow	Vechur, Gir, Sunandhini, Sahiwal, HF cross, Jersy cross	Milk, Manure
2	Buffalo	Murrah, Surti, Non descript	Milk, Meat, Manure
3	Goat	Malabari, Jamnapari, Attapady black , Osmanabadi	Milk, Meat, Manure , sale of kids
4	Pig	Non Descript, Large White Yorkshire, Cross breds, Duroc	Meat
5	Rabbit	Soviet Chinchilla, Grey Giant, White Giant, Cross breds.	Meat, sale of bunnies

II	Poultry Component		
1	Chicken	Gramalakshmi, Gramasree, Gramapriya, Athulya, Tellichery Chicken, Naked Neck, White Leghorn, Kadaknath	Egg, Manure, Meat, sale of day old chicks
2	Duck	Chara, Chempalli, Kuttanad ducks	
3	Quail	Japanese Quail	
4	Turkey	Broad Breasted Bronze	Meat , Manure
5	Goose	White Chinese, Grey Chines	

Table 4.23: Details of fisheries component seen in IFS of Kerala

Sl No.	Type	Scientific Name	Use
1	Catla	*Catla catla*	Fish, sale of Fingerlings
2	Rohu	*Labeo rohita*	
3	Mrigal	*Cirrhinus mrigala*	
4	Tilapia	*Oreochromis niloticus*	
5	Snakehead murrel	*Channa striatus*	
6	Walking Catfish	*Clarias sp*	
7	Pearlspot	*Etroplus suratensis*	

Table 4.24: Details of Apiculture units seen in IFS of Kerala

Sl No.	Type of bees	Scientific Name	Use
1	Indian Bee	*Apis cerana indica*	Honey, Pollination
2	Stingless Bee	*Trigona iridipennis*	

Table 4.25: Details of supporting components seen in IFS of Kerala

Sl No.	Types of Component	Varieties	Use
I	**Mushroom**		
1	Oyster Mushroom	KAU varieties, Hybrids	Spawn, Mushroom
2	Milky Mushroom		
II	**Composting**		
1	Vermi composting	Bio fertilizer	
2	Coir pith Composting		
3	Kitchen waste composting		

4.2.2. Extent of adoption of available components in the IFS units of Kerala

The successful combination of appropriate components in an integrated farming system gives higher productivity and returns than monocropping. A composite index was developed in order to determine the extent of adoption of available components in the study area. Table 4.26, shows the list of indicators retained after Principal Component Analysis along with their weightage.

Table 4.26: List of indicators retained after Principal Component Analysis

Sl No.	Indicators	Measurement Unit	Weightage
I	**Common Indicators**		
1	Technology adoption	Score	0.044
2	Farm waste management	Ratio	0.135
3	Need for input supply and services	Score	0.118
4	Farm machinery and equipment possession	Number	0.042
5	Natural resource utilization	Score	0.022
6	Permanent asset creation	Score	0.226

II	**Crop Component**		
7.	Dominance profile of crops	Number	0.170
8.	Cropping intensity	Ratio	0.292
9.	Area allocation for crops	Value	0.192
10.	Percentage of irrigated land	Percentage	0.126
III	**Dairy Component**		
11.	Milk production (l/day)	Value	0.032
12.	Milk marketing (l/day)	Value	0.032
13.	Area under fodder crop	Value	0.116
IV	**Apiculture**		
14.	Apiary size	Score	0.033
15.	Production per hive(Kg)	Value	0.117
16.	Types of hive used	Score	0.012
V	**Mushroom**		
17.	Quantity of fresh mushroom production/ annum	Value	0.424
VI	**Fisheries**		
18.	Pond size	Value	0.197
19.	Yield	Value	0.121
VII	**Poultry**		
20.	No. of Birds possessed	Number	0.067
21.	Marketed egg	Value	0.047
VIII	**Compost Unit**		
22.	Type of composting	Score	0.069
IX	**Biogas Plant**		
23.	Source of energy	Score	0.091
X	**Azolla**		
24.	Types of green manures used	Score	0.112
25.	Feed Ingredients	Score	0.059

As illustrated in Table 4.26, twenty five indicators for developing the adoption index were subjected to Principal Component Analysis and first nine principal components were selected with eigen values greater than 1. The eigen value for the selected nine principal components were 4.300, 3.131, 2.353, 2.054, 1.878, 1.470, 1.367, 1.167, 1.079. The values of first principal component in the rotational component matrix were taken as final weightage. The normalized values of each indicator were multiplied with its respective weightage. The multiplied values of indicators were summated for each respondent to obtain the final composite index. The respondents were finally categorized, based on composite index values obtained into low, medium and high adoption levels using the cumulative square root frequency method.

4.2.2.1. Categorization of IFS farmers based on extent of adoption of available components

Based on the composite index score obtained, the IFS farmers were categorized into low, medium and high adoption levels as follows (Table 4.27)

Table 4.27: Distribution of respondents based on extent of adoption of available components

Categories (Adoption Index Score)	Kollam (n=60)		Thrissur (n=60)		Kannur (n=60)		Total (n=180)	
	f	%	f	%	f	%	f	%
Low (<0.32)	22	36.67	24	40.00	26	43.33	72	40.00
Medium (0.32 – 0.60)	25	41.67	20	33.33	22	36.67	67	37.22
High (>0.60)	13	21.66	16	26.67	12	20.00	41	22.78
Total	60	100	60	100	60	100	180	100

According to the preceding table 4.27 and fig. 4.21, most (40 %) of the IFS farmers exhibited low level adoption of available components in their units, followed by medium level adoption (37.22 %). Only less than one fourth (22.78 %) had shown high level adoption. Same trend was noticed in Thrissur and Kannur ditrict also. Nearly two fifth of the respondents in both in Thrissur (40 %) and Kannur district (43.33%) were had low level adoption followed by medium with respective percentages 33.33 per cent and 36.67

per cent. A slight change was noticed from the general trend in Kollam district, as most (41.67%) of the respondents showed medium level adoption followed by low level (36.67 %). Across all districts, less than one third of the total respondents (21.66 % in Kollam, 26.67 % in Thrissur and 20 % in Kannur) only exhibited high level adoption of available components.

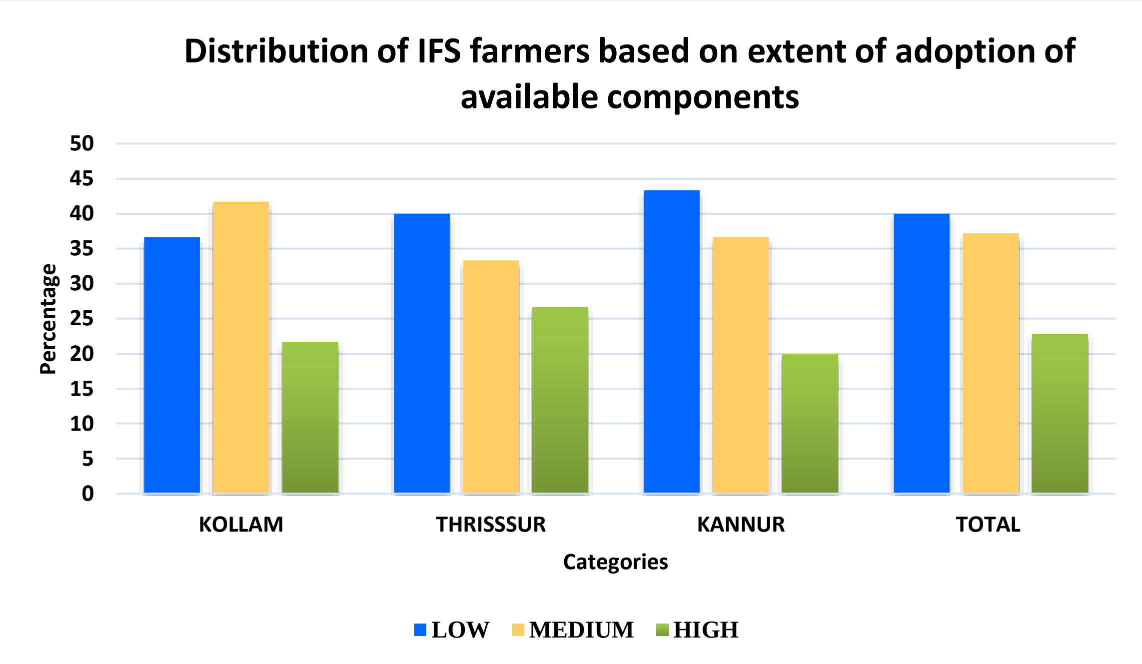


Fig 4.21: Distribution of IFS farmers based on extent of adoption of available components in the IFS units

The result on extent of adoption of available component shows low to medium adoption among most of the farmers. Despite the fact that majority of the farmers were aware about the benefits of IFS and had a strong extension oriention, the extent of utilization of selected components were reported to be low. Their financial situation may be one factor influencing this behaviour. Since the initial cost for adopting some components may have been high and some farmers may not be able to afford some components due to the need of high financial investment especially in the post covid situation. In this context, they might have decided that to concentrate first on stabilising their income from the components they have already implemented rather than investing in others. Based on the return, they might be expanding their unit by adding more components in near future. Some respondents considered IFS as a way to provide nutritional security for their family and generating income came in second. Thus, those farmers may favour only those components that can be used at home, this might also be a reason for this result. These findings were at odds with that of Akshitha and Dolli (2020), who conducted a research work in Belagavi and Vijayapur district of Karnataka, for identifying the factors influencing the adoption of IFS and found that nearly half of the respondents from each selected districts (46.67 % Belagavi and 40 % for Vijyapur) were belonged to medium level of adoption followed by one third (33.33 % each) were in high level adoption category. They also stated that the majority of the IFS units in the selected districts had three to five components.

4.2.2.2. Component wise extent of adoption in IFS

An adoption index score was derived based on the extent of adoption of specified components in each dairy based IFS unit. The selected components were ranked based on their score. The component-wise extent of adoption among IFS units is shown in table 4.28 and fig.4.22.

Table 4.28: Component-wise extent of adoption among IFS units

(n= 180)

Sl No.	IFS Components	Total number of units with specific component	Adoption index score	Rank
1	Dairy	180	1	I
2	Crop	180	1	I
3	Poultry	158	0.87	III
4	Fisheries	95	0.53	V
5	Apiculture	55	0.31	VII
6	Mushroom	11	0.06	VIII
7	Biogas	62	0.34	VI
8	Compost	115	0.64	IV
9	Azolla	159	0.88	II
Mean score			0.62	

The table 4.28 and fig. 4.22, showed that among the selected agricultural components dairy and crop component had the highest adoption rate (1). That means, in all dairy based IFS units crop components were present. Following that, greater adoption was observed in azolla (0.88), poultry (0.87) and compost (0.64). Least adoption was noticed for mushroom (0.06), apiculture (0.31), biogas (0.34) and fisheries (0.53).

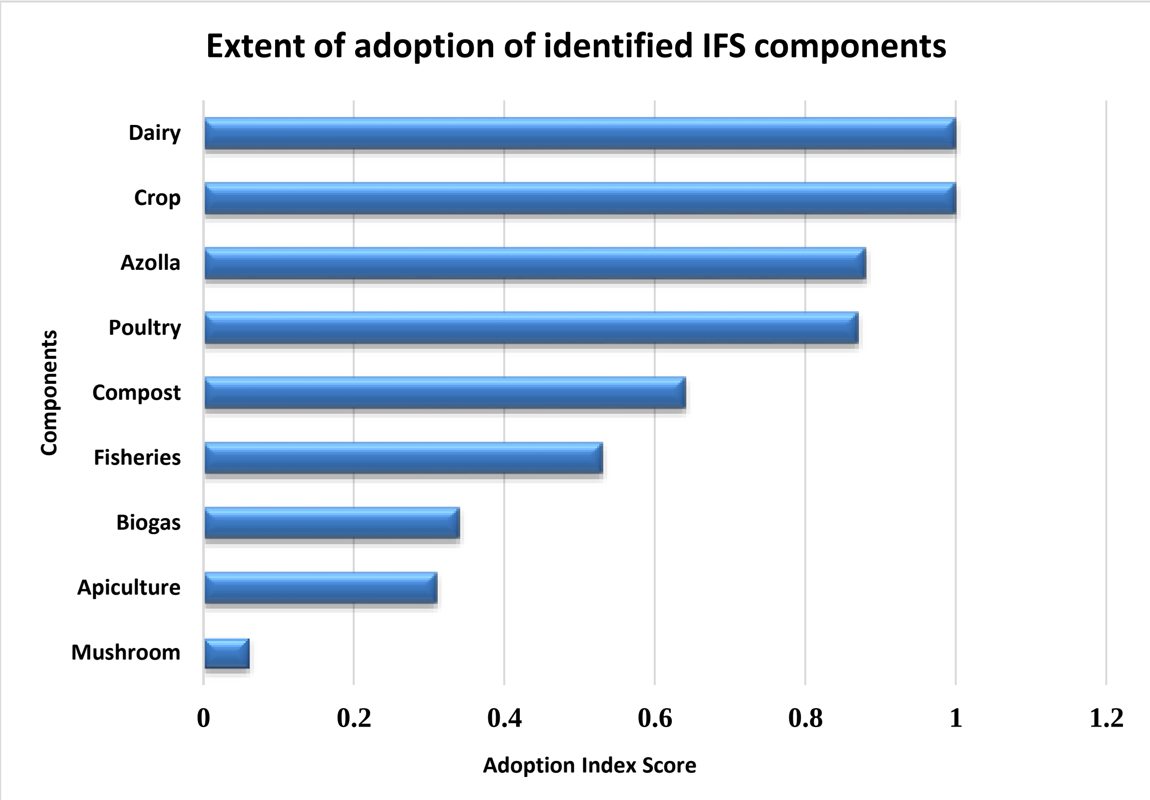


Fig 4.22: Extent of adoption of identified IFS components

Crop, azolla, poultry and compost were the most widely used components in dairy-based IFS units. These componets were inextricably linked to dairy, both in terms of feed and waste management. In Kerala, majority of the farmers were marginal and using their homesteads for various agricultural activities,usually they preferred components which required less space, care and investment and had multiple use. Small farming families, landless labourers and people with income below the poverty line rear chickens with low inputs and harvest the benefits like egg and meat via scavenged feed resources (Sonaiya, 2004). According to Roy and Kadian (2013) there was a strong connection between the poultry and crop components in IFS units, such as the use of poultry manure as a manure to crops and grain and crop remnants as feed for the poultry. Governent of Kerala implemented various programmes for promoting dairy and poultry in homesteads. Since, farmers had received chicks and ducks along with cages through these programmes, backyard poultry is gaining popularity among farmers of Kerala as a means of guaranteeing food security to the farm families. The direct strong link of azolla and compost with both crop and dairy sectors, may be the reason for its higher adoption rate. Low adoption rate of components like fisheries, apiculture, biogas and mushroom could be attributed to the fact that, it necessitates solid resource base such as water resources, cropping density, specific infrastructures facilities like clean and hygienic production area. Lack of proficiency in its management practises were also can be added into it.

4.2.2.3. Reasons for non adoption of available components

It was critical to highlight that none of the existing IFS units in the study area possessed all selected components (Appendix I). There could be a number of reasons for the non adoption of accessible components. Possible reasons for non adoption were enlisted through discussion with farmers as well as experts and scored based on their responses. The mean score for each reason was calculated and ranked in such a way that, one with the highest mean score being the most important reason. The findings were given below (Table 4.29).

Table 4.29: Reasons for non adoption of identified components in IFS units

(n=180)

Sl No.	Reasons	Mean score	Rank
1	More financial investment needed	2.78	I
2	Not profitable	2.56	II
3	Marketing difficulties	2.48	III
4	Difficulty in time management	2.29	IV
5	Lack of resources	2.14	V
6	Less demanding	2.06	VI
7	Lack of awareness	1.94	VII
8	Prejudice of the respondents	1.51	VIII

The reasons for non adoption of available components were listed in table 4.29. Need of more financial investment (2.78) was ranked as the main reason for non adoption. Table 4.28, denoted the least adopted components in IFS. By comparing these two observations, we might conclude that the high initial investment needed to set up a component hinders the majority of farmers from adopting it. As an impact of Covid, just like other sector, agriculture sector was also hit and the financial situation of farmers remained precarious. A study conducted by Habanyati *et al.* (2022) reported that as part of covid lockdown farmers in Kerala were faced a lot of difficulties such as farm labor shortages, input shortages, machinery shortages, poor access to credit as well as consultancy and movement restrictions and this affected the financial condition of farmers. As a result, most of them were hesitant to implement new programmes or technology unless they received financial assistance from the government. Recognizing this fact, the Kerala government launched a new IFS promotion scheme called '*Jaivagraham*' under which farmers were given financial support to add more components. However, since this is a government scheme, the amount authorised is limited. Farmers cannot invest in all components using the funds provided. As a result, they might have preferred those components that are doable within the specified budget.

Not profitable (2.56) and marketing difficulties (2.48) reported to be the second and third most important reason respectively for non adoption. For crop and dairy component, Governemnet procurement centres were there like Vipani, VFPCK, Supplyco and MILMA. However, for other components farmers themselves need to find out the market. In such cases exploitation by middle man can also take place. Perishability of the products and low value addition technologies also added to the situation. It also affected the profitability from the unit. Next important reason noted was difficulties in time management (2.29). Due to labour shortage and high wage rate which existed in Kerala, majority of the farm operations in the IFS units were carried out by the farmer himself or with the assistance of family members. Because of the nuclear family structure prevalent in Kerala, the number of family members accessible for agricultural activities was also limited. Since IFS has several components, farmers may have faced difficulty in managing all activities due to a lack of sufficient workers. Some componets necessitate a strong resource base such as water resources, nector yielding cropping systems and appropriate infrastructure, such as clean and sanitary production and processing units. This indicated that lack of resources (2.14) limited the applicability of some components in some areas. The other possible reasons were found to be less demanding (2.06), lack of awareness (1.94) and prejudice of the respondents (1.51).

4.2.2.4. Correlation of extent of adoption of identified IFS components with profile characteristics of respondents

To find the relationship between the extent of adoption of identified IFS components with profile characteristics of the respondents, correlation analysis was conducted and the results are provided below:

Table 4.30: Correlation of extent of adoption of identified IFS components with profile characteristics of respondents

Independent Variables	Correlation Coefficient
Age	-0.134
Education	0.068
Family size	-0.014
Occupation	0.029
Farm size	0.818**
Experience in farming	0.407**
Mass media exposure	0.076
Extension agency contact	0.309**
Participation in extension programmes	0.299**
Market orientation	0.062
Irrigation potential	0.055
Economic motivation	0.288**
Innovativeness	0.015
Risk orientation	0.190*
Social participation	0.134
Training undergone	0.031
Awareness towards IFS	0.036
Herd size	0.031

** Significant at 1 per cent level *Significant at 5 percent level

A glance at the above table (4.30) indicated, among the selected variables for studying the profile characteristics, adoption of various available component in the IFS units were positively and significantly correlated with farm size, experience in farming, extension agency contact, participation in extension programmes, economic motivation at 1 % level of significance and risk orientation with 5 % level of significance.

As farm size increases, the chances for expanding the IFS unit of the farmer by adding more components were also increasing. A study conducted by Ponnusamy and Devi (2017) also found that, landholding was a key factor for retaining different enterprises in an IFS unit. The experience in farming helps in familiarizing with various practices and hence adoption can be increased. Extension activities conducted in the area had direct effect on gain in knowledge about improved agricultural practices. High rate of contacts with extension personnel might have motivated the farmers in various ways and they might have gained more information about various components. It helped the farmers to adopt those components in their unit. Since IFS contain many components, so each unit had its own risk. When farmers were highly risk-oriented, there was a higher chance that they would adopt more components in their unit. The findings of Akshitha and Dolli (2020) indicated that education, land holding, progressiveness of the farmer and their information seeking behaviour as well as scientific orientation were the factor that influenced the rate of adoption of integrated farming systems in Karnataka.

4.2.3. Extent of integration among adopted components in the IFS units

Integrated Farming System is one of the viable options that can be recommended to the farming community, which helps to reduce cost of cultivation, recycling of farm waste, effective utilization of land as well as other resources and ensures maximum productivity and profitability. This concept relies on integration of several complementary components such as crop, livestock, poultry etc. An IFS unit is said to be ideal, only when the integration of all the selected components are effectively balanced. If the components are not supporting or compactable to one another, that system will not succeed. That means optimization of individual components in an IFS unit is also very important for increasing the overall productivity. Hence, while establishing an IFS units, primary focus should be given to the effective integration of various elements within a unit.

4.2.3.1. Categorization of IFS farmers based on extent of integration of adopted components

Integration of components in an IFS unit refers to the existing linkages between those components as well as the possibility of linking them. Understanding these interconnections and dependences among existing components, aids in the development of that unit, as it gives a clear idea about how the output from one component is more productively utilised as an input in another. Taking this into account, an attempt was made to understand the extent of integration that exists among various components in the IFS units.

Integration index score was computed for each respondent and based on the obtained score they were grouped in to low, medium and high category by using cumulative square root frequency method (Table 4.31).

Table 4.31: Distribution of respondents according to extent of integration of adopted components

Categories (Integration Index Score)	Kollam (n=60)		Thrissur (n=60)		Kannur (n=60)		Total (n=180)	
	f	%	f	%	f	%	f	%
Low (<0.57)	21	35.00	18	30.00	20	33.33	59	32.78
Medium (0.57 – 0.74)	25	41.67	22	36.67	27	45.00	74	41.11
High (>0.74)	14	23.33	20	33.33	13	21.67	47	26.11
Total	60	100	60	100	60	100	180	100

A glance at the table 4.31 and fig 4.23 indicated that in most (41.11%) of the selected IFS units medium level of integration found to exist among the components. Nearly one third of the units (32.78%) showed low integration between components whereas, more than one fourth (26.11%) showed high degree of integration among the components. In medium category, highest per cent was reported in Kannur district (45 %) followed by Kollam (41.67%) and Thrissur district (36.67 %). More than one third of the units (35%) in Kollam district belonged to low category of integration followed by less than one fourth (23.33%) in high category. Thirty per cent units in Thrissur and one third of the sample in Kannur district were having low integration among the components. Higher level of integration was found in Thrissur (33.33%) and least in Kannur (21.67%).

From the table 4.31, it was clear that the extent of integration of IFS units in Kerala was medium to low. Even though farmers were aware about the benefits of IFS, the result confirmed that they still lacked adequate awareness about how to link each component. Each unit is unique in terms of its component, area, climatic factors etc. So recommending a common linkage strategy to all units is impractical. In this context more attention needs to be given by the extension agencies to provide professional support for exploring the possibilities of integrating various components in each unit.

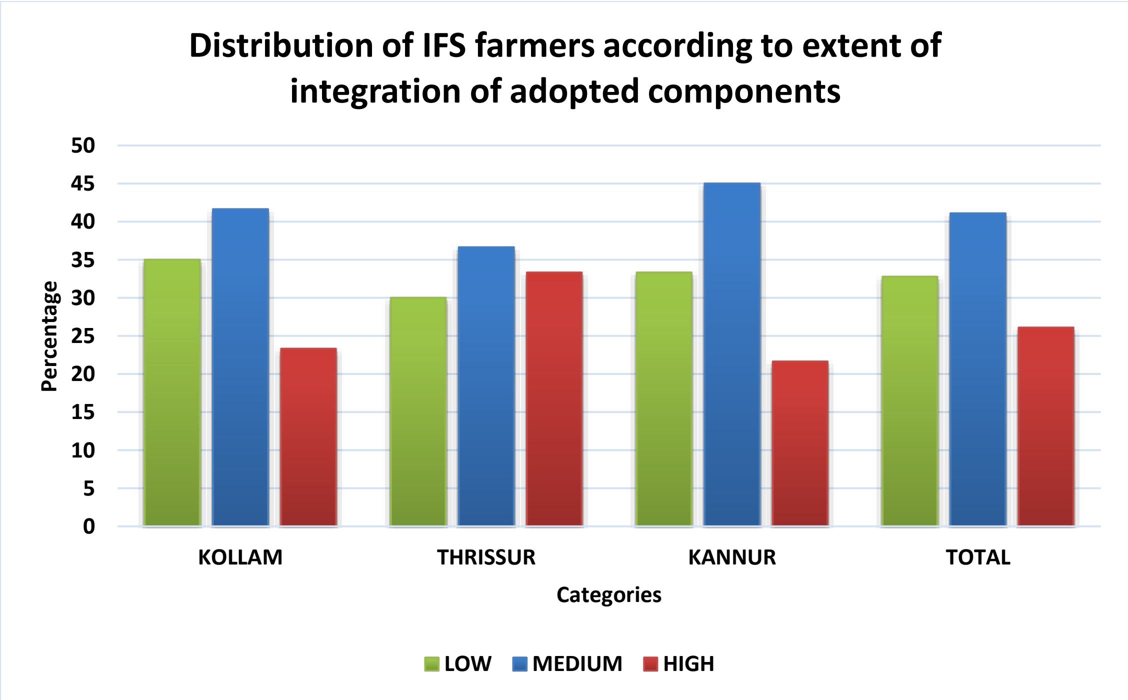


Fig. 4.23: Distribution of IFS farmers according to extent of integration of adopted components

4.2.3.2. Distribution of respondents as per the major dairy based IFS in Kerala

A system is a collection of interrelated components. In our country, there are various sub-systems that can be seen within a farming system. Farmers choose different combinations within an IFS unit as each enterprise complements the others and due to this all the components work together to support the growth of the farm family by ensuring the best use of available resources (Iqbal, 1992). Depending on the combinations, different types of systems can be observed in which some components are adopted extensively and some are at a low rate (Appendix I). Based on the combinations existing among selected components, eight dominant dairy based integrated farming systems were noticed in the study area. These existing systems were identified using Participatory Rural Appraisal (PRA) methodologies like transect walks and focus group discussion. Details are presented in the table 4.32 below.

Table 4.32: Existing dairy based integrated farming systems in Kerala

Dominant dairy based IFS	Frequency (n=180)	Percentage
D + C	4	2.22
D + C +Ap	7	3.89
D + C +P	56	31.11
D + C +F	7	3.89
D + C + F+ P	58	32.22
D + C + Ap + P	18	10
D + C + Ap + F	4	2.22
D + C + Ap + F +P	26	14.45
Total	180	100
(C–Crop, D-Dairy, Ap–Apiculture, P–Poultry, F-Fisheries)		

Table 4.32 and fig 4.24, provides an overview of the most prominent dairy based integrated farming systems in the study area. The identified systems were D+ C, D + C +Ap, D + C +P, D + C +F, D + C + F + P, D + C + Ap + P, D + C + Ap + F and D + C + Ap + F + P. Among these systems, figures in the table 4.32 pointed out that D + C + F + P (32.22%) and D + C + P (31.11%) were the most dominant dairy based integrated farming systems in Kerala. Other systems were found in much lower percentages than these two. The combination of D + C (2.22%) and its combination with fisheries and apiculture (3.89% each) were found to be the least seen farming systems. It was critical to highlight that none of the existing IFS units in the study area possessed all components. Backyard poultry is gaining popularity among farmers these days because it takes up less area and can be used to ensure nutritional and financial security of farm families. This was underlined by the position of poultry components among the dominant systems. As a

whole, all IFS systems were found to be having at least four components (Appendix I), with D + C serving as the main components that generated income along with a two or more auxiliary components that did not.

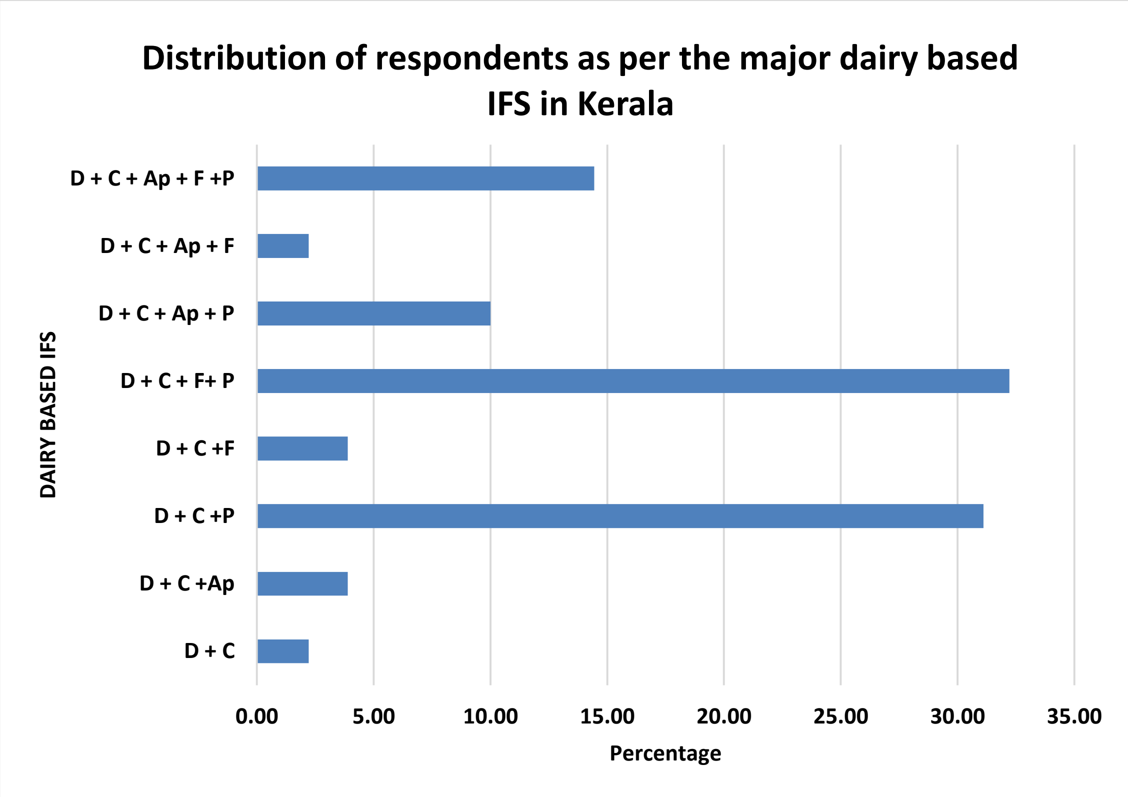


Fig. 4.24: Distribution of respondents as per the major dairy based IFS in Kerala

4.2.3.3.Extent of integration among identified dairy based integrated farming systems

On the basis of various integration practices, system wise extent of integration was examined separately and the finding were tabulated in table 4.33

In the first system (D + C), dominant components were crop and dairy. It was found that all farmers had high integration among the adopted components. This finding is supported by the findings of Apsara (2018), who discovered that agricultural and dairy enterprise linkage were prominent in the majority (76.67 per cent) of IFS units of Karnataka. Generally, the by-products of crops were used as fodder or feed for dairy animals while dung and urine from dairy animals were utilised as manure for agricultural crops as well as for the preparation and application of organic plant protection products like *panchagavya*, bio fertilizers etc. In D + C +Ap, D + C +Ap + F and D + C +F systems, the percentage of integration was noticed from medium (71%, 75% and 71%, respectively) to low (29%, 25% and 29%, respectively). Crop, dairy and apiculture were the dominant components in the D + C + Ap system, whereas fisheries was also added as a dominant component in other units. None of the respondents fell into the high integration group in any of these systems. Both in case of D + C + F + P and D + C + Ap + F + P based systems, medium (47% and 42%, respectively) to high (34 % and 35 %, respectively) integration were noticed.

Table 4.33: Distribution of IFS farmers based on their extent of integration

Sl No.	Dairy based IFS	Total	
		f	%
I	**D + C (n= 4)**		
	Low (< 0.36)	0	0
	Medium (0.36 -0.51)	0	0
	High (>0.51)	4	100
	Total	4	100
II	**D + C +Ap (n= 7)**		
	Low (< 0.65)	2	29
	Medium (0.65 -0.86)	5	71
	High (>0.86)	0	0
	Total	7	100
III	**D + C +Ap+ F (n=4)**		
	Low (< 0.58)	1	25
	Medium (0.58 – 0.86)	3	75
	High (>0.86)	0	0
	Total	4	100

IV	**D + C +F (n=7)**		
	Low (< 0.64)	2	29
	Medium (0.64-0.81)	5	71
	High (>0.81)	0	0
	Total	7	100
V	**D + C +F+P (n= 58)**		
	Low (< 0.45)	11	19
	Medium (0.45 – 0.76)	27	47
	High (>0.76)	20	34
	Total	58	100
VI	**D + C +Ap+F+P (n=26)**		
	Low (< 0.53)	6	23
	Medium (0.53 – 0.75)	11	42
	High (>0.75)	9	35
	Total	26	100
VII	**D + C +P (n= 56)**		
	Low (< 0.67)	11	20
	Medium (0.67-0.82)	22	39
	High (>0.82)	23	41
	Total	56	100
VIII	**D + C +Ap+P (n= 18)**		
	Low (< 0.61)	5	28
	Medium (0.61 – 0.85)	6	33
	High (>0.85)	7	39
	Total	18	100

While considering D + C +P and D + C +Ap+P system, in both cases the integration was found to be high (41% and 39 %, respectively) to medium (39% and 33%, respectively). The common components observed in these systems were crop-dairy-poultry and the high linkage that existed between these components might be the reason for the high integration percentage. Among the identified systems, four systems had crop – dairy- poultry combination and in those systems medium to high integration was noticed. In contrast, systems that included apiculture or fisheries alone or in combination, exhibited medium to low integration. Kerala is highly vulnerable to climate related issues like cyclones, unexpected rainfall etc. The incessant rain and continuing wet spell in the state hit the honey production, as bees were facing acute scarcity of pollen and nectar as they were unable to venture out for extended periods due to the rains, resulting in the colonies getting weak and dwindling of the brood (Rajeev, 2018). In this context, during these lean seasons the experts recommend protein enriched pollen substitutes, such as skimmed milk powder, soya powder, egg yolk powder and so on. However, majority of the farmers did not follow these practises, which may be the reason for the medium to low integration in those systems with an apiculture component.

Although the integration between crop and dairy was found to be high in all the systems, in the D + C + Ap + F and D + C + F systems, the integration with the fisheries component was found to be low. This result was in line with that of Lalrinsangpuii and Malhotra, (2020), who reported that in the IFS units of Mizoram, the different components of Dairy+ Crop + Poultry + Fisheries farming system were integrated, but the degree of integration was found to be weakest among all the faming systems. Since land scarcity was reported to be a serious issue, nobody was using the upper pond area for livestock or poultry component and the percent of farmers using cow dung or crop products in fish pond as feed was also observed as low in majority of the units. These reasons could have resulted in medium to low integration among the systems were these combinations existed. Eventhough the integration of apiculture and fisheries was found to be low, a strong linkage which existed between crop and dairy and crop and poultry in majority of the units might be the reason for medium integration in those systems.

The study of linkages helps to demonstrate the role played by various components in a unit. From table 4.33, it was observed that the crop and livestock components were closely integrated in the integrated farming systems of Kerala. Strong livestock to crop linkages were observed in all the farming systems. The degree of crop to livestock integration of different components of the various farming systems in terms of linkages is found to be strongest under Dairy + Crop + Poultry, as the crop products can be used as a feed to both dairy and poultry and its manures can be utilized in crop cultivation also. In units with apiculture and fisheries component, medium to low integration was reported. The finding also suggests the need for strengthening linkages through more utilization of fish and apiculture component in the units of Kerala. This is expected to enhance overall performance and economic viability of those units. The interdependence observed among various components of farming system suggests the need to adopt total systems approach for the development of total farming systems. These findings were in accordance with those of Lalrinsangpuii and Malhotra, (2020) who analyzed the integration existing among IFS units of Mizoram through transactional matrix and found that the inter component linkages from livestock to crop were stronger as compared to crop to livestock for all the farming systems. The degree of integration of different components of the various farming systems in terms of linkages is found to be strongest under Dairy + Crop + Piggery + Poultry farming systems.

4.2.3.4. Component wise extent of integration of different dairy based IFS units

The component wise integration of identified dairy based systems was also evaluated, by taking into account the various integration practices adopted by the IFS farmers for the components available in each system. The findings were given below (Table 4.34).

A close look at the table 4.34, revealed the extent of integration existing between various components in the different IFS units of Kerala. In D + C system all the farmers (100%) were following maximum integration between crop to dairy, dairy to crop, crop to composting, dairy to composting and composting to crop as well as dairy component. Followed by three fourth of the respondents were having a strong integration between dairy to biogas, biogas to compost as well as crop and half of them had adopted integration practices for linking azolla to crop and dairy. The overall extent of integration of this system was found to be high (fig 4.25) because the vast majority of farmers were adhering to the majority of the recommended integration practices.

In case of D + C + Ap system, all the farmers (100%) managed to maintain a strong linkage between crop to dairy, dairy to crop, crop to apiculture and apiculture to crop. For other components, the adoption of integration practices were found to be very low. In this system, less than half of the respondents were adopted the supporting components such as azolla, biogas, mushroom and composting. Since it could connect many components together, their low rate of adoption resulted in medium to low level integration among the components.

Table 4.34: Component wise extent of integration of different dairy based IFS units

Integration practices	Component To Component	Dairy Based Integrated Farming Systems								Total (n=180)
		D+ C (n=4)	D+C+Ap (n=7)	D+C+AP+F (n=4)	D+C+F (n=7)	D+C+F+P (n=58)	D+C+P (n=56)	D+C+AP+P (n=18)	D+C+AP+F+P (n=26)	
Crop included farm systems										
Cultivation of fodder crop as pure or mixed crop	Crop to Dairy	4 (100)	7 (100)	3 (75)	4 (57)	32 (55.17)	30 (53.57)	10 (55.55)	16 (61.53)	106 (58.89)
Using crop products as feed to livestocks	Crop to Dairy, poultry	4 (100)	7 (100)	4 (100)	7 (100)	58 (100)	56 (100)	18 (100)	26 (100)	180 (100)
Provide pollen for bees	Crop to Apiculture	-	7 (100)	4 (100)	-	-	-	18 (100)	26 (100)	55 (30.55)
Using crop residue for composting	Crop to Composting	4 (100)	2 (28.57)	3 (75)	6 (85.71)	41 (70.68)	34 (60.71)	9 (50)	16 (61.53)	115 (63.89)
Using crop products as feed to fisheries	Crop to fisheries	-	-	4 (100)	4 (57)	27 (46.55)	-	-	17 (65.38)	52 (28.89)

Using residue for mushroom production	Crop to Mushroom	-	1 (14.28)	1 (25)	1 (14.28)	1 (1.72)	3 (5.35)	1 (5.55)	3 (11.53)	11 (6.11)
Dairy included farming systems										
Using cow dung and urine for crops as fertilizer	Dairy to Crop	4 (100)	7 (100)	4 (100)	7 (100)	58 (100)	56 (100)	18 (100)	26 (100)	180 (100)
Using cow dung in fish pond as feed	Dairy to Fisheries	-	-	4 (100)	5 (71.42)	39 (67.24)	-	-	16 (61.53)	64 (35.56)
Using cow dung for Azolla production	Dairy to Azolla	2 (50)	3 (42.85)	3 (75)	5 (71.42)	57 (98.27)	50 (89.28)	15 (83.33)	24 (92.30)	159 (88.33)
Compost making from farm waste	Dairy to composting	4 (100)	2 (28.57)	3 (75)	6 (85.71)	41 (70.68)	34 (60.71)	9 (50)	16 (61.53)	115 (63.89)
Installing biogas plant	Dairy to biogas	3 (75)	1 (14.28)	2 (50)	5 (71.42)	22 (37.93)	14 (25)	7 (38.89)	8 (30.76)	62 (34.44)
Provide pollen substitute	Dairy to Apiculture	-	0 (0)	0 (0)	-	-	-	0 (0)	0 (0)	0 (0)

Poultry included farming systems										
Application of poultry manure to crop	Poultry to Crop	-	-	-	-	58 (100)	56 (100)	18 (100)	26 (100)	158 (87.78)
Use of poultry litter to biogas plant	Poultry to Biogas	-	-	-	-	5 (8.62)	2 (3.57)	2 (11.11)	3 (11.53)	12 (6.67)
Use of poultry litter to fish pond as feed	Poultry to Fisheries	-	-	-	-	28 (48.27)	-	-	11 (42.30)	39 (21.67)
Use of poultry litter to compost unit	Poultry to Composting	-	-	-	-	41 (70.68)	34 (60.71)	9 (50)	16 (61.53)	100 (55.56)
Fisheries included farming systems										
Water can be used for irrigation purposes	Fisheries to Crop	-	-	3 (75)	4 (57.14)	40 (68.96)	-	-	21 (80.76)	68 (37.78)
Use of water resources for duck farming	Fisheries to Poultry	-	-	0 (0)	0 (0)	22 (37.93)	-	-	4 (15.38)	26 (14.44)
Pond dikes provide space for erection of animal housing units.	Fisheries to Dairy	-	-	0 (0)	0 (0)	0 (0)	-	-	0 (0)	0 (0)

Azolla production included farming systems										
Utilized as bio fertilizer	Azolla to Crop	2 (50)	3 (42.85)	1 (25)	2 (28.57)	48 (82.75)	44 (78.57)	9 (50)	19 (73.07)	128 (71.11)
Utilized as feed for poultry	Azolla to Poultry	-	-	-	0 (0)	45 (77.58)	48 (85.71)	13 (72.22)	21 (80.76)	127 (70.55)
Utilized as feed for fish	Azolla to Fisheries	-	-	1 (25)	3 (42.85)	47 (81.03)	-	-	17 (65.38)	68 (37.77)
Utilized as feed for cattle	Azolla to Cattle	2 (50)	3 (42.85)	3 (75)	4 (57.14)	49 (84.48)	44 (78.57)	9 (50)	20 (76.92)	134 (74.44)
Mushroom production included farming systems										
Helps in the management of agricultural residues.	Mushroom to Crop	-	1 (14.28)	1 (25)	1 (14.28)	1 (1.72)	3 (5.35)	1 (5.55)	3 (11.53)	11 (6.11)
Medicinal mushrooms are used as a substitute for antibiotics on the broiler and laying hens	Mushroom to Poultry	-	-	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Use of mushroom supplemented food in fish culture	Mushroom to Fisheries	-	-	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Composting included farming systems										
Helps in the management of organic wastes generated in various enterprises	Composting to Crop, Dairy, Poultry	4 (100)	2 (28.57)	3 (75)	6 (85.71)	41 (70.68)	34 (60.71)	9 (50)	16 (61.53)	115 (63.89)
Provides quality rich organic manure for crop production	Composting to Crop	4 (100)	2 (28.57)	3 (75)	6 (86)	41 (70.68)	34 (60.71)	9 (50)	16 (61.53)	115 (63.89)
Compost as bedding material for mushroom	Composting to mushroom		0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Apiculture included farming systems										
Ensure good pollination to crops	Apiculture to Crop	-	7 (100)	4 (100)	-	-	-	18 (100)	26 (100)	55 (30.56)
Biogas Included farming systems										
Use biogas slurry to fish pond	Biogas to Fisheries	-	-	1 (25)	1 (14.28)	11 (18.96)	0 (0)	0 (0)	2 (7.69)	15 (8.33)
Use biogas slurry to compost	Biogas to Compost	3 (75)	-	1 (25)	3 (42.85)	16 (27.58)	6 (10.71)	2 (11.11)	6 (23.07)	37 (20.56)
Use biogas slurry to crops	Biogas to Crop	3 (75)	0 (0)	2 (50)	2 (28.57)	14 (24.13)	9 (16.07)	5 (27.78)	6 (23.07)	41 (22.78)

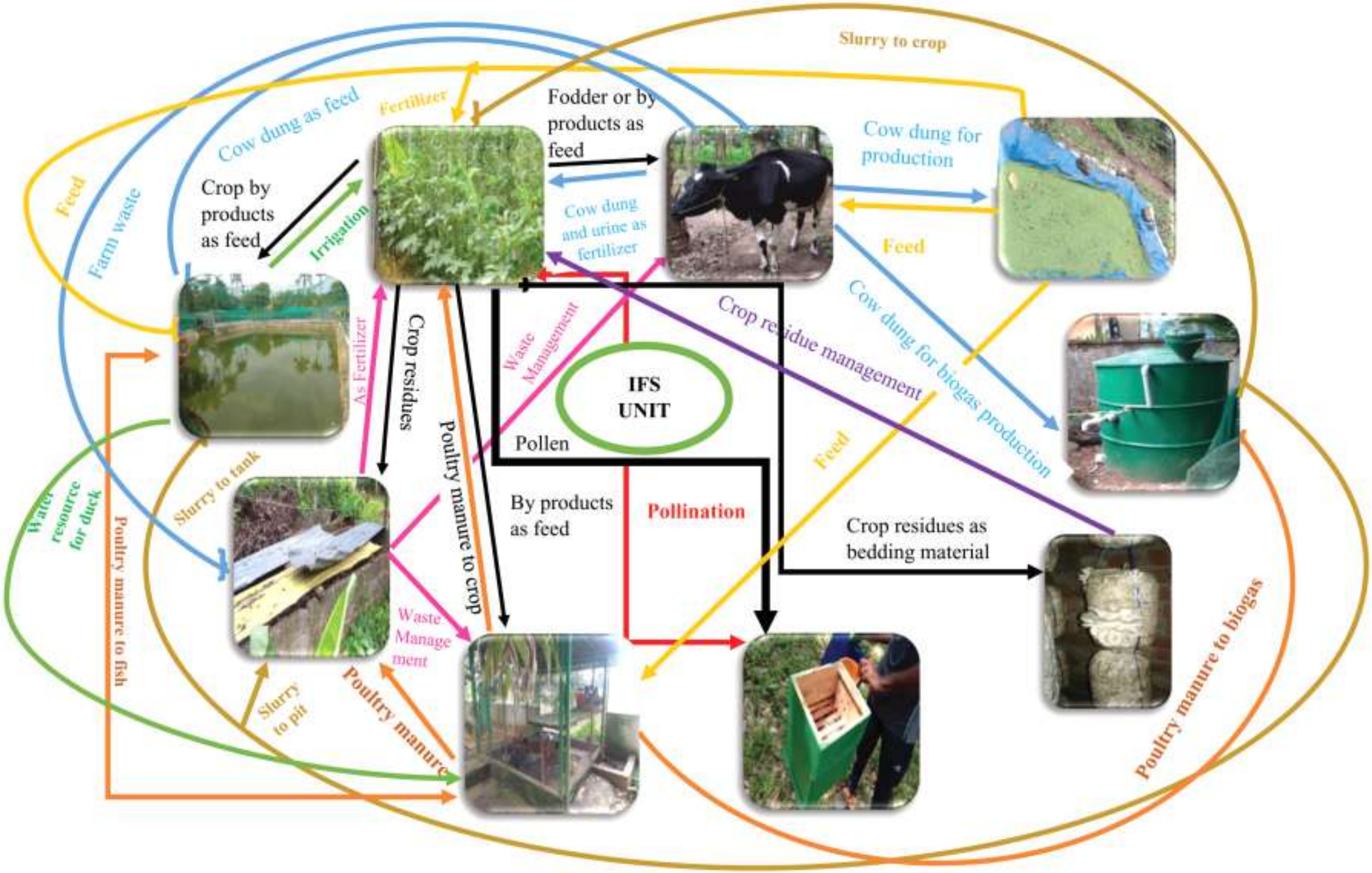


Fig. 4.25: Component wise integration practices existing in dairy based integrated farming systems of Kerala

While considering D + C + Ap + F system, all the farmers (100 %) were using crop byproducts and residues as feed to dairy, poultry and fisheries as well as they were using cow dung and urine for crops as fertilizer and cow dung in fish pond as feed. Which indicated that there was a close linkage between crops and dairy, crops and fisheries, dairy and crops as well as dairy and fisheries. Strong linkage existed between crop to apiculture as well as apiculture to crops were also observed. Only three fourth of the respondents kept linkage between fodder crops to dairy, crop to compost, dairy to azolla, dairy to compost, fisheries to crop, azolla to dairy and composting to crop and dairy. It was also noticed that there was little linkage between azolla to crop as well as fisheries (25%) and biogas, mushroom to various other components. This made it clear that more training and awareness programmes needed to be organised in order to maximise the integration between the major and supporting components in the system. So that the dependency on to outside resources could be reduced to a greater extent.

In D + C + F system, all the farmers were using the crop residues and byproducts as feed to cattle and at the same time the cow dung and urine were used in crop component also. Which implies that the farmers, who adopted D + C + F system retained a strong linkage among crop to dairy as well as dairy to crop. Followed by 85.71 per cent of the adopted farmers who kept a linkage between crop to composting, dairy to composting and composting to crop as well as dairy. Nearly three fourth (71 %) of the farmers had a linkage between dairy to fisheries, dairy to azolla, dairy to biogas. However, none of the farmers linked fisheries to dairy and the percentage of farmers linked azolla to crop (28.57 %) and fisheries (42.85 %) were also found to be low. Azolla was used as cattle feed by more than half (57.14 %) of the respondents, but it was a small percentage compared to the percentage of farmers who connected dairy to azolla. Even though the integration between crop as well as dairy components were found to be high in the system, this trend was not reflected in case of other components. This resulted in medium to low integration in the system. Therefore, more attention should be given to link all the available component in a sustainable manner.

Since all the farmers who adopted D + C + F + P system, were following various integration practices such as using crop products as feed to dairy, poultry and fishries, using cow dung and urine for crops as fertilizer and application of poultry manure to crop as a fertilizer, it indicated the strong integration that existed between crop to dairy and dairy to crop as well as crop to poultry and poultry to crop components in this system.

More than ninety per cent of the farmers (98.27 %) had linked dairy with azolla. The per cent of farmers who adopted azolla as a feed to cattle was found to be 84.48 per cent, which implied that all the farmers those who linked dairy component with azolla did not link azolla with dairy. Among the farmers who adopted D + C + F + P system, more than three fourth of the farmers linked azolla with various component. Highest linkage was noticed between azolla to dairy (84.48 %) followed by azolla to crop (82.75 %), azolla to fisheries (81.03 %) and azolla to poultry (77. 58 %). Nealry seventy per cent of the farmers had kept a strong linkage between crop and dairy to composting and vice versa. In addition to these, some other integration practices were also seen in the D + C + F + P system, such as cultivation of fodder crops for dairy components (55.17%), the use of water resources from fish tank for irrigation purposes (68.96%), and the use of cow dung as feed in some fish ponds (67.24%). It was also discovered that some components, including fisheries, biogas and mushrooms had very little integration with other components. Among the remaining components, the majority of respondents were still maintaining good integration, which led to a medium to high level of integration.

The overall extent of integration in D + C+ P system was found to be high to medium. It was clear from the table that the majority of the farmers were adhering to many of the recommended practices. Thus, a high to medium level of integration between the components was observed. All the farmers, those who adopted this system, were using crop residues and crop byproducts as a feed to dairy and poultry. At the same time the cowdung and urine as well as poultry litters were also utilized in crop component as a fertilizer. This indicated that all the farmers maintatined a strong integration between crop to dairy, dairy to crop, crop to poultry and poultry to crop. Followed by these, more than three fourth of the farmers retained integration between dairy to azolla (89.28%), azolla to poultry (85.71%), azolla to dairy and crop (78.57 % each). The difference in percentage of farmers who linked dairy to azolla with azolla to dairy emphasised the need for more extension activities for maximizing the integration between these components. Since, more than half of the farmers in the system were practising composting by using the farm waste produced from crop, dairy and poultry component, a strong integration was also noticed between crop, dairy, poultry to composting and vice versa.

In case of D + C + AP + P system, the major components identified were dairy, crop, apiculture as well as poultry and various integration practices were also noticed among the identified components. All the farmers were using crop products and residues as feed to dairy and poultry. At the same time the cow dung, urine, poultry litters were utilized as a fertilizer in crop. That means a linkage existed among crop to dairy as well as poultry and vice versa. Since the honey production from beehives depended on the pollen supply from the cropping system, a strong linkage between crop and apiculture was also noticed, in which the crop provides sufficient pollen to bees and bees ensure good pollination among the crops. Even though, more than three fourth (83.33%) of the farmers retained a linkage between dairy and azolla, only half of the respondents linked azolla to dairy. Azolla was used by the farmers more frequently as poultry feed (72.22%) than as a bio fertilizer for crops (50%) or as a dairy feed (50%). Majority of the farmers had small azolla units and the quantity of azolla produced from those units was insufficient to feed cattle or used as bio fertilizers, which might have contributed to this trend. Along with these practices, more than half (55.55 %) of the respondents adopted fodder cultivation for cattle and half of them were practicing composting by using farm waste generated from crop, dairy and poultry components. In these units, composting was linked to crop dairy and poultry such a way that, it helped in farm waste recycling for other components and also it provided bio fertilizers to crop component. Among the adopted farmers the integration between the major components with mushroom and biogas were also found to be very low. The strongest linkage existed between crop-dairy-poultry and crop – apiculture, led to high to medium level of integration among the system.

With respect to D + C + AP + F + P system, all the farmers adopted various practices for integrating crop and dairy, crop and poultry, crop and apiculture and vice versa. The percent of farmers who linked dairy to azolla was 92.30 per cent, while only 76.92 per cent of the respondents practiced azolla-to-dairy integration. More than three fourth of the adopted respondents were retained integration between fisheries to crop (80.76 %) by using water from fish tank for irrigation purpose and azolla to poultry (80.76%) by giving azolla as a feed. The use of azolla as a feed to fisheries component was also observed in some units (65.38%). More than half (61.53 %) of the farmers were following various practices for linking crop-dairy-poultry with composting and vice versa. When the major components of the system were examined, it was discovered that the integration of the fisheries component with poultry and dairy was low. Similarly, the integration of mushroom and biogas with other components was found to be low throughout the system. In this context, more effort is needed from extension agencies to maximize the integration of various components in a sustainable way.

A glance at the various dairy based integrated farming systems confirmed that, among the identified components, the common components observed in all the systems were crop and dairy. A strong integration between crops and dairy component was noticed in the all dairy based IFS units of Kerala. The by products and residues of crops were generally used as fodder or feed for dairy animals, while cattle dung and urine were used as manure for agricultural crops as well as for the preparation and application of organic plant protection products such as *panchagavya*, bio fertilizers etc. In terms of crop component, aside from integration with dairy and poultry majority of the farmers were practicing highest integration with composting (63.89 %) followed by 58 per cent of the respondents were cultivating fodder crops for cattle. Less than one third (30.56%) of the total respondents adopted apiculture component and among the adopted units a strong linkage was observed between crop and apiculture, as crop provides sufficient pollen for honey production and bees ensures good pollination in the system. The integration of crop to fisheries was found to be low in the majority of the fisheries included systems (28.89%). Regarding dairy component, next to crop component highest linkage was noticed with azolla (88.33 %) followed by composting (63.89 %). The integration of dairy component with fisheries was found to be low (35.56 %). Among the total farmers, more than one third (34.44 %) of the farmers were adopted biogas in their unit and in all such unit a linkage between dairy and biogas was noticed. Since the number of adopted farmers were less, the overall integration per cent was also found to be low. None of the farmers used any practices that linked dairy and apiculture.

In case of poultry component, highest linkage was observed with crop component (87.78%), as majority of the respondents were following application of poultry manure to crop, followed by poultry to composting (55.56 %) as use of poultry litter to compost unit. The integration of poultry to fisheries (21.67 %) and poultry to biogas (6.67 %) was discovered to be fairly low. Among the various integration practices followed in fisheries included system, highest integration was noticed between fisheries and crop component (37.78 %). The integration between fisheries to poultry as well as dairy was very low. The highest integration in an azolla included farming system was observed between azolla and dairy (74.44 %) followed by azolla to crop as a bio fertilizer (71.11 %), azolla to poultry as a feed (70.55 %) and azolla to fisheries as a feed (37.77 %). Only six per cent of the total respondents had a mushroom component in their unit and among the adopted units, there existed a linkage between mushroom and crop component. The extent of integration of mushroom with other components were found to be quite low. Less than one third of the farmers linked biogas with other component. Among the possible practices, highest linkage was noticed for use of biogas slurry to crops (22.78 %) followed by use of biogas slurry to compost (20.56 %). Among the compost included farming systems, a strong linkage was noticed between composting with crop and dairy. As farm waste management is critical for IFS, it was obvious for farmers to adopt more waste management techniques. The analysis of various dairy based integrated farming systems helped to identify the common integration practices followed by the IFS farmers of Kerala (fig.4.25). Since high cost of production was reported to be a serious issue among IFS farmers, through integrating the available components helps to reduce cultivation costs to a greater extent. More training and awareness programmes should be organised by the extension agencies at the grassroots level to improve their skills and knowledge on various integration practises as some components' integration was found to be low. A special focus should be placed on each unit individually to ensure that farmers properly integrated all the components.

4.2.4. Contribution of various components of IFS on household annual income

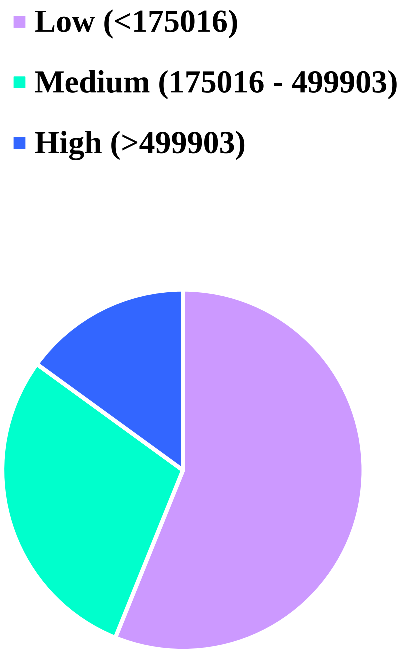
In economic point of view, combining various components in the same units helps to diversify farmers income. An attempt was made to determine the contribution of various components in annual household income of IFS farmers. The table 4.35 shows the distribution of farmers based on their component wise contribution of annual income.

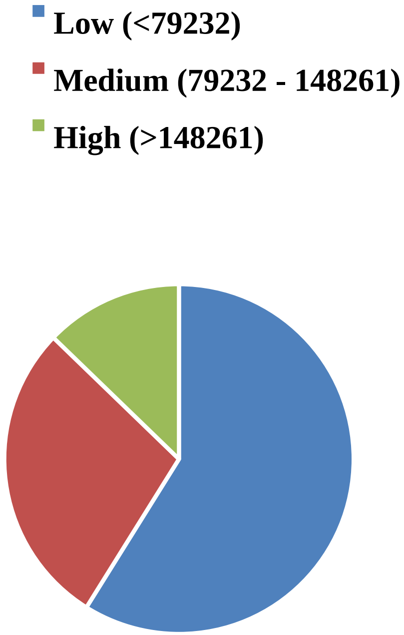
Table 4.35, presents component wise contribution of income to the farm families. From the figures 4.26 to 4.32, it was evident that among the selected components the contribution of income from crop component, dairy component and poultry component were found to be low to medium. More than half (55 %) of the respondents in all districts reported that they had low income from crop component. The percentage was higher for Kannur (58.33%) followed by Thrissur (55 %) and Kollam (51.67%). In case of crop component, different type of crops such as fodder crops, pulses, fruit crop, tubers, vegetables, spices, plantation crops, oil yielding crops, ornamentals and medicinal crops were seen in IFS units of Kerala. Among these, main income yielding crop were rice, tubers, fruit crops, pulses, oil seeds and plantation crops. In case of vegetables, the number of farmers those who were cultivating it commercially in a large area were very less among the total sample. Majority of the farmers were marginal and they cultivated vegetables in the homestead area, the products were mainly utilized for household consumption than marketing purpose.

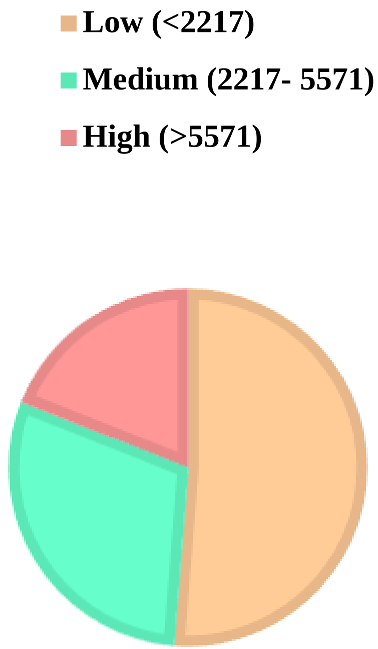
Table 4.35: Distribution of farmers based on their component wise contribution of annual income.

Components	Kollam		Thrissur		Kannur		Total	
Crop Component (n =180)								
	f	%	f	%	f	%	f	%
Low (<175016)	31	51.67	33	55.00	35	58.33	99	55.00
Medium (175016-499903)	20	33.33	19	31.67	15	25.00	54	30.00
High (>499903)	9	15.00	8	13.33	10	16.67	27	15.00
Total	60	100	60	100	60	100	180	100
Dairy (n= 180)								
	f	%	f	%	f	%	f	%
Low (<79232)	35	58.33	34	56.67	37	61.67	106	58.89
Medium (79232 -148261)	18	30.00	20	33.33	13	21.66	51	28.34
High (>148261)	7	11.67	6	10.00	10	16.67	23	12.77
Total	60	100	60	100	60	100	180	100
Poultry (n =158)								
	f	%	f	%	f	%	f	%
Low (<2217)	21	42.00	27	51.92	33	58.93	81	51.26
Medium (2217- 5571)	17	34.00	18	34.62	12	21.43	47	29.75
High (>5571)	12	24.00	7	13.46	11	19.64	30	18.99
Total	50	100	52	100	56	100	158	100

Fisheries (n= 95)								
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Low (<368456)	11	35.48	10	31.25	8	25.00	29	30.53
Medium (368456 - 529279)	15	48.39	13	40.63	17	53.13	45	47.37
High (>529279)	5	16.13	9	28.12	7	21.87	21	22.10
Total	31	100	32	100	32	100	95	100
Apiculture (n=55)								
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Low (<43523)	3	20.00	3	18.75	6	25.00	12	21.82
Medium (43523-77466)	8	53.33	7	43.75	11	45.83	26	47.27
High (>77466)	4	26.67	6	37.50	7	29.17	17	30.91
Total	15	100	16	100	24	100	55	100
Mushroom (n=11)								
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Low (<27320)	1	50.00	0	0	1	14.29	2	18.18
Medium (27320- 31190)	1	50.00	1	50.00	4	57.14	6	54.55
High (>31190)	0	0	1	50.00	2	28.57	3	27.27
Total	2	100	2	100	7	100	11	100
Annual farm income (n=180)								
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Low (<361254)	34	56.67	29	48.33	32	53.34	95	52.78
Medium (361254 -823059)	19	31.67	21	35.00	20	33.33	60	33.33
High (>823059)	7	11.66	10	16.67	8	13.33	25	13.89
Total	60	100	60	100	60	100	180	100







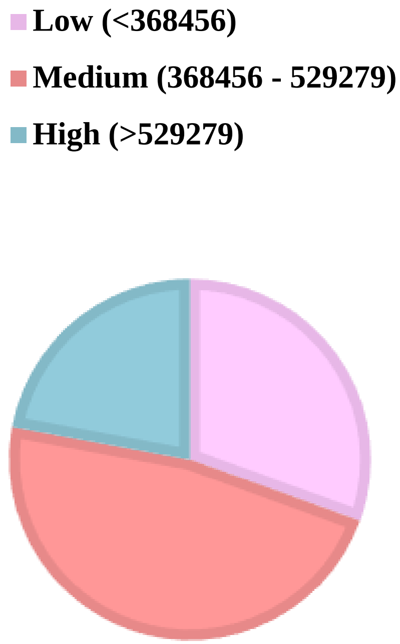


Fig.4.26: Annual income crop

Fig. 4.27: Annual income dairy

Fig. 4.28: Annual income poultry

Fig.4.29: Annual income fisheries

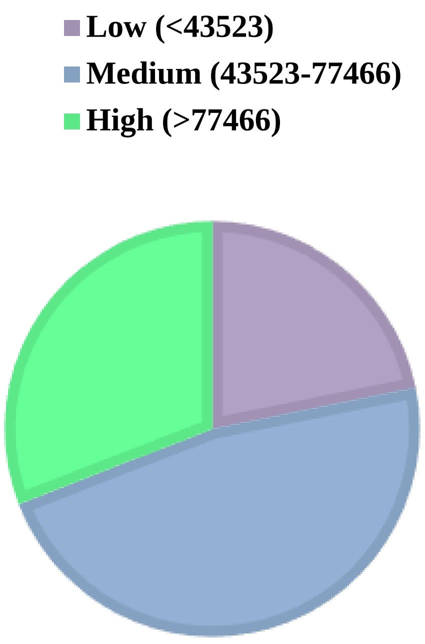


Fig. 4.30: Annual income apiculture

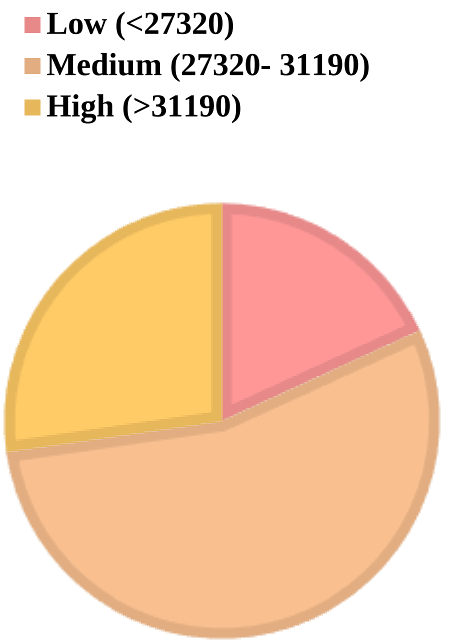


Fig.4.31: Annual income mushroom

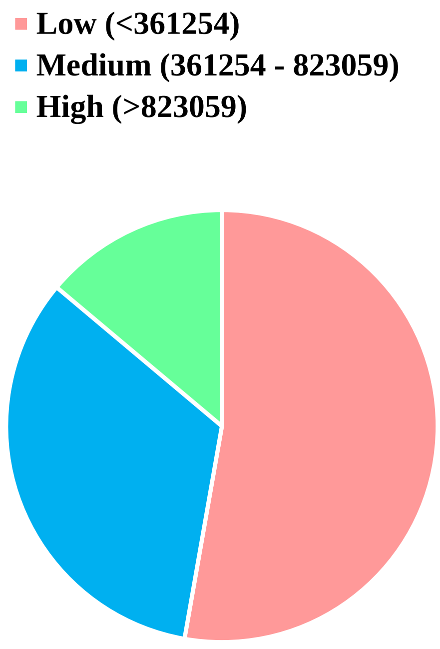


Fig. 4.32: Total annual farm income

In such units the quantity marketed was very less as compared to marketable quantity. Even though most of them had vegetable cultivation in the form of kitchen garden, major portion of vegetable grown were utilized within their family. This might be a reason for low income. Since, they cultivate crops for maintaining the food security of their family and also crop wastes were fed to different components, the IFS farmers were generally following organic cultivation practices and that affected pest and disease incidence and productivity, therefore, resulted in low yield.

Support price was already fixed for some type of crops like rice and rubber, based on the quality and quantity. Due to unexpected climate change such as cyclones, rain fall etc. farmers in Kerala were frequently facing crop failures and were unable to market their products on time, can also be considered as a reason. Apart from these, due to hike in fertilizer price as a post covid impact increased their cost of cultivation and reduced the profit from crop components. The findings were in line with those of Thomas (2004), who found that more than half the homestead farmers (52.88%) generated an annual home garden income ranging from Rs. 25,000/- to Rs.1,00,000/-. and are in contradiction to Sebastian (2014), who found that 56 per cent of the home garden respondents in Thriuvanathapuram district had high income category followed by 46 per cent in low income category.

In case of dairy, more than half (58.89 %) of the dairy farmers were getting low income from their dairy units. Less than one third (28.34 %) had medium income followed by 12.77 per cent who had high income from dairy units. District wise data also follow the same trend. More than half of the farmers in all districts belonged to low income category. Highest percent was reported for Kannur (61.67 %) followed by Kollam (58.33 %) and Thrissur (56.67 %). In case of medium category highest per cent was reported in Thrissur (33.33%) followed by Kollam (30 %) and Kannur (21.66 %). In case of high income category, highest percent was noted in Kannur (16.67 %) district followed by Kollam (11.67 %) and Thrissur (10 %).

According to the latest Livestock Census Report, 2019, crossbred cattle produced 93.25 percent of the milk in Kerala (Anon, 2020). The net income received depended on the cost of production, herd size and productivity of crossbreds. Even though majority of the cattle population were crossbreds, the dairy farmers could not reap a higher income from their herd. In the study area majority of the dairy farmers had low herd size and they were selling their milk in dairy cooperative societies (MILMA). An earlier survey by

Kerala Cooperative Milk Marketing Federation pegged Rs. 28 as the average production cost per litre of milk when the price paid to cooperative member was Rs.30-32 (NDDB, 2016). As an impact of covid and lockdown, the price for feed was hiked. Even though Government is providing some subsidies for milch animals and heifers etc., but with those subsidies alone dairy farmers could not balance the cost of production. Under this reality, MILMA still procured milk for a low price. It was apparent that the profit margins were less in dairying and gain to the farmers was through local sales, where a better price was received than cooperatives. Majority of the farmers were in rural areas and most of the household had at least one cattle, forced them to sell their milk at cooperative societies with low price. Since majority of the cattle population were cross breeds and due to the price hike in concentrates majority of them were not following the recommended diet practices also affected the yield and health condition of cattle. The finding was similar to Suraj (2021), who conducted a study among dairy entrepreneurs and found that 77.05 per cent of the dairy entrepreneurs in Kerala fell in low income category

In case of poultry component also, majority (51.26 %) of the respondents belonged to low income category followed by medium (29.75 %) and high (18.99 %). District wise data also followed the same trend. In low income category highest percent was noted in Kannur district (58.93 %) followed by Thrissur (51.92 %) and Kollam (42 %), whereas in high income category high percent was noted in Kollam (24 %) followed by Kannur (19.64 %) and Thrissur (13.46 %). Since majority of the IFS farmers were following backyard poultry, major portion of eggs were utilized in the home itself. That means in IFS units of Kerala, they added poultry component to their IFS unit, mainly for ensuring nutritional security to the family and for getting manures and waste management aspects. Generating income was only secondary. Most of them were not following the proper diet balance which also affected the productivity. These reasons might have resulted in low income from poultry component. The results were supported by the findings of Kumar, *et al.* (2013). They found that the average flock size reported in villages of Northern zone were as 5.62 and also discovered that as high as 52.15 per cent of the eggs and 59.38 per cent of the cockerels produced are consumed in the home.

While considering fish component, the trend in income generation was from medium (47.37%) to low (30.53%). Only less than one fourth (22.10%) of the farmers were receiving high income from their unit. In case of low income category, highest percent was reported in Kollam district (35.48%) followed by Thrissur (31.25%) and

Kannur (25%). Majority of the farmers in all districts were following the general trend and more than half of the farmers in Kannur district belonged to medium category (53.13 %) followed by Kollam (48.39%) and Thrissur (40.63 %). In the study area, majority of the farmers had added fish farming in their IFS units, as part of *Jaivagraham* programme and in that unit they were not following the scientific production and management technologies. Even though so many technologies were available for scientific production, farmers in the study area were not following those techniques mainly because of high initial investment and small production unit. Through *Jaivagraham* programme, a maximum amount of Rs.50000 were provided to IFS farmers for adding more components and upgrading the existing units, with this amount adopting scientific production practices were economically not feasible. So mainly in IFS units, farmers were following artificial ponds (*Padutha ponds*), from which they could not make much yield. Apart from this low marketing and value addition facilities forced them to sell their fish for low price also can be a reason for this result.

In case of apiculture and mushroom component, medium to high income generation was noticed. Near to half of the respondents who adopted apiculture (47.27 %) and more than half (54.55%) of the respondents who had adopted mushroom cultivation belonged to medium income generation category. In apiculture all districts showed the same trend. In medium category high percentage was reported in Kollam district (53.33 %) whereas in case of high income category, highest percent was noted in Thrissur district (37.50 %). While considering mushroom, a slight change from general trend was visible in Kollam district, as half of the total farmers who had adopted mushroom, each were belonged to medium and low category. But in case of Thrissur, the results show medium to high income generation. Among the total adopted farmers in Kannur district, more than half of them were found falling into medium category followed by less than one third (28.57 %) in high income category. Since the number farmers who had adopted these two components were comparatively low, among the adopted farmers majority of them were getting remunerative price as compared to other components. Even though the farmers those who adopted apiculture were facing a lot of difficulties, but still the demand for honey was very high, so this helped them to earn sustainable income. Many programmes were conducted by Kerala Agricultural University and Govt. of Kerala like Popularization of Meliponi culture in the homesteads of Kerala, *Trigona iridipennis* one of the best pollinator for many agricultural crops, was the first effort in India, but despite this, the rate of adoption of that component was found to be low. Different reasons were noticed like fear of bees, inadequate skills etc. for promoting apiculture and mushroom cultivation. The result highlighted the need for more programmes in the form of training, awareness classes, field visits etc. for attracting more farmers to these sectors, through which the income from IFS units can be increased.

The annual farm income is the combined income from all the components. It is revealed from Table 4.35 and depicted in Fig 4.32 that 52.78 per cent of respondents were found in low total income category, followed by 33.33 per cent in medium and 13.89 per cent in high income category. The same pattern was visible in all districts. In Kollam 56.67 per cent of the total respondents were found in low category whereas, 31.67 per cent in medium and 11.66 per cent in high category. The respective percentages in low, medium and high category of Thrissur district were, 48.33 per cent, 35 per cent and 16.67 per cent. In case of Kannur also, majority (53.34 %) belonged to low category followed by one third in medium and 13.33 per cent in high category. Even though, the farmers adopted many components, the income level was found to be low to medium. Generally, in Kerala the cost of cultivation is very high, owing to high wage rate, high price for fertilizers and feed etc. besides these frequent crop failures due to unexpected climate change also affected the productivity and profitability. Through proper integration of all the components the cost of cultivation can be reduced to certain extent. Furthermore, the attitude of farmers about IFS is also important. Some of the farmers considered IFS as an option for ensuring food and nutritional security of their family. For such farmers income generation is secondary. They consumed majority of the product in their own home and sold rest of the quantity. In such farms the adoption of scientific management practices might be very low, as high investment and low income might affect their financial conditions. The findings were contradictory to that of Sreelakshmi (2018), who found that by adding more specialized components in homestead system, the income of farmers can be increased.

4.3. The technological needs of the farmers and the constraints faced by them for adopting IFS.

4.3.1. Characterization of IFS in terms of technology needs and techno- socio- economic dimensions

In this section, IFS units of Kerala were characterized based on technology needs and techno-socio-economic dimensions.

4.3.1.1. Technology needs of various components in IFS

A farmer may have different technology needs, depending on how various components are integrated and how the field is managed and the shortfalls in availability and requirement for the specialized components. In light of this, the technology needs of IFS farmers were examined and on the basis of that, they were categorized into the different groups. The technology needs assessments were worked out using the procedure followed by Thomas, 2004 with slight modification. Tables below summarize the findings of a technology need assessment for selected components.

4.3.1.1.1. Technology needs for dominant crops in IFS

The technology needs for dominant crop component in a unit with respect to different aspects of crop cultivation had been recognized and scored according to its need. Table 4.36 shows the details.

A perusal of the table (4.36) showed that regarding various aspects of crop cultivation, IFS farmers had adequate availability of technologies except few. Highest need was noticed for processing technologies (414) followed by farm inputs and new varieties (411), plant protection related technologies (399), storing related technologies (387), product diversification (374) and climate monitoring and forecasting technologies (343). Since most of the respondents were felt that technologies like water harvesting, waste management, soil management, harvesting and farm mechanization were readily available, applicable and sustainable, this suggests that there was little need for these technologies in the study area. When examining the existing technologies in terms of their availability, applicability and sustainability, the figures showed that none of the farmers had an opinion that the technologies were not available for adoption, but majority of them were worried about the applicability as well as sustainability of existing technologies. In case of value addition technologies, less than half of the farmers were reported to be satisfied with the technologies that were availed for value addition and most of them were facing applicability and sustainability issues of available technologies. This highlights the need for more technologies related to value addition which can be applied easily in field conditions in a sustainable manner.

According to the results (Table 4.36), the technology needs of farmers with regards to crop component vary in various aspects of cultivation. Furthermore, this finding highlights the need for more market driven technologies that aid in increase the value of agricultural products and thereby increase the income of farm families.

Table 4.36: Distribution of respondents based on technological needs in crop component

Categories of technology needed for crop cultivation	Frequency and Percentage (in bracket) (n=180)				Total technology need score	Expected score range
	Technology not available for adoption (4)	Technology available but not applicable (3)	Technology available but not sustainable (2)	Technology available, applicable & sustainable(1)		
Water harvesting and management	0	0	59 (33)	121(67)	239	180-720
Farm inputs and new varieties	0	93 (52)	45 (25)	42 (23)	411	
Plant protection related	0	65 (36)	89 (49)	26 (15)	399	
Soil management	0	0	78 (43)	102 (57)	258	
Climate monitoring and forecasting	0	45 (25)	73 (41)	62 (34)	343	
Waste management	0	0	48 (27)	132 (73)	228	
Harvesting related	0	53 (29)	48 (27)	79 (44)	334	
Farm mechanization	0	32 (18)	67 (37)	81 (45)	311	
Storing	0	77 (43)	53 (29)	50 (28)	387	
Processing	0	89 (49)	56 (31)	35 (20)	414	
Product diversification	0	74 (41)	46 (26)	60 (33)	374	
Mean Technology Need Score					336.18	

The high technology need reported for processing, product diversification and storing facilities in the study area may be attributed to the high perishability of agricultural products and the inadequate storage facilities available to farmers. Due to the hike in input prices and climate related issues, more than half of the farmers might have felt applicability issues led to a need of new inputs combinations and new climate resilient varieties among the IFS farmers.

Since climate change was a serious issue, they might have thought that if new technologies were available for monitoring and forecasting climate changes, they could take precautions accordingly and reduce the issues like crop loss to a greater extent. Various awareness programmes conducted with regards to ‘safe to eat’ concept created awareness among some of the farmers for the use of chemicals. Now more farmers prefer green labeled new generation pesticides and fungicides. Besides these the unscientific usage of some plant protection methods gradually led to development of resistance in some pests and diseases towards that chemical and genetic modification of the same also occurred, making it difficult to control those attacks with existing methods. These factors may have contributed to the high demand for new plant protection related technologies. These findings corroborated with that of Jacob (2015) who found that in totality majority (82%) of the homestead farmers in Kerala believed that KAU production technologies were very effective for crop production. Similar findings were reported by Thomas (2004) that among homesteads of Kerala, it was seen that farmers required more technologies for processing, value addition and storage irrespective of the crop categories. In terms of technological need of the farmers, the result implies that, a drastic shift had been taken place from traditional to more scientific technologies. This might be attributed to the high socio economic condition of homestead growers.

4.3.1.1.2. Technology needs for dairy components in IFS

The technologies needed for maintaining a dairy component in an IFS unit were recognized and scored. The details of the technology need of dairy component were given below (Table 4.37).

Figures in table 4.37 highlighted the technological needs associated with dairy in IFS units. Among the selected technologies, high degree of technological need was noticed in feed related technologies (402) followed by processing (343) and storing (299) technologies. Regarding, feed related technologies, the per cent of completely satisfied farmers in terms of availability, applicability and sustainability of feed related technologies were very less (19.44 %) as compared to other technological aspects.

Table 4.37: Distribution of respondents based on technological needs in dairy component

Categories of technology in dairy farming	Frequency and Percentage (in bracket) (n=180)				Total technology need score	Expected score range
	Technology not available for adoption (4)	Technology available but not applicable (3)	Technology available but not sustainable (2)	Technology available, applicable & sustainable (1)		
Housing management	0	0	29 (16.11)	151 (83.89)	209	180-720
Breeding related	0	0	63 (35.00)	117 (65.00)	243	
Feed related	0	77 (42.78)	68 (37.78)	35 (19.44)	402	
Clean milk production	0	27 (15.00)	37 (20.56)	116 (64.44)	271	
Disease management	0	0	97 (53.89)	83 (46.11)	277	
Farm waste management	0	0	54 (30.00)	126 (70.00)	234	
Storing	0	22 (12.22)	75 (41.67)	83 (46.11)	299	
Processing	0	61 (33.89)	41 (22.78)	78 (43.33)	343	
Product Diversification	0	0	49 (27.22)	131 (72.78)	229	
Mean technology need score					278.55	

Among the total farmers, nearly half of them (42.78%) reported that the existing technologies could not be applied to the field conditions. More than one third of the farmers (37.78 %) were dissatisfied with the sustainability of existing feed related technologies**.** In terms of value addition technologies like storing and processing, nearly half of the respondents had concern about the applicability and sustainability of existing technologies.

In all aspect dealt in the above table 4.37, also revealed that, nobody in the study area was reported to have unavailability of technology for adoption, but had worries related to its applicability and sustainability. This implies that due to the high level extension orientation they were aware of available technologies and they may have tried those technologies as much they could. The performance might not have met their expectations which may be the reason for small percent concern expressed in case of applicability and sustainability. In spite of these concerns, majority of the respondents were pleased with the housing management technologies, includes establishment of high tech cattle shed with climate adaptive practices, breeding related technologies like artificial insemination facilities, milk production related technologies and disease management and farm waste management technologies that were currently available in Kerala. Since majority of the respondents were satisfied with current technologies, the need for new technologies was less in those areas. However, in case of feed related and value addition technologies, the per cent of satisfied farmers was very less as compared to farmers those who expressed worries about its applicability and sustainability. This implies that the extension system needs to pay more attention to the development of new feed combinations and value related technologies that can be applied easily and sustainably to the current field conditions.

With the goal of improving socioeconomic conditions of dairy farmers, sustaining productivity and increasing the adoption of scientific management practices, Kerala's government has launched numerous programmes and schemes, including *MSDP, Pasugram, Ksheera Gramam, Tsunami rehabilitation* programmes and others. These programmes provided financial assistance to dairy farmers for infrastructure development and mechanization in the dairy sector. Some of the actions carried out at the field level included modernization of dairying activities, herd induction, need based help for improving cow comfort factors, provision of mineral mixtures etc. As a result, majority of dairy farmers were exposed to numerous technologies related to welfare and milk production aspects and they were able to apply into their field condition in a sustainable manner. That might be the reason for low technological need in these aspects. At the same time, due to the increase in feed prices, farmers were unable to choose scientific feed management and instead chose more unscientific approaches, which had an impact on both health and productivity. Since the raw materials were acquired from other states, lowering the price of feed was also difficult. As a result, new cost effective feed combinations should emerge in that area.

4.3.1.1.3. Technological needs for poultry and fisheries component

Various technologies related to maintaining poultry and fisheries components in IFS were identified and scored. The findings were given below (Table 4.38):

Table 4.38 revealed the technological needs that existed among the IFS who had adopted poultry. Processing (389) and product diversification (350) were identified as having the greatest need among the selected technologies. Since majority of the farmers were satisfied with other production technologies like housing related, feed related, waste management related, storing, health and brooding management of poultry that were already available, there was less need for new technologies. However, when it came to value-adding technologies, most of the farmers were concerned about applicability of available technologies, which highlights the need for more technologies that are readily accessible and adaptable in field conditions in a useful manner.

When looking at fisheries technologies, the table 4.38, indicated that a technology need was noticed for product diversification (245), processing (239), nursery and rearing management (221) and water quality management (201). With regards to the processing and product diversification technologies the per cent of IFS farmers who adopted fisheries component in their unit and completely satisfied with available technologies were very less as compared to other categories. More than half of the farmers (61 % for processing and 63.10 % in product diversification) were marked that the available technologies were not practically applicable in their field condition. Less than one third (29.50 % and 31.60 % respectively for processing and product diversification) argued that these technologies could not be used in long term basis. In case of production related technologies, only less than one third of the IFS farmers who adopted fisheries component were satisfied with water quality management and nursery as well as rearing stock management technologies. From the table (4.35), it was proved that the income obtained from fisheries component in IFS units was medium to low in the study area. This could be connected to the technology need of farmers.

Table 4.38: Distribution of respondents based on technological needs in poultry and fisheries component

Categories of technologies needed for identified components	Frequency and Percentage (in bracket)				Total technology need score	Expected score range
	Technology not available for adoption (4)	Technology available but not applicable (3)	Technology available but not sustainable (2)	Technology available, applicable & sustainable (1)		
Poultry (n=158)						
Scientific housing techniques	0	38 (24)	14 (9)	106 (67)	248	158 -632
Nutrition and Feed management	0	0	72 (46)	86 (54)	230	
Health management	0	0	76 (48)	82 (52)	234	
Farm waste management	0	0	0	158 (100)	158	
Hatchery, Brooding and rearing management	0	24 (15)	38 (24)	96 (61)	244	
Storing	0	36 (23)	24(15)	98 (62)	254	
Processing	0	97 (61.40)	37 (23.41)	24 (15.19)	389	
Product Diversification	0	69 (44)	54 (34)	35 (22)	350	
Mean technology need score					263.38	
Fisheries (n=95)						
Pond Preparation	0	0	0	95(100)	95	95 - 380
Water Quality Management	0	37 (39)	32 (34)	26 (27)	201	
Nursery, Rearing and Seed Stocking/ breeding stock management	0	48 (50.50)	30 (31.60)	17 (17.90)	221	
Feeding management	0	0	57 (60)	38 (40)	152	
Pest & Disease management	0	0	26 (27)	69 (73)	121	
Harvesting	0	0	0	95 (100)	95	
Storing	0	24 (25)	20 (21)	51 (54)	163	
Processing	0	58 (61)	28 (29.5)	9 (9.5)	239	
Product Diversification	0	60 (63.10)	30 (31.60)	5 (5.3)	245	
Mean Technology Need Score					170.22	

Although there were numerous technologies available for scientific fish farming, most farmers had trouble in implementing those technologies in their units, since they had artificial ponds (*Padutha ponds*) with small size, in which there was a limitation for introducing advanced production technologies. Since majority of the farmers were dissatisfied due to the applicability and sustainability issue with the technologies that were available, it necessitated the introduction of more technologies to existing IFS units for both fisheries production and value addition. In this context, serious attention is needed for the development of more farmer friendly technologies that can be easily applied to the field condition in a sustainable way.

4.3.1.1.4. Technological needs for apiculture and mushroom

Various technologies needed for maintaining the apiculture and mushroom component in an IFS unit were enlisted and ranked. Based on the total technology need score obtained for each technology, technology needs associated with these components were identified. The findings were given below (Table 4.39).

A glance at the technological needs of apiculture component (table 4.39) in IFS units showed that all the farmers those who had added apiculture in their units were satisfied with the existing production technologies such as seasonal colony management, feeding management, harvesting related technologies and storing. Thus, majority of the farmers agreed that the existing technologies could be applied sustainably in productions related aspect, there was no need for new technologies in those area. In case of value addition, a need was noticed for processing (111) and product diversification (116) technologies. In order to apply the existing value addition technology profitably, they might have fewer beehives than recommended and produce less honey than necessary, which compelled them to make compromises with its use. In this context, serious attention is needed for the development of more farmer friendly technologies that can be easily applied to smaller units in a sustainable way.

In case of mushroom related technologies, both in case of production and value addition aspects, among the mushroom farmers majority of them perceived difficulties for applying available technologies in field condition. In production related technologies, when compared to other technologies, a need was noticed for sterilization and inoculation related technologies (26). Regarding value addition aspect, highest need was noticed for processing (27) and product diversification (27) followed by storing (26) technologies.

Table 4.39: Distribution of respondents based on technological needs in apiculture and mushroom component

Categories of technologies needed for identified components	Frequency and Percentage (in bracket)				Total technology need score	Expected score range
	Technology not available for adoption (4)	Technology available but not applicable (3)	Technology available but not sustainable (2)	Technology available, applicable & sustainable (1)		
Apiculture (n=55)						
Seasonal Colony management	0	7(12.72)	10 (18.18)	38 (69.10)	79	55-220
Feeding management	0	0	10 (18.18)	45 (81.82)	65	
Harvesting related	0	0	0	55 (100)	55	
Storing	0	0	0	55 (100)	55	
Processing	0	18 (32.73)	20 (36.36)	17 (30.91)	111	
Product Diversification	0	26 (47.27)	9 (16.37)	20 (36.36)	116	
Mean technology need score					80.16	
Mushroom (n=11)						
Sterilization and inoculation technologies	0	6 (55)	3 (27)	2 (18)	26	11- 44
Substrate related	0	0	6 (55)	5 (45)	17	
Climate control technologies	0	0	0	11 (100)	11	
Waste management	0	0	0	11(100)	11	
Harvesting	0	0	0	11(100)	11	
Storing	0	6 (55)	3 (27)	2 (18)	26	
Processing	0	7 (64)	2 (18)	2 (18)	27	
Product Diversification	0	6 (55)	4 (36)	1 (9)	27	
Mean Technology Need Score					19.50	

It was obvious from the table (4.39) that no one believed that technologies were not available, but rather that they were concerned about their application and sustainability in their field conditions. Even though they were aware of the technologies, they had not yet adopted them, this could be due to the fact that the majority of the mushroom farmers had small production units and adopting technologies which require advanced infrastructure facilities and a high cost are unfeasible for their condition. The findings highlighted the need for more cost effective, convenient, and efficient new methods that can be easily deployed in small units.

4.3.1.1.5. Technological needs for other supporting components

Technology need was assessed with respect to production of azolla, biogas and compost in the IFS units. Table (4.40) below figured out the distribution of respondents based on technology need for the production of azolla, compost and biogas.

Perusal of the data in the table 4.40, revealed the status of technological needs of other supporting components in IFS. Majority of the farmers those who adopted azolla (92 %) and compost units (88 %) in their IFS units were satisfied with the available production technologies. Few farmers reported some issues regarding its sustainability, but the percent was very less. In case of biogas, all adopted farmers opined that the available technologies for biogas production can be applied easily and maintained it sustainably in their units. In the IFS units of the study area, farmers considered these components as supportive components to the main components, rather than making income from these components. So majority of them where satisfied with the existing production technologies and did not feel the need of new technologies.

Table 4.40: Distribution of respondents based on technological needs for the production of other supporting components

Categories of technology needed for production	Frequency and Percentage (in bracket)				Total technology need score	Expected score range
	Technology not available for adoption (4)	Technology available but not applicable (3)	Technology available but not sustainable (2)	Technology available, applicable & sustainable(1)		
Azolla production technologies (n = 159)	0	0	12 (8)	147 (92)	171	159 - 636
Compost production technologies (n = 115)	0	0	14 (12)	101 (88)	129	115 - 460
Biogas production technologies (n =62)	0	0	0	62 (100)	62	62 - 248

4.3.1.1.6. Component wise categorization of technological needs in an IFS unit

Various technologies needed for identified components in an IFS unit had been recognized mainly in terms of production and value addition aspects and the technology needs of IFS farmers were examined. In light of this, the technological needs were compiled again to analyze the most needed technology among those components for which a technology need had already been identified. The category with the highest score was considered to be the most needed technology for each component. Component wise categorization of technological needs based on mean technology need score was presented in Table 4.41.

It was quite evident that from table 4.41 that in case of value addition more need was reported for processing technologies (2.28) followed by product diversification (2.12) and storing (1.75). This implies that IFS farmers perceived the need for value addition technologies more when compared to production (1.86) technologies. For major crops, plant production (2.28) and plant protection (2.22) were identified as having the greatest need in terms of production, while dealing with value addition, processing (2.30) followed by storage technologies (2.15) and product diversification (2.08) were identified as having the greatest need. Similarly, in dairy component highest need was marked for production (2.23), processing (1.91) and storage (1.66). In the case of poultry, IFS farmers prioritized processing (2.46) and product diversification (2.22) as the most needed. When it comes to fisheries, the highest score was given to product diversification (2.58) followed by processing (2.52) and production techniques (2.33). In mushroom related technologies highest demand was for processing and product diversification with a score of 2.45 each followed by storing and protection related technologies (2.36 each). In general, more attention should be paid to value-added technologies that will help to boost product diversification, which was expected to improve the profitability of IFS units. An IFS farmer, on the other hand, expects more cost-effective, easily available, efficient technologies that can be deployed and used eternally.

Table 4.41: Component wise categorization of specific technological needs

Agricultural operations	Categories of technologies	Mean Technology Need Score						Mean Total Score
		Crop	Dairy	Fisheries	Poultry	Mushroom	Apiculture	
Production	Production	2.28	2.23	2.33	1.57	1.55	1.18	1.86
	Harvesting	1.87	1.51	1.00	1.23	1.00	1.00	1.27
	Protection/ health management	2.22	1.54	1.27	1.48	2.36	1.36	1.71
	Farm Waste management	1.27	1.30	1.00	1.00	1.00	1.00	1.09
Value addition	Storing	2.15	1.66	1.71	1.61	2.36	1.00	1.75
	Processing	2.30	1.91	2.52	2.46	2.45	2.02	2.28
	Product diversification	2.08	1.27	2.58	2.22	2.45	2.11	2.12
Mean total		2.02	1.63	1.77	1.65	1.88	1.38	1.72

4.3.1.2. Techno- Socio- Economic Dimensions as perceived by IFS farmers and officials

At the field level, different characteristics of technology can significantly influence its rate of adoption. Six dimensions were taken into account. Tables (4.42 to 4.44) below outlines various dimensions of technology that seemed to be significant for various components in IFS. It had been rated based on the evaluation by IFS farmers and officials associated with IFS in the study area. The analysis of the results revealed the disparity in priorities between IFS farmers and officials. Some of the dimensions that were important to farmers were deemed unimportant by the other group of respondents.

4.3.1.2.1 Techno- Socio- Economic Dimensions as perceived by IFS farmers and officials in selected districts.

4.3.1.2.1.1 Techno- Socio- Economic Dimensions as perceived by IFS farmers and Officials of Kollam district

Twenty officials and sixty IFS farmers were selected from Kollam district and their perception under various dimensions were recorded separately (Table 4.42). Table 4.42 and fig. 4.33 shows the details of techno- socio- economic dimensions as perceived by IFS farmers and officials in Kollam district.

Table 4.42 revealed the perceptions of IFS farmers and experts on significance of dimensions. Score for each dimension was computed and it was ranked based mean total. The findings revealed that the relevancy pattern varied for both farmers and experts. Some characteristics viewed as relevant by the IFS farmers were not a priority for experts, and vice versa.

In case of economic dimension, in farmers perspective, the most relevant attributes of a technology was its income generation potential (2.68) followed by initial cost (2.50), regularity of returns (2.33) and commercialization (2.25). While the experts perceived that regularity of returns (2.75) as the most relevant economic dimension that a technology should have followed by its income generation potential (2.65) and its initial cost of investment (2.45). IFS farmers perceived income generation potential more than initial cost due to the fact that without continuous income generation the specialization will be vague and of no use. Since an IFS unit contains different components they were interested in commercialization also.

Table 4.42: Techno- Socio- Economic dimensions perceived as important by farmers and officials in Kollam district

Dimensions	IFS Farmers (n= 60)				Officials (n=20)			
	Total Score	Mean total score	Rank over class	Over all rank	Total Score	Mean total Score	Rank over class	Over all rank
Economic Dimension								
Initial cost (E1)	150	2.50	2	5	49	2.45	3	5
Income generation potential (E2)	161	2.68	1	1	53	2.65	2	3
Employment generation potential(E3)	90	1.50	6	20	45	2.25	4	8
Commercialization (E4)	135	2.25	4	10	44	2.20	5	9
Regularity of returns (E5)	140	2.33	3	7	55	2.75	1	1
Rapidity of returns (E6)	120	2.00	5	17	40	2.00	6	13
Mean Total	132.67	2.21			47.67	2.38		
Technical Dimension								
Physical compatibility (T1)	129	2.15	6	13	45	2.25	5	8
Efficiency (T2)	153	2.55	2	3	54	2.70	1	2
Trialability (T3)	90	1.50	7	21	39	1.95	8	14
Complexity (T4)	130	2.17	5	12	42	2.10	7	11
Predictability (T5)	72	1.20	10	26	33	1.65	9	19
Flexibility (T6)	140	2.33	4	8	49	2.45	3	5
Viability (T7)	81	1.35	8	23	43	2.15	6	10
Desirability (T8)	79	1.32	9	24	45	2.25	5	8
Availability of supplies (T9)	143	2.38	3	6	47	2.35	4	6

Time saving (T10)	160	2.67	1	2	50	2.50	2	4
Mean Total	117.7	1.96			44.7	2.24		
Environment Dimensions								
Energy saving potential (En1)	75	1.25	3	25	35	1.75	3	17
Local resource utilization/recycling capacity (En2)	151	2.52	1	4	42	2.10	2	11
Sustainability (En3)	132	2.20	2	11	46	2.30	1	7
Mean Total	119.33	1.99			41.00	2.05		
Socio-Cultural Dimensions								
Social acceptability (S1)	121	2.02	1	16	38	1.9	1	15
Social approval (S2)	66	1.10	2	28	19	0.95	3	23
Cultural compatibility (S3)	65	1.08	3	29	21	1.05	2	22
Mean Total	84.00	1.40			26.00	1.30		
Psychological Dimensions								
Attitude (P1)	115	1.92	2	18	34	1.70	2	18
Perceived social status (P2)	70	1.17	3	27	30	1.50	3	20
Level of satisfaction (P3)	125	2.08	1	15	37	1.85	1	16
Mean Total	103.33	1.72			33.67	1.68		
Human Resource Dimensions								
Family labour (H1)	86	1.43	4	22	28	1.40	4	21
Hired labour (H2)	140	2.33	1	9	35	1.75	3	17
Skilled labour requirement (H3)	129	2.15	2	14	43	2.15	1	10
Physical labour requirement (H4)	100	1.67	3	19	41	2.05	2	12
Mean Total	113.75	1.90			36.75	1.84		

Under technical dimension, in case of farmers more preference was for time saving technologies (2.67). Other preferences where, efficiency (2.55), availability of supplies (2.38), flexibility (2.33), complexity (2.17) and physical compatibility (2.15) to the situation. However, experts think that the efficiency of technology should consider first (2.70). The other technological features regarded to be important by officials were, time saving (2.50), flexibility (2.45), availability of supplies (2.35) desirability (2.25) and physical compatibility (2.25). Desirability and availability of supplies were found to be vital because unless there is resource availability one cannot continue farm activities. In a changing scenario, flexibility in all aspects aids in risk management. Farmers viewed complexity as important, which implied that they were interested in more user-friendly technologies.

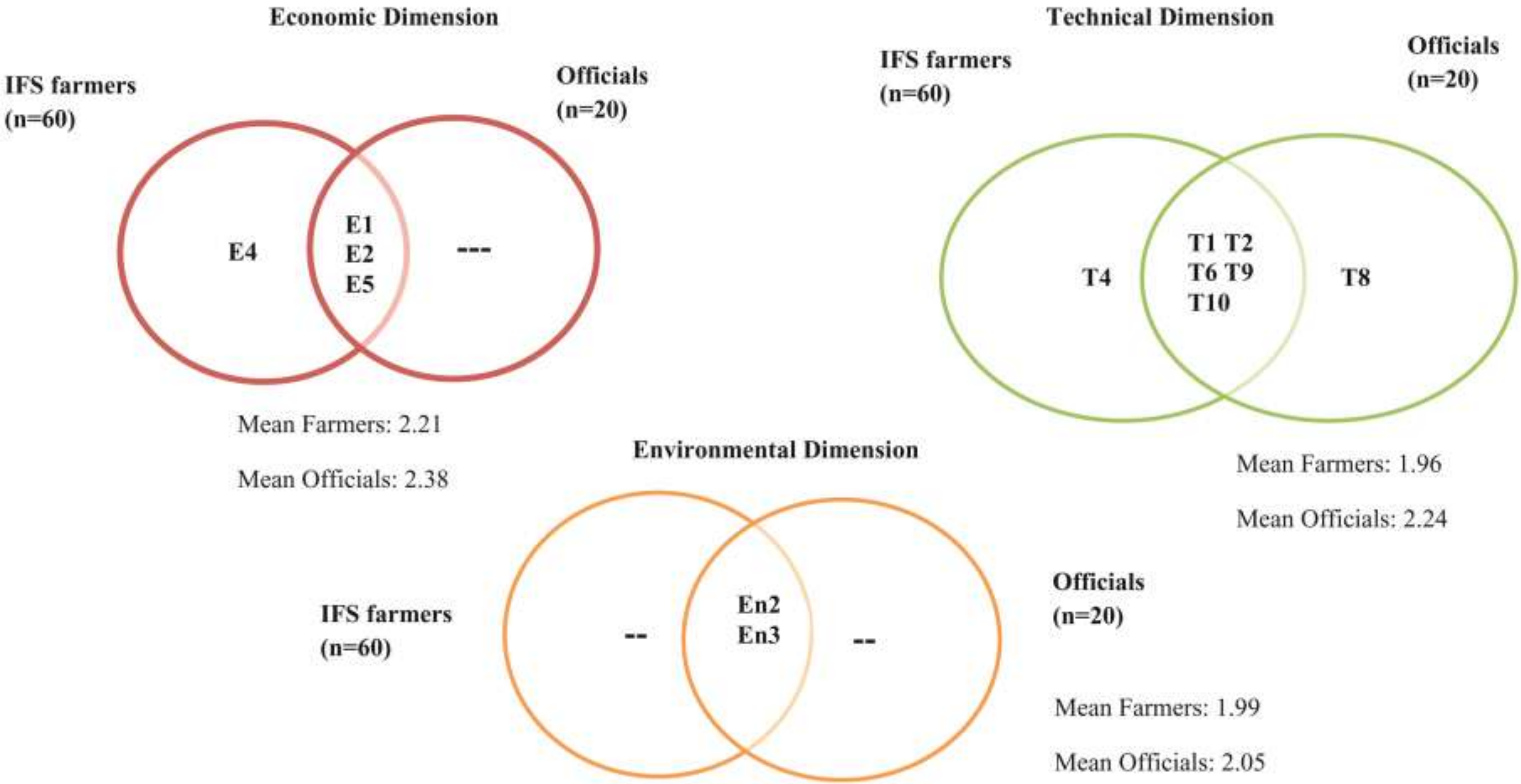
Local resource utilization/recycling capacity (2.52) and sustainability (2.20) were the most important environmental dimensions in farmers perspectives whereas; officials prioritized sustainability (2.30) than local resource utilization (2.10). Similarly, social acceptability (2.02 for farmers and 1.9 for officials) from the socio-cultural dimension, as well as level of satisfaction (2.08 and 1.85 for farmers and officials, respectively) and attitude (1.92 and 1.70, respectively for farmers and officials) from the psychological dimensions, were also shown to be relevant. When the IFS unit gets commercialized, acceptance from society can assist farmers in generating additional economic benefits. In case of human resource dimension farmers gave more preference to hired labour (2.33) followed by skilled labour requirement (2.15) and for officials skilled labour requirement (2.15) and physical labour requirement (2.05) were found to be more important. Since, scarcity of labour and lack of skilled workers were the major constraints in the agricultural system, both farmers and officials were concerned about the labour requirement for technology application.

4.3.1.2.1.2. Techno- Socio- Economic dimensions perceived as important by both farmers and officials in Kollam District

The findings (table 4.42) indicated certain disparity in priorities between IFS farmers and officials. Some of the dimensions that were important to farmers were deemed unimportant by the other group of respondents. Fig.4.33, shows dimensions perceived to be important for both the categories of respondents. The Venn diagram was plotted for emphasizing the common dimensions perceived to be most important by both categories of respondents in Kollam district. It was interesting to observe that from fig 4.33, a total of 14 dimensions were felt to be important by both categories of respondents. Those dimensions were E1 - E2 - E5 from the economic, T1 - T2 - T6 -T9 -T10 of technological, En2 -En 3 of Environmental, S1 from socio cultural dimension, P1 - P3 of psychological and H3 from human resource dimension.

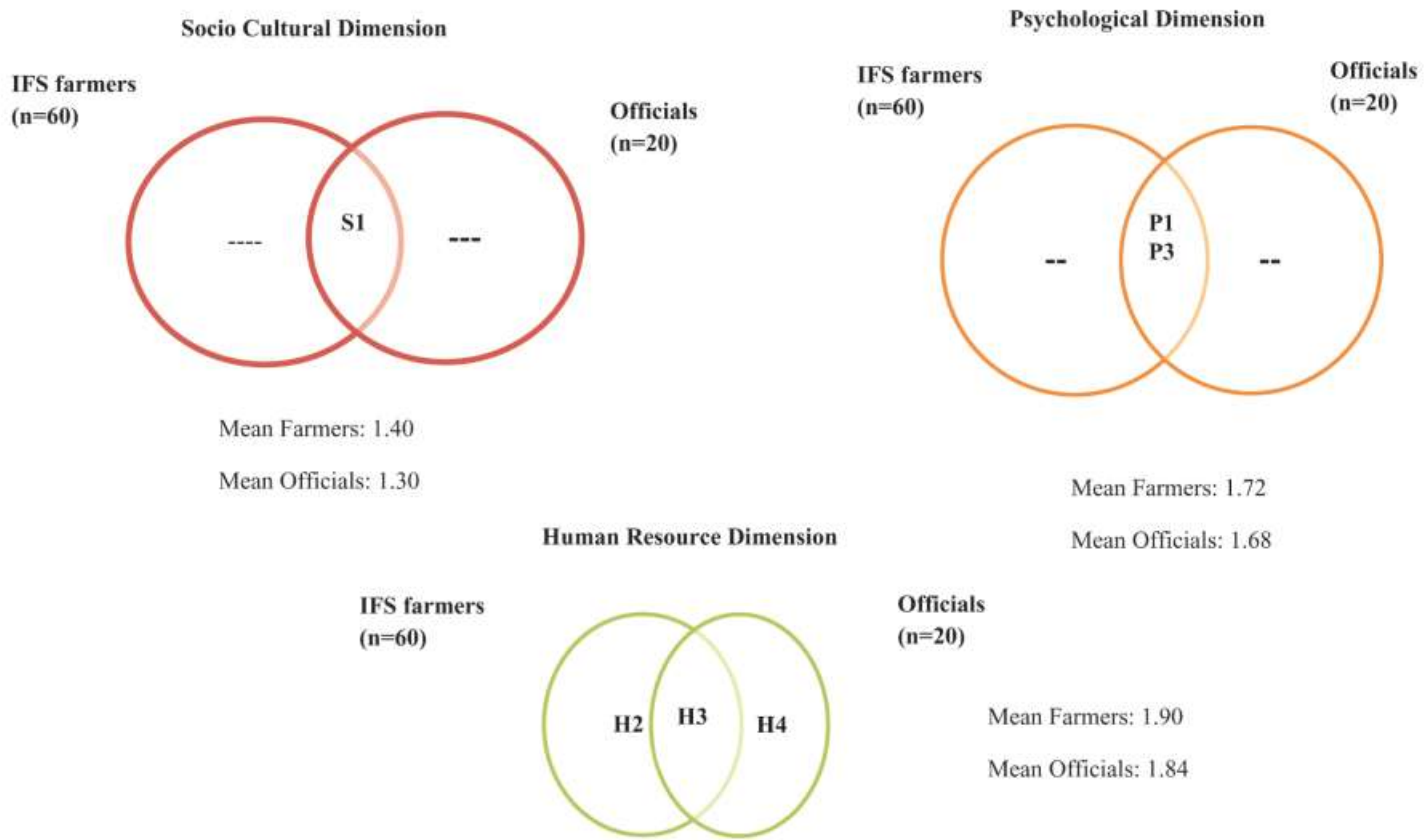
Under economic dimension, the dimensions that were felt important by both the categories were regularity of returns (E 5), income generation potential (E 2) and initial cost (E 1). Economic dimensions were essential for farmers since they affected the profitability of their unit. The data also pointed to the fact under economic dimension, commercialization (E 4) was found to be significant by farmers but not by officials. Farmers may have viewed commercialization as a significant dimension since they included many components in their units for profit. Under technical dimension, the dimensions that were considered as important by both categories include physical compatibility (T1), efficiency (T2), flexibility (T 6), availability of supplies (T 9) and time saving (T10). Meanwhile, the factors considered essential by farmers but not by officials include complexity (T 4). Similarly, for officials, desirability (T8) was found to be significant. Sustainability (E3) and local resource utilization (E2) were ranked as important under environmental dimension by both categories. Sustainability, which has become a policymaker's buzzword, is not a new concept in agriculture. So it was unequivocally favored by both categories of respondents.

The appropriate use of available local resources may boost profit and also aid in product diversification. Under the sociocultural aspect, both groups found social acceptability (S 1) as the most relevant. Generally, any components that are introduced symbolically should fit within sociocultural framework of the society for its better adoption. Attitude (P 1) and level of satisfaction (P 3) were two psychological dimensions that were significant to both groups of respondents. Attitude and level of satisfaction are the two key factors that influence adoption of a technology. A positive attitude combined with a high satisfaction level can enhance the adoption.



Initial cost (E1), Income generation potential (E2), Commercialization (E4), Regularity of returns (E5), Physical compatibility (T1), Efficiency (T2), Complexity (T4), Flexibility (T6), Desirability (T8), Availability of supplies (T9), Time saving (T10), Local resource utilization /recycling capacity (En2), Sustainability (En3)

Fig.4.33: Techno- Socio- Economic dimensions perceived as important by both farmers and officials in Kollam district



Hired labour (H2), Skilled labour requirement (H3), Physical labour requirement (H4), Social acceptability (S1), Attitude (P1), Level of satisfaction (P3)

Skilled labour requirement (H3) was found to be the most relevant human resource dimension for officials as well as farmers. In an IFS unit several components are there, so requires additional skilled labour to carry out the complex technology. Hired labour (H 2) was perceived as important by IFS farmers whereas for officials it was physical labour requirement (H4). Labour shortage was a serious constraint expressed by the farmers in Kerala. In that context, these dimensions seemed to be very important, as they were linked to the field level application of technologies.

This result highlighted that before technology application, farmers consider different aspects of that technology. All are concerned about different aspects of selected dimensions. Generally, we can conclude that IFS farmers in the Kollam district prefer socially acceptable technologies which assured optimum utilization of local resources in a sustainable way and had minimum labour requirement. They also insisted that the technology should provide high level satisfaction and a stable income to their units.

4.3.1.2.1.3. Techno- Socio- Economic dimensions as perceived by IFS farmers and officials of Thrissur district

A list of relevant dimensions of a technology was prepared in order to understand the significant techno - socio -economical dimensions perceived as important by IFS farmers and officials. The table (4.43) below summarises the views of IFS farmers and Officials on various techno-socio-economic dimensions of technology in Thrissur district.

The table 4.43, pointed to the perception of farmers and officials associated with various technological dimensions. Under economic dimension, farmers gave more preference to income generation potential (2.68) followed by regularity of returns (2.45) and initial cost of the technology (2.38). Whereas in case of the officials the highest focus was on income generation potential (2.70) followed by initial cost (2.55) and commercialization (2.5). According to the officials, commercialization capacity was an important factor to be considered while designing a technology. Since IFS contains many components, the officials realized the potential for commercialization of various farm output, allowing farmers to increase their profits. Irrespective of the farming system and components all farmers consider income generation potential and initial cost of the technology that they use. They will adopt those technologies only when it is economically feasible to them and could generate more income

Table 4.43: Techno- Socio- Economic dimensions perceived as important by IFS farmers and officials in Thrissur district

Dimensions	IFS Farmers (n= 60)				Officials (n=20)			
	Total Score	Mean total score	Rank over class	Over all rank	Total Score	Mean total score	Rank over class	Over all rank
Economic Dimension								
Initial cost (E1)	143	2.38	3	6	51	2.55	2	3
Income generation potential (E2)	161	2.68	1	1	54	2.70	1	1
Employment generation potential(E3)	85	1.42	6	20	44	2.20	6	9
Commercialization (E4)	110	1.83	4	15	50	2.50	3	4
Regularity of returns (E5)	147	2.45	2	5	46	2.30	4	7
Rapidity of returns (E6)	105	1.75	5	16	45	2.25	5	8
Mean Total	125.16	2.08			48.33	2.42		
Technical Dimension								
Physical compatibility (T1)	127	2.12	6	10	41	2.05	6	11
Efficiency (T2)	140	2.33	3	7	50	2.50	2	4
Trialability (T3)	96	1.60	7	17	36	1.80	9	15
Complexity (T4)	128	2.13	5	9	44	2.20	5	9
Predictability (T5)	75	1.25	10	24	35	1.75	10	16
Flexibility (T6)	148	2.47	2	4	47	2.35	4	6
Viability (T7)	82	1.37	8	22	40	2.00	7	12
Desirability (T8)	81	1.35	9	23	38	1.90	8	14
Availability of supplies (T9)	160	2.67	1	2	48	2.40	3	5
Time saving (T10)	135	2.25	4	8	53	2.65	1	2

Mean Total	117.20	1.95			43.2	2.16		
Environment Dimensions								
Energy saving potential (En1)	64	1.07	3	27	39	1.95	3	13
Local resource utilization/recycling capacity (En2)	156	2.60	1	3	45	2.25	1	8
Sustainability (En3)	128	2.13	2	9	42	2.10	2	10
Mean Total	116.00	1.93			42.00	2.10		
Socio-Cultural Dimensions								
Social acceptability (S1)	117	1.95	1	13	42	2.1	1	10
Social approval (S2)	69	1.15	3	26	29	1.45	2	20
Cultural compatibility (S3)	71	1.18	2	25	28	1.40	3	21
Mean Total	85.67	1.43			33.00	1.65		
Psychological Dimensions								
Attitude (P1)	120	2.00	1	12	35	1.75	2	16
Perceived social status (P2)	84	1.40	3	21	31	1.55	3	18
Level of satisfaction (P3)	112	1.87	2	14	38	1.90	1	14
Mean Total	105.33	1.76			34.67	1.73		
Human Resource Dimensions								
Family labour (H1)	90	1.50	4	19	30	1.50	4	19
Hired labour (H2)	95	1.58	3	18	47	2.35	1	6
Skilled labour requirement (H3)	125	2.08	2	11	45	2.25	2	8
Physical labour requirement (H4)	135	2.25	1	8	34	1.70	3	17
Mean Total	111	1.85			39	1.95		

While considering technical dimension, the characters preferred by IFS farmers were availability of supplies (2.67), flexibility (2.47), efficiency (2.33), time saving capacity (2.25), complexity (2.13) and physical compatibility (2.12). In case of officials, highest preference for time saving capacity (2.65) followed by its efficiency (2.50), availability of supplies (2.40), flexibility (2.35) and its complexity (2.20). The results reveal that complexity can have an impact on its adoption. In terms of technical advancement and climate-related challenges, the agriculture sector is changing dramatically. In this changing scenario, the sustainability of available technologies has been called into doubt. As a result, farmers and the authorities recognized the need for more flexible technologies that could be used in a sustainable manner.

Other important dimensions to consider from the perspective of both farmers and officials included local resource utilization capacity (2.60 and 2.25, respectively) and sustainability (for farmers -2.13 and for experts -2.10) under environmental dimensions, social acceptability (1.95, 2.1 for farmers and officials, respectively) under socio cultural dimension. In terms of psychological dimensions, farmers rated attitude (2) higher than satisfaction level (1.87) but official considered satisfaction level (1.90) higher than their attitude (1.75). Under human resource dimension, farmers preferred physical (2.25) and skilled labour requirements (2.08) while officials favoured hired (2.35) and skilled labour requirements (2.25).

The findings revealed that, like officials, farmers also realized the need of making the best use of local resources in order to maintain sustainable production. They felt that their attitude and degree of satisfaction could influence the acceptance or rejection of a technology. They preferred more technologies that help in risk management and increase profits at the same time it must be socially acceptable. Since, labour shortage is a serious concern for both farmers and officials, they also considered the labour requirement of a technology before adopting it.

4.3.1.2.1.4. Techno- Socio- Economic dimensions perceived as important by both farmers and officials in Thrissur district

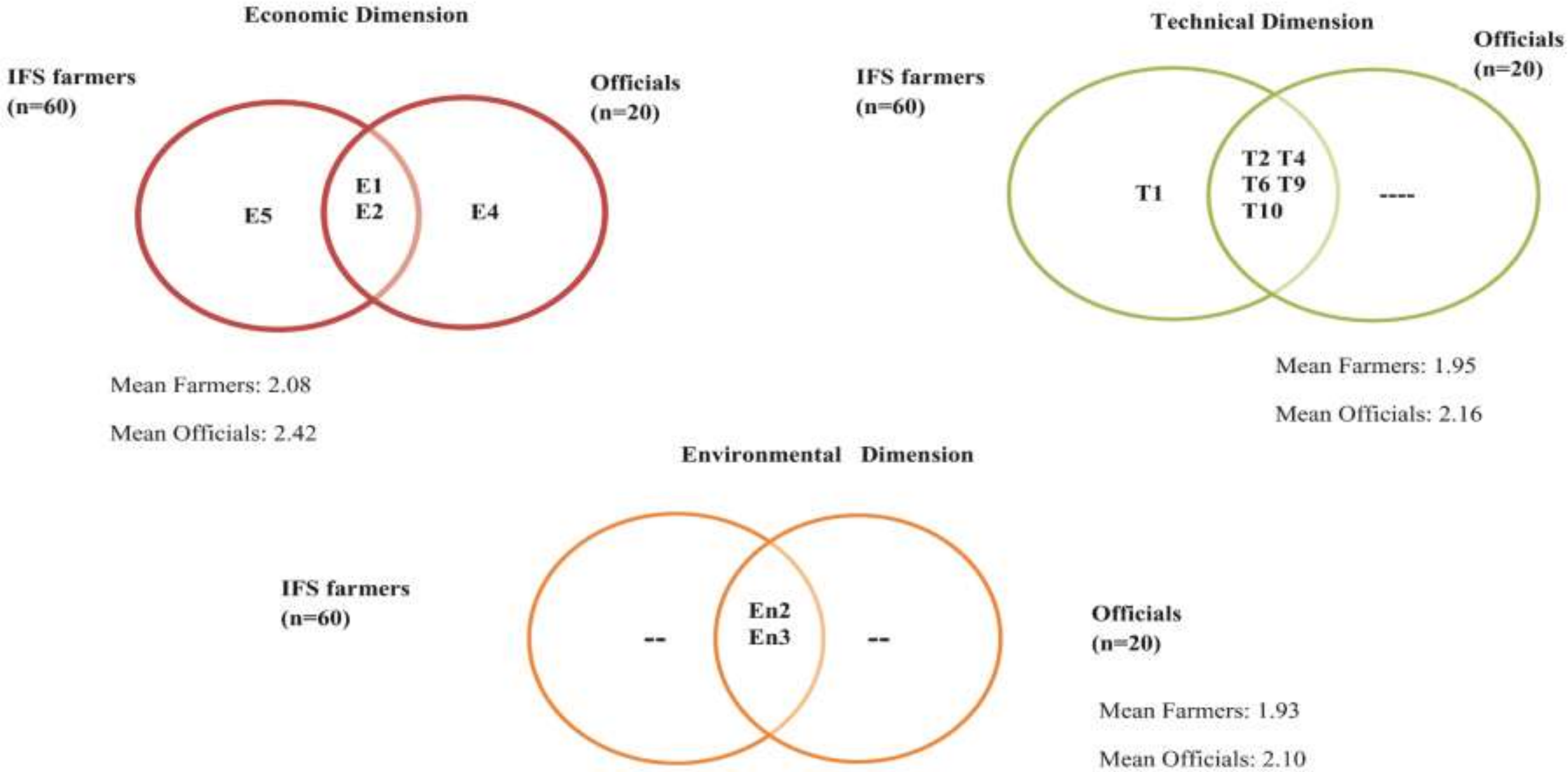
The preferences for various dimensions by the IFS farmers and officials were collected and evaluated separately. According to the findings, there existed some differences in preferences between farmers and authorities. So, using a Venn diagram, an attempt was made to identify those dimensions that received equal preference from both categories. When designing a technology for Thrissur district, these dimensions should be considered for adoption of technologies.

According to Fig. 4.34, it is worth noting that, out of the selected dimensions, a total of 13 characteristics were found to be relevant based on the perceptions of both categories of respondents. The selected dimensions were E1 and E2 from economic dimension; T2-T4-T6-T9-T10 under technical; En2 and En3 from environmental; S1 under socio cultural; P1 and P3 from psychological and finally H3 from human resource dimension.

Under economic dimension, the dimensions that were felt important by the IFS farmers and Officials were initial cost (E 1) and income generation potential (E 2). Some difference in preferences can also be noted in case of economic dimension, as in addition to the common dimensions selected farmers preferred regularity of returns and officials preferred commercialization. Both of them put little emphasis on the rate of return and the possibility for employment generation. So, despite certain differences between farmers and officials, both backed the initial cost and income generation potential of a technology, which cannot be overlooked as considering the significance of profit-oriented functions in IFS.

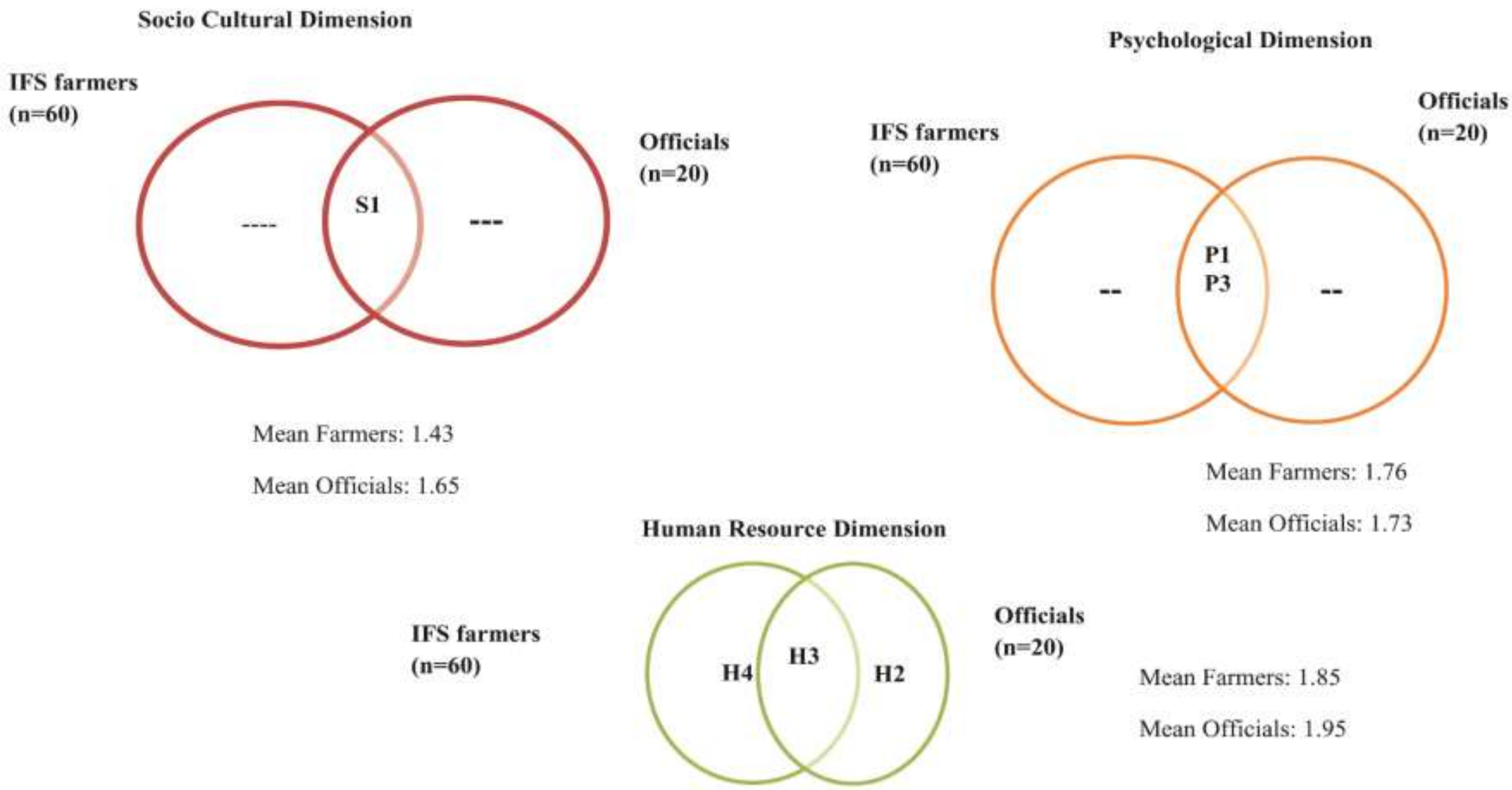
In case of technical dimension, efficiency (T2), complexity (T4), flexibility (T6), availability of supplies (T9) and time saving (T10) were found to be the most preferred dimensions by both categories. Meanwhile, physical compatibility was found to be important to farmers but not for officials. Farmers and officials in the Thrissur district put less attention on characteristics such as trialability, desirability, predictability and viability. In general, it could be concluded that in Thrissur district more acceptance will be given to less complex, highly efficient, flexible technologies with high accessibility and less time requirement.

With respect to environmental aspect, both farmers and officials supported local resource utilization and sustainability. IFS farmers preferred to limit dependency on outside sources by making the best use of existing resources within the same unit, such as waste recycling. As a result, the technologies implemented in IFS units must promote local resource utilization, otherwise profitability may be affected. Irrespective of the system sustainability was essential in ecological and production perspective. It was noteworthy that both farmers and officials are aware of this, and they took these factors into account when dealing with technology adoption.



Initial cost (E1), Income generation potential (E2), Commercialization (E4), Regularity of returns (E5), Physical compatibility (T1), Efficiency (T2), Complexity (T4), Flexibility (T6), Availability of supplies (T9), Time saving (T10), Local resource utilization /recycling capacity (En2), Sustainability (En3)

Fig.4.34: Techno- Socio- Economic dimensions perceived as important by both farmers and officials in Thrissur district



Hired labour (H2), Skilled labour requirement (H3), Physical labour requirement (H4), Social acceptability (S1), Attitude (P1), Level of satisfaction (P3)

In case of socio cultural dimension both considered social acceptability as an important aspect rather than social approval and cultural compatibility. Whereas in case of psychological factors preference was given to both attitude and satisfaction level. They opined that social status and adoption were not parallel. With respect to human resource dimension, both commonly preferred skilled labour requirement. At the same time officials also considered hired labour requirement as important while for farmers concern was reported for physical labour requirement. From the result it was clear that, social acceptance was a process rather than an end product. A new technology might be economically and environmentally viable, yet it might not be adopted if it is socially unacceptable. Likewise now farmers were more practical in adopting various components and technologies in their unit. They were not interested in adopting something new just to increase their social status; rather, a positive attitude towards the technology and high level of satisfaction can boost adoption rates.

From the result we can conclude that, at the time of field level application, a technology will pass through different type of evaluations. The final decision to adopt the technology may be affected by its characteristics. So it is very important to ensure that the particular technology could fulfill the needs of farmers. From the study conducted in Thrissur district it was evident that for better adoption, the technology should have high income generation potential along with easy accessibility. It also should have high recycling capacity and flexibility and can be used in a sustainable manner.

4.3.1.2.1.5. Techno- Socio- Economic Dimensions as perceived by IFS farmers and officials of Kannur district

An attempt was made to understand the perspectives of IFS farmers and officials in Kannur district on the significance of various dimensions of technologies. On each dimension, the responses of sixty IFS farmers and twenty officials in the study area were collected and ranked based on the mean total. Table 4.44 depicts the distribution of various dimensions of technology in the IFS units of Kannur district.

A glance at a table (4.44) highlighted the preference of farmers and officials on various technological dimensions. In farmers perspective, regularity of returns (2.72) was found to be the most significant aspect under economic dimension followed by initial cost (2.53) and income generation potential (2.43). Despite the fact that officials also shared the opinion, a slight changes in its order were visible.

Table 4.44. Techno- Socio- Economic dimensions perceived as important by farmers and officials in Kannur district

Dimensions	IFS Farmers (n= 60)				Officials (n=20)			
	Total score	Mean total score	Rank over class	Over all rank	Total score	Mean total score	Rank over class	Over all rank
Economic Dimension								
Initial cost (E1)	152	2.53	2	3	54	2.7	1	1
Income generation potential (E2)	146	2.43	3	5	53	2.65	2	2
Employment generation potential(E3)	100	1.67	6	19	46	2.3	5	8
Commercialization (E4)	109	1.82	4	16	49	2.45	4	6
Regularity of returns (E5)	163	2.72	1	1	50	2.50	3	5
Rapidity of returns (E6)	106	1.77	5	18	39	1.95	6	13
Mean Total	129.33	2.16			48.5	2.42		
Technical Dimension								
Physical compatibility (T1)	118	1.97	6	14	40	2.00	7	12
Efficiency (T2)	156	2.60	1	2	52	2.60	1	3
Trialability (T3)	90	1.50	7	20	34	1.70	8	16
Complexity (T4)	126	2.10	5	11	49	2.45	4	6
Predictability (T5)	80	1.33	10	24	28	1.40	10	20
Flexibility (T6)	145	2.42	3	6	46	2.30	5	8
Viability (T7)	88	1.47	8	21	33	1.65	9	17
Desirability (T8)	84	1.40	9	22	41	2.05	6	11
Availability of supplies (T9)	140	2.33	4	8	50	2.50	3	5
Time saving (T10)	150	2.50	2	4	51	2.55	2	4

Mean Total	117.7	1.96			42.4	2.12		
Environment Dimensions								
Energy saving potential (En1)	72	1.20	3	26	37	1.85	3	14
Local resource utilization/recycling capacity (En2)	144	2.40	1	7	43	2.15	2	10
Sustainability (En3)	120	2.00	2	13	48	2.40	1	7
Mean Total	112.00	1.87			42.67	2.13		
Socio-Cultural Dimensions								
Social acceptability (S1)	113	1.88	1	15	32	1.6	1	18
Social approval (S2)	70	1.17	2	27	25	1.25	3	21
Cultural compatibility (S3)	68	1.13	3	28	30	1.50	2	19
Mean Total	83.67	1.39			29.00	1.45		
Psychological Dimensions								
Attitude (P1)	107	1.78	2	17	39	1.95	1	13
Perceived social status (P2)	77	1.28	3	25	33	1.65	2	17
Level of satisfaction (P3)	130	2.17	1	10	30	1.50	3	19
Mean Total	104.67	1.74			34.00	1.70		
Human Resource Dimensions								
Family labour (H1)	83	1.38	4	23	33	1.65	4	17
Hired labour (H2)	130	2.17	2	10	40	2.00	2	12
Skilled labour requirement (H3)	122	2.03	3	12	35	1.75	3	15
Physical labour requirement (H4)	138	2.30	1	9	44	2.20	1	9
Mean Total	118.25	1.97			38	1.90		

High preference was for initial cost (2.7) followed by income generation potential (2.65), regularity of returns (2.50) and commercialization (2.45). In Kannur district farmers were not considering commercialization power of technology as important however officials may have noticed the potential available to IFS farmers and hence preferred such technologies that allow more value to the product. Regarding the technical dimensions of the technologies, the highest preference was for technological efficiency (2.60 each) and time saving for both farmers and experts (2.50 and 2.55). Next to that, farmers prefer flexible technologies (2.42) followed by availability of supplies (2.33). Along with these characters they also considered the complexity (2.10) as well as its physical compatibility (1.97). Whereas, officials were more concerned about availability of supplies (2.50) than complexity (2.45) and flexibility (2.30) of the technologies.

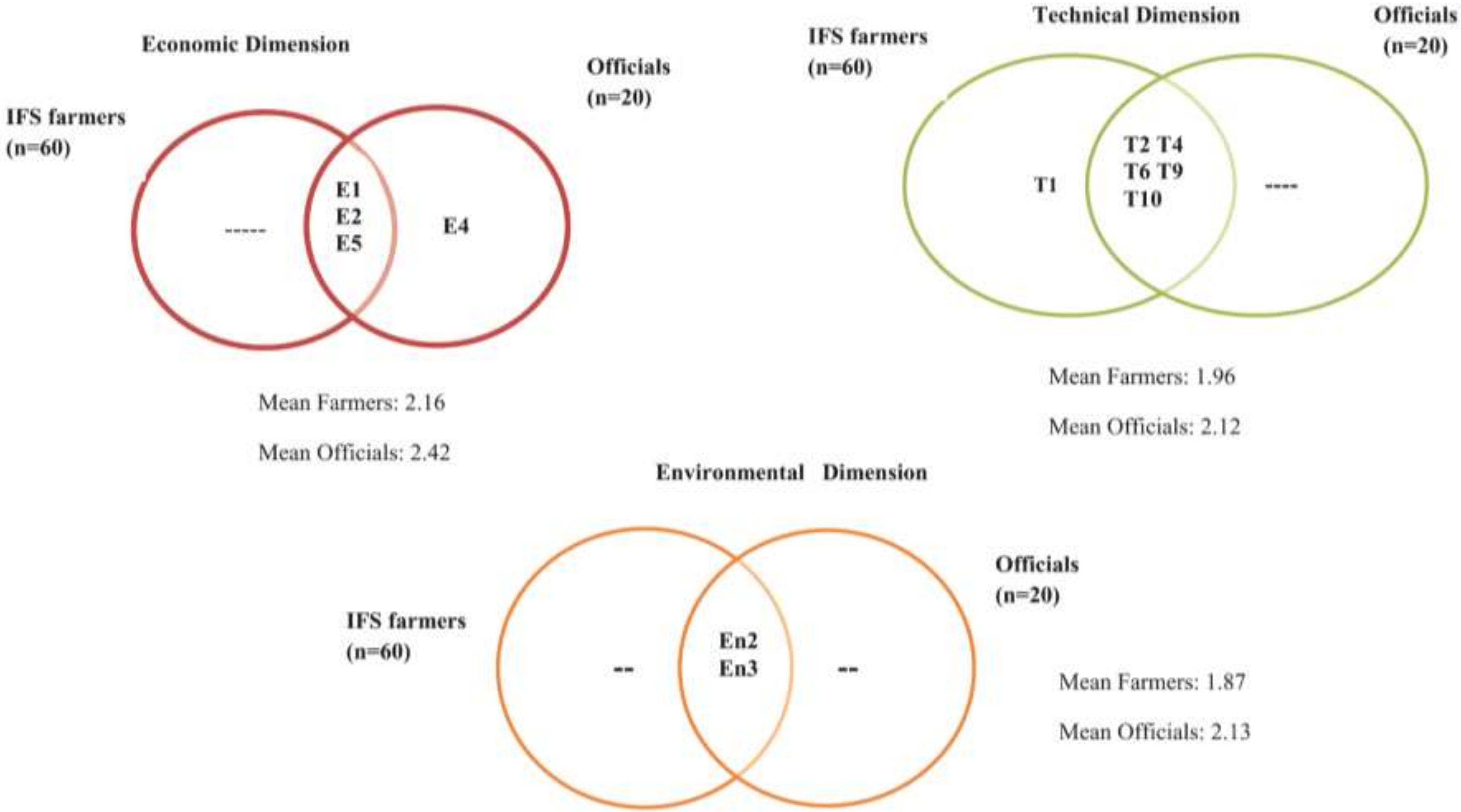
In case of socio cultural aspects, farmers preferred social acceptability (1.88) as an important character whereas in officials view, both social acceptability (1.6) and cultural compatibility (1.50) were important. In connection to environmental factors, farmers preferred the capacity to use local resource (2.40) followed by sustainability (2), whereas for officials, high preference was given to sustainability of technologies (2.40) followed by its recycling capacity (2.15). Officials consider attitude of farmers (1.95) as an important psychological factors. On the other hand, farmers prefer satisfaction level (2.17) more than attitude (1.78). The concerns of farmers related to human resource dimension were more for physical labour requirement (2.30) followed by hired labour (2.17) and skilled labour requirement (2.03). In the same context officials preference was more for physical labour requirement (2.20) followed by hired labour (2).

4.3.1.2.1.6. Techno- Socio- Economic Dimensions as perceived by both IFS farmers and officials of Kannur district

Among the specified dimensions some variation in the preferences was noted among farmers and officials. In this context, it was necessary to identify the common characteristics that a technology should have in order to gain acceptability among the farming community. Figure 4.35, shows the dimensions of technologies that were unanimously considered important by both IFS farmers and Kannur district officials. The Venn diagrams in fig.4.35 indicated the common characteristics that a technology should have based on the perceptions of its users and officials. According to fig. 4.35 out of the selected dimensions a total of 14 characteristics were found to be relevant based on the perceptions of both categories of respondents. The selected dimensions were E1- E2-E5 from economic dimension; T2-T4-T6-T9-T10 under technical; En2 and En3 from environmental; S1 under socio cultural, P1 from psychological and finally H2 and H4 under human resource dimension.

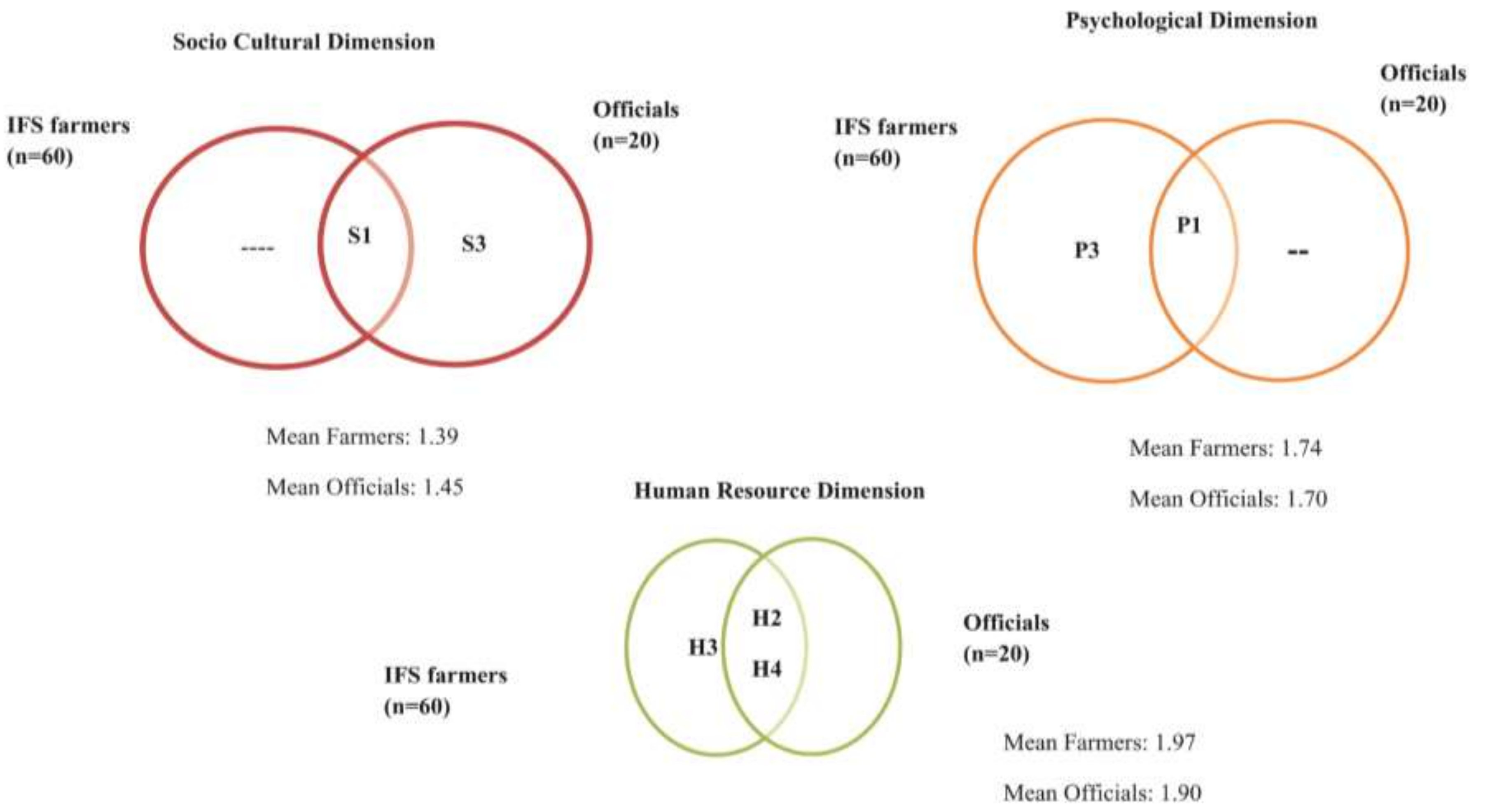
When farmers learn about a new technology, those who rely solely on agriculture are deeply concerned about the economic dimension of the same. In Kannur district, the economic dimensions felt important by both the categories were regularity of returns (E 5), income generation potential (E 2) and initial cost (E 1). Venn diagram also revealed that, in addition to these three dimensions, the officials had seen the commercialization capacity of the technology also as an important aspect to be taken in to consideration. However, neither group appeared to be concerned about the potential for employment generation and rapidity of returns of the particular technology. In terms of technical dimension, both categories preferred efficiency (T2), complexity (T 4), flexibility (T 6), availability of supplies (T 9) and time saving (T10). Similarly, for farmers, physical compatibility (T1) of the technology was also found to be significant. According to the findings, both farmers and officials in Kannur district paid less emphasis on criteria such as trialability, desirability, predictability and viability. Similar to other districts, officials and farmers in Kannur district also prioritized local resource use and sustainability as far as the environment is concerned. These two elements could not be avoided when picking a technology for IFS units, since IFS models rely on the linkage between various resources available in a unit

Regarding socio cultural dimension both considered social acceptability as an important aspect rather than social approval but officials had opined that cultural compatibility of a technology can also determine its adoption. With respect to psychological factors, common preference was identified for attitude towards the technology. For farmers their level of satisfaction also seemed to be important. Both groups focused on hired and physical labour requirements, while evaluating the human resource dimension. Besides from these two aspects, farmers were also concerned about the skilled labour requirement. Since labour shortage and lack of skilled labours were very serious issue in Kerala, it was quite natural that they were concerned more about the hired labour than family labour.



Initial cost (E1), Income generation potential (E2), Commercialization (E4), Regularity of returns (E5), Physical compatibility (T1), Efficiency (T2), Complexity (T4), Flexibility (T6), Availability of supplies (T9), Time saving (T10), Local resource utilization /recycling capacity (En2), Sustainability (En3)

Fig.4.35: Techno- Socio- Economic dimensions perceived as important by both farmers and officials in Kannur district



Hired labour (H2), Skilled labour requirement (H3), Physical labour requirement (H4), Social acceptability (S1), Cultural compatibility (S3),Attitude (P1), Level of satisfaction (P3)

From the results, it can be concluded that IFS farmers in Kanuur district preferred socially accepted low cost technologies with high income generation capacity, efficiency, flexibility, easy accessibility and permitting sustainable and maximum utilization of local resources. It should provide high satisfaction to farmers with minimum labour requirement. If such technology is introduced in Kannur district, the rate of adoption will be more.

4.3.1.2.2. Distribution based on mean average scores of all dimensions

Previous section dealt with different aspects perceived as important by both farmers and officials. For the study, six major dimensions of technologies were considered, such as economic, technical, environmental, socio - cultural, psychological and human resource dimension. District wise analysis was carried out to identify relevant attributes of technologies under each dimension. Furthermore, in order to acquire a full grasp of the subject, an attempt was made to determine the most important dimension among the selected dimensions. The details are given below:

Table 4.45: Distribution based on mean average scores of all dimensions

Dimensions	Kollam	Thrissur	Kannur	Total	Rank
Economical	2.29	2.25	2.29	2.28	I
Technical	2.10	2.06	2.04	2.07	II
Environmental	2.02	2.01	2.00	2.01	III
Human Resource	1.87	1.90	1.93	1.90	IV
Psychological	1.70	1.75	1.72	1.72	V
Socio Cultural	1.35	1.54	1.42	1.44	VI

District wise distribution of dimensions of technology based on mean average scores in the decreasing ranking order were as follows- economical dimensions (2.28) followed by technical dimension (2.07), environmental dimension (2.01), human resource dimension (1.9), psychological dimension (1.72) and socio-cultural dimension (1.44).

From the table (4.45), it can be therefore inferred that economic dimension has the most importance. As the specialisations require more complex technologies that are remunerative, economic dimensions needs to be given importance. However, technical dimension also gains equal importance because of the adoption of different specialisations. Furthermore, it can be found that IFS farmers were more concerned about environmental aspects than human resource dimension. The findings were in line with those of Sreelakshmi (2018), who found that among various technological dimensions, homestead growers of Thriruvananthapuram district preferred economical dimension as the most important followed by technical and human resource dimension.

4.3.2. The constraints faced by the farmers for establishing and maintaining an IFS

In agricultural system, farmers are experiencing various constraints, which has a significant impact on agricultural growth (Prasannakumaran *et al.*, 2018). When an IFS unit is viewed holistically, farmers face a number of challenges while establishing and maintaining an IFS unit. The identification of these constraints will enable farmers to take necessary actions to overcome the situation immediately and lay the foundation for policymakers to restructure the existing policies. An effort was made to comprehend the constraints that were experienced by IFS farmers of Kerala for establishing and maintaining an IFS unit. The findings were given below:

4.3.2.1. Constraints experienced by the IFS farmers for establishing and maintaining identified components

In order to evaluate the constraints experienced by the IFS farmers for establishing and maintaining the identified components in an IFS unit, component wise constraints were enlisted and ranked through Garrett ranking method. The ranked constraints were given below:

Table 4.46: Component wise constraints experienced by the IFS farmers

Sl No.	Constraints	Garett Mean Score	Rank
I	**Crop component**		
1	Natural calamities and extreme weather events	78.07	I
2	High cost of production	77.22	II
3	Lack of remunerative price	71.02	III
4	Price fluctuation	59.22	IV
5	High labour charges	56.22	V
6	Insufficient Government incentives	55.79	VI

7	Labour scarcity	54.28	VII
8	Non availability of quality inputs on time	53.25	VIII
9	Marketing difficulties	52.72	IX
10	Pest and disease incidence	35.63	X
11	Crop damage due to animal attack	31.81	XI
12	Inadequate facilities for value addition	31.38	XII
13	Lack of storage facilities	30.55	XIII
14	Lack of training	29.91	XIV
15	Inadequate extension support	29.64	XV
II	**Dairy specific**		
1	Higher cost of feed	75.56	I
2	Low price for the produce	72.66	II
3	High initial investment	63.77	III
4	Diseases incidence	54.57	IV
5	Insufficient government incentives	46.62	V
6	Unavailability of green fodder during lean season	45.99	VI
7	Lack of market for value added products	37.50	VII
8	High transportation cost	34.04	VIII
9	Inadequate veterinary services	32.92	IX
10	Problems of predators	31.30	X
III	**Fisheries**		
1	Price fluctuation	74.52	I
2	Marketing difficulties	68.57	II
3	High initial investment	66.92	III
4	Insufficient government incentives	45.03	IV
5	Inadequate processing facilities	41.60	V
6	Lack of quality inputs	40.13	VI
7	Lack of extension support	38.84	VII
8	The presence of pests (snakes, birds, toads)	37.37	VIII
9	Irregular water supply	33.02	IX

IV	**Poultry**		
1	High cost of feed	61.11	I
2	Low production performance	59.93	II
3	Mortality due to disease outbreak	52.85	III
4	Non availability of day old chicks round the year	40.54	IV
5	Attack of predators	33.57	V
V	**Apiculture**		
1	Bad weather	61.13	I
2	Pest and diseases	57.05	II
3	Lack of processing facilities	47.38	III
4	Inadequate skill and knowledge	32.44	IV
VI	**Mushroom**		
1	Lack of infrastructure	61.73	I
2	High microbial contamination due to improper post harvest handling	52.45	II
3	Lack government incentives	48.27	III
4	Lack of knowledge about value addition techniques	45.36	IV
5	Non-availability of spawn in time	40.18	V
VII	**Compost**		
1	Bad weather	61.07	I
2	Limited supply of organic wastes	56.73	II
3	Lack of proper knowledge and expertise	47.28	III
4	Pests might get attracted(Rats, snakes, ant and bugs)	32.59	IV
VIII	**Azolla**		
1	Bad weather condition	62.18	I
2	Difficulty in maintenance of the tank	50.62	II
3	Very poor growth of azolla	48.96	III
4	Conserving the propagation of stock requires more care	36.23	IV

IX	Biogas		
1	High installation and maintenance costs	60.69	I
2	Inadequate government support	57.97	II
3	Feedstock availability and other technical issues	47.26	III
4	Inadequate expertise and training	32.08	IV

A thorough examination of the table (4.46) revealed that the severity of various constraints with respect to crop components in farmers perspective was in an order natural calamities and weather change (78.07), high cost of production (77.22), lack of remunerative price (71.02), price fluctuation (59.22), high labour charges (56.22), insufficient Government incentives (55.79), labour scarcity (54.28), non availability of quality inputs on time (53.25), marketing difficulties (52.72), pest and disease incidence (35.63), crop damage due to animal attack (31.81), inadequate facilities for value addition(31.38), lack of storage facilities (30.55), lack of training (29.91) and inadequate extension support (29.64).

Kerala is highly prone to different natural disasters like cyclones, drought, flood, landslides etc. and crop loss due to unforeseen rains has now become the norm. Unexpected rain and associated flooding and landslides have caused a number of issues such as surface crusting, cracking, destruction of floura and fauna, loss of nutrients due to leaching. As per the primary analysis by the state Agriculture department, around 56,844.44 ha of cropped area has been affected by the floods, causing a loss of Rs 1355.68 crore to 3.14 lakh farmers (Anon., 2018). This might be the reason for giving first rank to natural calamities and extreme weather events. In Kerala, for both urban and rural areas, the average wage rate is considerably higher than that of the national scene. In 2020–21, the average wage rate for men increased to rupees 741.89 and for women, it increased to rupees 536.68. This represents a significant change in the wage rate of Kerala from last few years, as there was a 230.61 per cent increase for men and a 237.49 per cent increase for women was reported from that of 2008-09 (Anon., 2022). Due to this high wage rate and hiked price for fertilizers and other inputs especially during the post covid scenario, resulted in the high cost of cultivation. Since the profitability from the component directly depends on the cost of cultivation and price of the agricultural products, farmers were more worried about high cost of production, lack of remunerative price, price fluctuation and high wage rate.

Even though the Kerala government introduced various programmes to provide financial assistance to farmers, yet they were unable to meet their expenses with the available incentives because the cost of fertilizer and other inputs had increased, the caps on the amount sanctioned per head, as well as the delay in fund disbursement. In this context, there was a high demand for additional government level subsidies. The dynamics in Kerala agricultural labour market indicated that despite having higher pay, the state is reportedly experiencing a severe scarcity of agricultural labourers to carry out traditional agricultural practices (Viswanathan, 2016). Since farm mechanization was not widely adopted due to a number of reasons, such as the high cost of machines, fragmented land holdings and high demand for government owned machineries during peak crop seasons, etc., this was also related to labour shortage. The outflow of youngsters to look outside of India for skilled labour and better paying jobs was causing a decline in the work force in Kerala, especially in the agricultural sector. The attitude of youth that agriculture is not a white collar profession, especially those with formal education, as well as more employment opportunities in non agricultural sectors can both be seen as contributing factors to the labour shortage.

The state and central government play a major role in providing inputs and other support services to the farmers. However, the result shows that still farmers were facing difficulty for getting quality inputs such as seeds, fertilizers, machines etc. on time. The limited quantity available through government schemes and the delay in distribution compelled them to purchase inputs at higher price from private sources. In these circumstances, the quality was also in danger due to adulteration in fertilizers and poor quality seeds. Some farmers complained that the major share of benefits in the agricultural support system were cornered by large and medium farmers, whereas small and marginal farmers were being neglected to a greater extent. Even though various insurance schemes and minimum support prices offered and government oriented procurement centers for specific crop products were available, some farmers had marketing difficulties. The incidence of pest and disease was the next important constraint that farmers had to deal with. Due to the current weather conditions such as sporadic rains and increase in day temperature, humidity has led to rise in pest and disease incidence among the crops (Nambudiri, 2018). Other likely causes include low adoption rate of plant protection practices, lack of crop rotation and the irrational use of chemicals caused resistance among some pest and diseases which in turn led to an increase in attack.

Another serious issue experienced by the farmers was the crop damage due to animal attack. According to the report of Kerala Forest Research Institute, the crops were primarily being damaged by seven different species of wild animals, including elephant, sambar, wild pig, porcupine, giant squirrel, peafowl and monkey (Jayson, 2013). Since these animals were coming under wide life protection act and farmers alone could not take any action, it remained as a major concern. As compared to other constraints, lack of training and inadequate extension support were the results of the moderate level of participation in extension, training and other social activities.

Among the various constraints enlisted for dairy farming, higher cost of feed (75.56) was ranked first followed by low price for the produce (72.66), high initial investment (63.77), disease incidence (54.57), insufficient government incentives (46.62), unavailability of green fodder during lean season (45.99), lack of market for value added products (37.5), high transportation cost (34.04), inadequate veterinary services (32.92) and problems of predators (31.3).

The hike in feed cost adversely affected the dairy farmers, as it is very important for maintaining the productivity. The price of milk has not changed significantly over the past three years whereas the cost of feed has shot up to 30 to 40 per cent (Sudhish, 2022). An earlier survey by Kerala cooperative milk marketing federation pegged Rs. 28 as the average production cost per litre of milk when the price paid to cooperative member was Rs.30-32 (NDDB, 2016). As an impact of covid and lockdown, the price for feed was hiked. Under this reality, MILMA still procured milk at a low price. The profitability of the dairy industry is impacted by the low price obtained from these government procurement centers because the majority of farmers rely on cooperative societies for the sale of their milk. Dairy farming demands significant financial outlays. Land, buildings, equipment and cost of cows are more than that of goats. In addition, high maintenance costs, high feed costs and low milk prices made it difficult for farmers to expand their farms.

The high price of cattle feed forced the dairy farmers to reduce the amount of feed they purchased. Due to a shortage of green fodder and high price for concentrates, the animals were underfed in some respondents households. Additionally, some farmers switched from feeding concentrates to rice and locally available fruits such as jackfruits etc. The high intake of these carbohydrate and sugar rich foods led to the high disease incidence. Since majority of the cattle population were cross breeds and due to the price hike in concentrates majority of the farmers were not following the recommended dietary practices, also affected the yield and health condition of cattle. Even though Government was providing some subsidies for dairy farmers for purchasing feed and development of the dairy units but with this limited amount of money and quantity of feeds alone dairy farmers could not meet their needs. High price of the inputs and low milk prices resulted in a low financial conditions of the farmers. In this situation, farmers needed more assistance from the government in order to obtain high quality feed at reasonable prices as well as the milk prices needed to be increased significantly. The majority of the farmers in the study area were experiencing lack of green fodder availability round the year and also due to land constraints. Even though farmers in Kerala realized that fodder could be grown as a single crop and were also cognizant of its marketability, they have not yet fully tapped into this sector (Jacob and Ashokan, 2020). These findings were in line with that of Sreeram *et al.* (2018), who conducted a study in four districts of Kerala and found that hiked price of feeds and non remunerative price for milk was the top ranked constraints associated with dairy sector in Kerala. Another study conducted by Smitha *et al.* (2019) among the dairy farmers of Kerala, also reported similar findings. According to them, the major challenges faced by dairy farmers in Kerala were rise in the cost of cattle feed, the cost of veterinary services and medicine and the insufficient availability of green and dry fodder throughout the year.

Related to fisheries, the order of severity of constraints were price fluctuation (74.52), marketing difficulties (68.57), high initial investment (66.92), insufficient government incentives (45.03), inadequate processing facilities (41.6), lack of quality inputs (40.13), lack of extension support (38.84), the presence of pests (snakes, birds, toads) (37.37) and irregular water supply (33.02). As there were no regional procurement centers to collect fish directly from farmers, they were having trouble in marketing their products. As majority of the farmers depended on local market for selling their product, they were highly susceptible to price fluctuations. In addition, farmers were compelled to sell their products at a lower price due to the low adoption of processing technologies. In Kerala, during the post-monsoon season, fish are generally sold at very low prices, whereas retail prices skyrocket during times of recession (Salim *et al*., 2017).

In the study area, majority of the farmers had added fish farming in their IFS units, as part of *Jaivagraham* programme and they were unable to follow scientific production techniques mainly because of high initial investment and small production unit. Since IFS contains many components, investing a huge amount of money in any one of the component appears to be impractical for farmers in the context of price fluctuation, high cost inputs and limited marketing and value addition facilities available. These findings are in line with that of Pandey and Dewan (2006), who conducted a study to examine the limitations of fish farming practices in Uttar Pradesh and identified financial constraints as being the most significant limitations faced in fish farming.

Through *Jaivagraham* programme, maximum amount of Rs.50000 were provided to IFS farmers for adding more components and upgrading the existing units however, with this amount adopting scientific fish production practices were economically not possible for them. So mainly in IFS units, farmers were following artificial ponds (*Padutha ponds*) from which they could not make much yield. Lack of quality inputs has an impact on production and productivity (Singh and Ahmad, 2003). The medium to low income from aquaculture components that was discovered might be due to the poor quality of the inputs that are readily available. Similar findings were reported in a study conducted to investigate the challenges encountered in cage aquaculture practices in Ernakulum district of Kerala by Kappan *et al.* (2018.) They stated that a lack of quality seeds, increase in feed price, lack of timely and sufficient supply of seeds were the main problems faced by the farmers in the Ernakulum district.

With respect to poultry, high cost of feed (61.11) was the top ranked constraint followed by low production performance (59.93), mortality due to disease outbreak (52.85), non availability of day old chicks round the year (40.54) and attack of predators (33.57). According to the IFS farmers in the study area, the most important constraint with respect to poultry component was the increased price of feeds. Farmers alleged that the state government lacked a system for monitoring and controlling poultry feed prices. Proper management of feeds, shelter and health care aspects is critical for ensuring high production in poultry. As the majority of farmers had backyard poultry and they valued nutritional security over income generation, they did not invest heavily in existing poultry units. The hike in price of feeds, forced farmers to withdraw from purchasing of feed from market and started using other locally available resources as feed. The lack of balanced feed and poor management of the poultry units led to low production performance.

High mortality rates have been reported in some areas as a result of the unexpected occurrence of some diseases like bird flu. This condition could be caused by a lack of expertise in recognizing symptoms as well as a lack of isolation facilities. A study conducted for finding out the mortality pattern of poultry in Wayanad district of Kerala reported that disease outbreaks can cause financial crisis in the poultry industry and some of them can be avoided through vaccination. The study found that proper management of feeding, housing, and brooding practices can prevent 69.18 per cent of diseases (Prasanna and Neethu, 2014). Another study conducted in 2009 by Durga and Subadra also reported the issue of occurrence of viral and bacterial diseases among poultry farmers in the selected blocks of Thrissur district. Despite the fact that the government has many schemes for providing day old chicks to farmers, they have been unable to meet the high demand for chicks among farmers, resulting in an insufficient supply of day old chicks. Predator attacks are quite common in backyard poultry. The implementation of scientific housing could help to prevent the attack to a greater extent. Without such physical protection, predators would prowl, reducing flock size. This finding concurs with Singh *et al.* (2000).

In case of apiculture component, the major constrains were bad weather (61.13), pest and diseases (57.05), lack of processing facilities (47.38) and inadequate skill and knowledge (32.44). Kerala is highly vulnerable to climate related issues like cyclones, unexpected rainfall etc. The incessant rain and continuing wet spell in the state hit the honey production, as bees are facing acute scarcity of pollen and nectar as they were unable to venture out for extended periods due to the rains, resulting in the colonies getting weak and dwindling of the brood (Rajeev, 2018). Bad weather can also lead to a variety of diseases in hives. Inadequate knowledge and skills in handling, management, and processing aspects were also identified as major issues in IFS units of Kerala.

When considering mushroom component, lack of infrastructure (61.73) was found to be the most important constraint followed by high microbial contamination due to improper post harvest handling (52.45), lack of government incentives (48.27), lack of knowledge about value addition techniques (45.36) and non-availability of spawn in time (40.18). Since mushroom cultivation is highly susceptible to various contaminations, it is critical to maintain specific sanitary and hygienic conditions. Hence, adequate infrastructure facilities are required to ensure sanitary conditions and proper production management. In their view, more intervention from government side is needed for the promotion of mushroom cultivation. The number of farmers who had adopted mushroom in their unit were found to be very low. This could be attributed to the need of more government initiatives. By using the appropriate value addition techniques, issues regarding perishability of the product and marketing could be resolved (Wakchaure, 2011). To increase the profit from the mushroom component, it is necessary to address the lack of knowledge about various processing methods.

In case of composting, bad weather (61.07) was ranked as the major constraint. Second important constraint was limited supply of organic wastes (56.73) followed by lack of proper knowledge and expertise (47.28) and pests might get attracted (32.59). Unexpected weather changes have an influence on the temperature and moisture levels inside the compost pits, which affect the quality of compost. Since recycling of farm waste among various components is common in IFS units, farmers occasionally may encounter challenges gathering the necessary amount of organic waste because a large volume of waste is needed to produce an adequate amount of compost. IFS units in Kerala offer a variety of composting options, including vermi and coirpith composting, kitchen waste composting etc. Even though the processes for composting might seem simple, each type had unique production techniques that made managing these pits difficult. In vermi composting, sufficient skill is needed to handle earthworms as they are very sensitive to sunlight and the moisture content of their bedding, it requires special maintenance. Concern over the pervasiveness of pests in composting pits has also been expressed by some farmers.

Bad weather condition (62.18), difficulty in maintenance of the tank (50.62), very poor growth of azolla (48.96) and conserving the propagation of stock requires more care (36.23) were found to be the important constraints faced by farmers with respect to azolla cultivation. Environmental parameters such as temperature, light intensity, humidity and so on have an impact on azolla biomass production and excessive wind and turbulent water can shatter the pits (Sadeghi *et al.*, 2013). Farmers face difficulties in maintaining the azolla tank during the summer and rainy seasons because it requires specific climatic conditions. The growth of azolla is hampered if the tank is not properly maintained or if good quality stock is not used. The majority of farmers get their stock from friends or other progressive farmers, and the fact that the quality of the stock cannot be guaranteed may be the cause of poor growth in some units.

Regarding biogas component, high installation and maintenance costs (60.69) was ranked as the most important constraint. Next to that farmers ranked inadequate government support (57.97) followed by feedstock availability and other technical issues (47.26) and inadequate expertise and training (32.08). The installation and maintenance costs vary according to tank size. Despite the fact that the government had launched some schemes to assist farmers in installing biogas plants, the majority of IFS farmers have yet to benefit from those schemes. According to Naik *et al.* (2014), the key aspects to maintain a small biogas tank are feedstock variability, feeding regime, proper temperature and pH.

Since IFS emphasizes farm waste recycling among various components within the unit, a lack of sufficient quantity of farm waste can also have an impact on the production. Lack of skills and expertise in biogas production results in difficulty to understand the technical aspects of the tank, which, in turn, affects the functioning.

4.3.2.2. Constraints experienced by the IFS farmers for establishing and maintaining an IFS unit in Kerala

IFS is a system composed of different complementary components, so establishing and maintaining a unit involves considerable risk. An attempt was made to identify the major constraints experienced by the IFS farmers for establishing and maintaining an IFS unit in Kerala. The Garett ranking technique was used to rank various constraints and the results were listed below.

Table 4.47: Constraints experienced by the IFS farmers for establishing and maintaining an IFS unit

Sl No.	Constraints	Garret Mean Score	Rank
1	Lack of remunerative prices for farm produces	78.40	I
2	High cost of production	76.60	II
3	Natural calamities and climate changes	68.77	III
4	High investment in the initial stage	58.16	IV
5	Non availability of quality inputs on time	55.17	V
6	Marketing difficulties for the produce from different enterprises	54.27	VI
7	Land constraints	51.49	VII
8	Insufficient government incentives	50.24	VIII
9	High labour charges	41.00	IX
10	Labour scarcity	34.66	X
11	Difficulty in time management for multiple activities	33.57	XI
12	Inadequate storage and value addition facilities	32.81	XII
13	Lack of awareness and knowledge about improved practices	31.57	XIII
14	Inadequate extension support and lack of proper access to training	27.10	XIV

A close look at the table (4.47) revealed that lack of remunerative price for the farm produces (78.40) was the top ranked constraints for maintaining an IFS unit sustainably. Following to that high cost of production (76.60), natural calamities and weather changes (68.77), high investment in the initial stages (58.16), non availability of quality inputs on time (55.17), marketing difficulties for the produce from different enterprises (54.27), land constraints (51.49), insufficient government incentives (50.24), high labour charges (41) and labour scarcity (34.66) were the other constraints prevalent in IFS systems of Kerala, in their order of severity.

Since regional procurement centers at government level were available mainly for crop and dairy component, the farm products from other components were facing risk of lack of remunerative price and issues of price fluctuations. The hiked price for feeds, fertilizers and other inputs affected the economical balance of the system severely. Since IFS contains several components, the cost of production for each component was increased due to the hiked price of various inputs, especially during the post Covid situation. Even though the government took some steps to help farmers by providing financial and technical assistance, the results showed that farmers were still struggling with higher production costs. Climate change is a harsh reality for most of our farmers and one of the most serious threats to agricultural development of the state. In order to ensure stable agricultural production, appropriate actions must be taken to address these challenges (Anon., 2021).

For the establishment of some components like fisheries, mushroom, apiculture high financial investment was needed in the initial stage, which some farmers could not afford. The result also showed that farmers were still having difficulty for obtaining quality inputs for maintaining various components in a unit. Farmers were receiving inputs through various schemes and government outlets. However, the limited quantity available through government schemes, as well as the delay distribution and inadequate quantity of inputs available through government outlet, exacerbated the issue of insufficient supply of quality input on time. The lack of government procurement centers for other components, besides crop and dairy, made it difficult for IFS farmers to find markets for diversified products. Since, majority of the farmers in Kerala were marginal in nature, they might face difficulties for expanding their units by adding more components. For example, due to a scarcity of green fodders, some farmers were eager to cultivate fodder crops but were unable to do so due to land constraints. Despite the fact that the Kerala Government implemented various programmes to provide financial assistance to farmers, they were unable to meet their expenses with the available incentives due to increases in input costs. Since the labour issues like high labour scarcity and labour charges were found to be a serious issue, majority of the farmers were performing farm operation by themselves or through family labour utilization. Time management was a major concern for such farmers when it came to adopting and maintaining new components. Inadequate storage and value addition facilities, lack of awareness and knowledge about improved practices and inadequate extension support and lack of proper access to training were also reported by some farmers.

4.3.2.3. Suggestions to overcome the constraints

4.3.2.3.1. Suggestion for overcoming the constraints as perceived by farmers.

The suggestions made by the IFS farmers to overcome their constraints were listed below.

A careful examination of the table (4.48) showed that, majority of the sample (97.22%) believed that they could overcome their constraints to a greater extent if they were provided with quality feed as well as fertilizers at low price. Further, 95 per cent of the IFS farmers opined that raising the price of milk in cooperative society would enable them to get past the difficulties that they were currently facing. Some farmers believed that bringing MGNREGS workers in to agricultural sector would help them to overcome the constraints of labour shortages and high wage rates since Kerala was found to have a serious labour shortage problem (93.33 %). Government is providing financial assistance to IFS farmers through *"Jaivagrham programme*". More than ninety per cent of the sample indicated that if the government could give them more financial assistance, they could add more components and maintain the IFS units more effectively. They suggested that since IFS unit contain many components and the establishment and maintenance cost of each component vary, in this context, component wise special emphasis was needed. More than three fourth of the farmers (86.11%) opined that the farm mechanization should be increased. Most farmers (82.78%) had a suggestion that, animal husbandry department needed to take more effort to ensure the production potential of breeds brought from other states. Nearly eighty per cent of the sample suggested the need of low cost technologies.

Table: 4.48: Suggestions for overcoming the constraints as perceived by farmers (n=180)

Sl no	Suggestions	f	%
1	Increase farm mechanization	155	86.11
2	Production potential of breeds brought from other states should be given more attention	149	82.78
3	Provide more subsidy facilities to IFS farmers	164	91.11
4	Ensure the availability of quality feed and fertilizer at low price	175	97.22
5	Power supply should be regular to increase the farm efficiency	73	40.56
6	Hasten the distribution of subsidies and support price	137	76.11
7	Inclusion of accessible and low cost technologies	145	80.56
8	The market price of milk should be remunerative	171	95.00
9	More training and demonstrations on integration in IFS units	106	58.89
10	Establishment of separate market facility for sale of organic produce	80	44.44
11	Participation of MGNREGS to agricultural sector	168	93.33
12	Promotion of small scale value addition technologies and facilities	133	73.89
13	Arrangements for supply of quality inputs in time through Cooperative system	140	77.78
14	More government organized market outlets for value added products of different components	128	71.11
15	Fill the vacancies of veterinary surgeons post	89	49.44

More than three fourths (77.78%) of the farmers suggested that a scheme was needed to provide input through cooperative societies in a regular and cost effective manner in order to avoid procuring it from private agencies at a high cost. Even though they occasionally received inputs from cooperative systems, regularity of supply should be maintained. Farmers believed that this was the best way to avoid relying on private agencies because the cost and quality of inputs was in question. Despite the fact that the government announced the minimum support price, insurance and financial assistance through other schemes for crops and other components, most farmers (76.11 %) have expressed their concerns about the delay in distribution of these funds. According to them, in order to reap more benefits, the distribution of these funds should be expedited. Since the majority of the respondents had small units, less than three quarters (73.89%) of respondents felt that they needed more exposure to value added technologies that could be easily and sustainably maintained in a small scale unit. As marketing of the value added products is a major concern for IFS farmers, they (71.11%) also suggested the need for separate market outlet giving special attention for value added products of different components. More than half of the respondents (58.89 %) stated that they required additional training and demonstrations on the integration of different components in their unit in order to further reduce production costs by implementing more integration practices.

4.3.2.3.2. Suggestions for overcoming the constraints with regards to identified components

Climate change is a harsh reality for most of our farmers and one of the most serious threats to agricultural development of the state. In order to ensure stable agricultural production, appropriate actions must be taken to address these challenges (Anon., 2021). Both at the government and farmers level, more climate resilient agricultural practices can be adopted in order to minimize the impacts of climate change and maintain farming sustainably. The practices such as use of resistant / adaptive crops, change in cropping pattern, crop diversification, soil and land management etc. may be promoted. Encourage the use of non-lodging, saline-tolerant varieties and conserve indigenous varieties which can withstand varying climatic conditions. For instance, the Kerala Agricultural University recently released two rice varieties, Mithila and KAU Manuvarna, which are resistant to flooding and salinity (Anon., 2019b). The adoption of these varieties needs to be encouraged. Farmers were finding it difficult to reduce the cost of cultivation due to the rising of price of fertilizers such as potash and high labour charges. Immediate involvement from the government is required to control fertilizer prices and ensure the availability of quality inputs. More government oriented procurement centers should be established to address the issues like lack of remunerative price, price fluctuations as well as marketing difficulties. With respect to labour shortage, many

Krishibhavans had created a group called *'Karmasena,'* the primary goal of which is to address labour shortages. Such efforts can be undertaken by all Krishibhavans in order to address the issue of labour scarcity and high wage rates. In addition, ensuring maximum involvement by family members reduces the need for hired labour.

The promotion of safe plant protection practices needs to receive more attention. Some farmers often use pesticides despite being unaware of the chemical name that distributors have recommended. Therefore, an integrated approach needs to be promoted among the IFS farmers for managing pests and diseases by the relevant authorities, which is crucial to minimize the production losses due to pests and diseases. According to Kathiresan (2007), combining integrated pest and disease management strategies with integrated farming methods aids in addressing biodiversity concerns while concurrently reducing the use of agrochemicals. Crop loss due to wild animal attack was a serious issue that some IFS farmers had to deal with. Although farmers were using different strategies to secure their crop from the attack, still this issue was very serious in some areas. The majority were using traditional techniques, while few had shifted to novel techniques. Building electric fences with energizers in trouble spots is one of the short-term solutions. However, it necessitates high initial investment as well as maintenance costs. Farmers should be given subsidies and bank loans in order to implement these measures. Kerala Government has decreed that those who suffered harm or lost life or properties including crop loss due to attack of wild animals must be compensated. Adequate action should be taken to release these compensations in a timely manner.

The growth and productive performance of the dairy animals can be directly linked to the availability of concentrates and fodder. When considering cattle diet, the use of green fodder is unavoidable. However, some farmers were having difficulty in growing fodder crops due to land constraints. In this context, milk cooperative societies (MILMA) could make some efforts to encourage the cultivation of fodder crops on open and other usable lands in their localities. The increase in feed prices was detrimental to dairy farmers. The lack of locally available raw materials for the production of cattle feed poses a significant challenge for the state. Majority of the raw materials being brought from neighbouring states, as a result feed prices were skyrocketing, especially in the post covid situation. In this context, immediate action must be required by Kerala government to lower the price of cattle feed. Through cooperatives, the government must exert more effort to ensure that dairy farmers have access to sufficient supplies of cattle feed at reasonable rates in order to reduce input costs in the dairy industry. Since profitability of a dairy unit directly related to the price of milk, immediate action is required to assure that dairy farmers are paid fairly for their products. In order to safeguard both consumers and dairy farmers, a more scientific method of fixing the price of milk is urgently required from government level. Dairy farming demands significant financial outlays. In addition, high maintenance costs, high feed costs, and low milk prices made it difficult for farmers to expand their farms. more support should be provided in terms of financial and technological assistance to expand the herd size as well as improve the profitability.

Dairy farming necessitates significant financial investments. Land, buildings, equipment and the cost of cows all require a significant initial investment. The incidence of various diseases need to address seriously as it affects the population and productivity of cattle in the state. Some cases have been reported as a result of not following a balanced diet. Conduct more awareness programmes at the panchayat level to show the importance of balanced diet. More para-veterinary staff and doctors are needed in the department to properly monitor the cattle population and provide vaccination on time. More effort should be made to educate farmers on how to identify various symptoms, as early diagnosis leads to more effective control. More support is required for dairy farmers by providing insurance benefits to people who lost their animals due to the disease on time.

For adopting more advanced production practices under fish components in IFS units, farmers require more assistance from government sector in the form of subsidies, insurance, more government controlled marketing facilities etc. Better price stabilizing measures that provide remunerative prices to farmers and a ceiling price to consumers should also be implemented. Regional procurement centers need to be established in order to purchase fish and fish products directly from farmers at reasonable prices. Based on the demand for fresh fish and fish products as well as being motivated by the success of *Matsyafed Fresh Fish Marts* in Ernakulam and Kottayam districts, the State Government recently decreed the setting up of centers for procuring and selling of fresh fish directly from farmers in all districts. The procedures for the setting up of procurement centers needs to be hastened because it can be a viable solution for those facing price fluctuations and marketing challenges. The adoption of value-added technologies was found to be low among the IFS farmers, since majority of freshwater fish were sold as unprocessed. There is a need of low-cost value-added technologies that would enable them to earn more money. More training programmes should be organized at the panchayat, block, and district levels in order to promote more value addition techniques.

Vaccination camps ought to be held on a regular basis to avoid disease outbreaks in poultry. In addition to other inputs like vaccines and antibiotics, actions should be taken to promote low-cost scientific housing techniques against attack of predators and distribute high-quality feed at a reasonable price. Extension agencies should organize more training and awareness programmes for improving their knowledge and skills on feeding, housing and disease management in poultry. Their awareness on these issues enables them to take more precautionary measures in their unit, resulting in less economic loss. As the demand for day old chicks rises, steps should be taken to increase the capacity of government-owned hatcheries. While procuring day old chicks from firms outside the state, KSPDC (Kerala State Poultry Development Cooperation) should carry out a thorough screening and monitoring to ensure the its health and productive performance.

To encourage the development of improved beekeeping practices, more extension services and technical assistance should be made available in the localities, which can substantially enhance yield. More training and demonstrations should be organized at the panchayat, block and district levels to promote high-tech management and processing techniques during different seasons, such as colony division, honey extraction, value addition and so on. To increase awareness on the need for providing enriched food substitutes during inclement weather and lean seasons, as well as pest and disease management, more programmes and workshops should be held.

Since there were few mushroom farmers who have adopted IFS, there exist a gap regarding awareness on mushroom cultivation practices, their nutritional value and their medicinal properties. In this context, more extension activities should be organized to bridge this gap. As there is a high demand for products with added value like pickles, cutlets, cakes, etc., mushroom farming opens up more opportunities in the food processing sector. Therefore, more training programmes and demonstrations should be held to help farmers improve their knowledge and skills with regard to various aspects of mushroom production, such as maintaining sanitary and hygienic production units, preventing contamination, harvesting and value addition. The government should help mushroom farmers by enacting new schemes that provide both financial and technical assistance. At the same time, efforts should be made to ensure timely access to quality inputs such as spawn, straw, fungicides, pesticides and other things.

Since IFS consists of a number of complementary components, sometimes it might be difficult for a farmer to collect enough farm waste to continue the composting process conventionally. This is because the production of compost depends on a number of factors, including the weather, the amount of waste produced, the availability of cow dung etc. In order to maintain production, more cost effective technologies related to composting should be promoted in IFS units. We can use cutting edge technologies like the composting inoculum developed by the Kerala Agricultural University in a unit with little waste or if setting up a composting pit is impractical due to land constraints or a lack of sufficient cow dung. Similarly, the three-layered "biobins" or "biocomposters" suggested by IFSRS Karamana seem to be an excellent composting tool for both household waste and the organic waste generated in terrace gardens. Due to its structure, it is very convenient to include in areas with little space. Additionally, the embedded coir pith inoculum aids in preventing leachate, pest infestations, and offensive foul smell. some farmers facing difficulties to manage these units in rainy season, some were lacking knowledge about the management and some had reported pest infestations in their pits. Hence there is a need for more trainings and demonstrations on various composting techniques and its management through various government agencies like KVK, agriculture department, as farm waste management is an essential practice that must be taken care of.

Despite the fact that the azolla cultivation procedure is very simple, farmers face some challenges in maintaining the tank, especially during bad weather. As azolla can be integrated with multiple components in an IFS unit, it necessitates more care. More demonstrations and training programmes can be organized to improve the knowledge and skills of IFS farmers regarding the production and maintenance of the azolla component and exploring its potential for generating income. Improve the stock of azolla in government outlets in order to provide farmers with pure culture that is free of contamination, which is essential for good yield. Cow dung is obviously an important raw material for biogas plant. The accessibility of dung will be ensured by increase in herd size. Government should take necessary actions to promote the use of municipal waste (organic) for biogas production in order to get rid of the limitations of feed stock availability. Since biogas is seen as a way to address the fuel crisis while also halting environmental degradation, the government should provide more financial and technical assistance to farmers in order to alleviate their difficulties and encourage the production of biogas, as some farmers cannot afford the installation and maintenance costs.

4.3.2.4. Strategies to mitigate the constraints

By discussing with various officials associated with the implementation and maintenance of integrated farming system units in Kerala, different strategies to mitigate the constraints faced by the IFS farmers for establishing and maintaining an IFS unit were formulated (Table 4.49).

Lack of remunerative price for the products, higher cost as well as non availability of inputs, natural calamities, high initial investment, lack of government incentives, marketing difficulties and labour issues were some of the major constraints experienced by the IFS farmers while establishing and maintaining an IFS unit. Some of the challenges necessitate quick action from government level, such as reducing the skyrocketing cost of inputs, bringing scientific pricing of agricultural products, increasing availability as well as supply of quality feed and fodder to farmers, promotion of more climate adaptive agricultural practices and establishing more regional government procurement centers. More effort is required to reach farmers through cooperative societies. Necessary steps should be taken to provide the inputs through cooperative societies in a regular and cost-effective manner in order to avoid procuring it from private agencies at a high cost. By strengthening the existing agricultural work force by converging MGNREGS workers, helps to reduce labor related issues to a greater extent.

Flooding in 2018 and 2019, as well as an unexpected crisis caused by Covid 19, had a negative impact on farmers' financial situation. Government assistance in the form of subsidies via new schemes as well as training and demonstration for the adoption of more components and new technologies, is critical in this context for maintaining production and attracting more people to farming. The establishment of IFS units is not an end, rather it is only a means for achieving self sufficiency in agricultural production. Like establishing a new unit, its maintenance is also need equal consideration. The number of IFS units increased as part of the *Jaivagrham programme*, but now more emphasis should be put on maintaining existing units and improving their performance. It is necessary to coordinate various departments under one umbrella, especially for supporting IFS farmers, because it has many components. It is not just a matter of allocating more funds and manpower, but the entire delivery mechanism must be altered to ensure timely delivery of the inputs.

Table 4.49: Strategies to mitigate the constraints

Sl. No.	Constraints faced	Proposed Strategies	Supporting / Implementing agencies	Short term / Long term
1	Lack of remunerative prices for farm produces and high price fluctuation	Further policy interventions are required for adopting scientific pricing of farm products and better price stabilizing measures (eg: MSP)	Department of Agriculture Development and Farmers' Welfare, Kerala State Animal Husbandry Department, Department of Fisheries Kerala, Dairy Development Department Kerala,	Long term
2	High investment in the initial stage and high cost of production	Enhancement of financial assistance in the form subsidies from Government		Short term
		Interventions to control feed and fertilizer prices.		Short term
		Adequate action should be taken to release the compensations/insurance in a timely manner.		Long term
3	Natural calamities and extreme weather events	Promotion of more climate adaptive agricultural practices both at the government and farmers level		Long term

4	Non availability of quality inputs on time	Necessary action should be taken to provide the inputs through cooperative societies in a regular and at a reasonable price	Kerala State Poultry Development Cooperation (KSPDC), Kerala Co-operative Milk Marketing Federation Ltd (MILMA), Kerala Agricultural University (KAU), Kerala Veterinary and Animal Sciences University (KVASU), Kerala University of Fisheries and Ocean Studies (KUFOS), Krishi Vignyan Kendra (KVK),	Long term
		Establish more custom hiring centers and Eco shops		Long term
5	Lack of marketing facilities for the produce from different enterprises	Establishment of regional procurement centers for all components		Long term
6	Labour scarcity and high labour charges	Further strengthening of the agricultural workforce with convergence of MGNREGS workers		Long term
		Promote the initiatives like establishment of 'Karmasena' group in entire panchayath		Long term
7	Inadequate storage and value addition facilities	Promote low cost processing and value addition technologies		Long term

8	Inadequate extension support and lack of proper access to training	Further strengthening the extension system in terms of manpower, financial and technical aspects in order to reaching to farmers in timely manner.	Agriculture Technology Management Agency (ATMA)	Long term
		More consultancy services can be provided through mobile agriclinics		Long term
		Further strengthening the training programmes through Farmers organizations / Farmers interest groups / Farmers field school		Short term
		Convergence of line departments under one umbrella to support IFS farmers		Long term

4.4. Measurement of attitude of farmers towards IFS

Farmers attitude towards any developmental activity is a priceless resource to policy makers for designing policies in order to reduce vulnerabilities of farmers. Therefore, by analyzing the attitude of farmers, better strategy can be formulated for increasing its adoption among the farmers. Here an attempt was made in order to identify the attitude of farmers towards integrated farming systems. The results were given below.

4.4.1. Distribution of respondents according to attitude towards IFS

Farmers' attitudes toward IFS units have a significant impact on its upkeep. This study was carried out among farmers who already possessed IFS units. In order to find the attitude of farmers towards integrated farming system concept, an attitude scale was developed. The scale consisted of 22 statements, among which 9 were negative and 13 were positive. Based on the obtained score, by using mean and standard deviation method, the respondents were grouped in to three categories, unfavorable, neutral and favorable attitude towards IFS as follows (Table 4.50)

Table 4.50: Distribution of respondents according to their attitude towards IFS

Categories (Score)	Kollam (n =60)		Thrissur (n =60)		Kannur (n =60)		Total (n =180)	
	f	%	f	%	f	%	f	%
Unfavourable (< 73.78)	4	6.67	7	11.67	7	11.67	18	10.00
Neutral (73.78 - 86.38)	35	58.33	37	61.66	33	55.00	105	58.33
Favorable (> 86.38)	21	35.00	16	26.67	20	33.33	57	31.67
Total	60	100	60	100	60	100	180	100

From the table 4.50 and fig. 4.36, it was evident that, 58.33 per cent of the total respondents had a neutral attitude towards IFS, followed by favourable attitude (31.67 %). It was worth noting that the percentage of farmers who fell into the unfavourable category was very low (10 %). The district wise data also mimic the same trend. Among the districts, Kollam district had the highest percentage of farmers in the 'favourable category'

(35 %) followed by Kannur (33.33 %) and Thrissur (26.67 %). The result revealed that the attitude of majority of the farmers varies from neutral to favourable. Since IFS contains many components, the risk of maintaining the unit in a sustainable manner as well as the constraints encountered for each adopted component, might have led to a neutral attitude toward IFS.

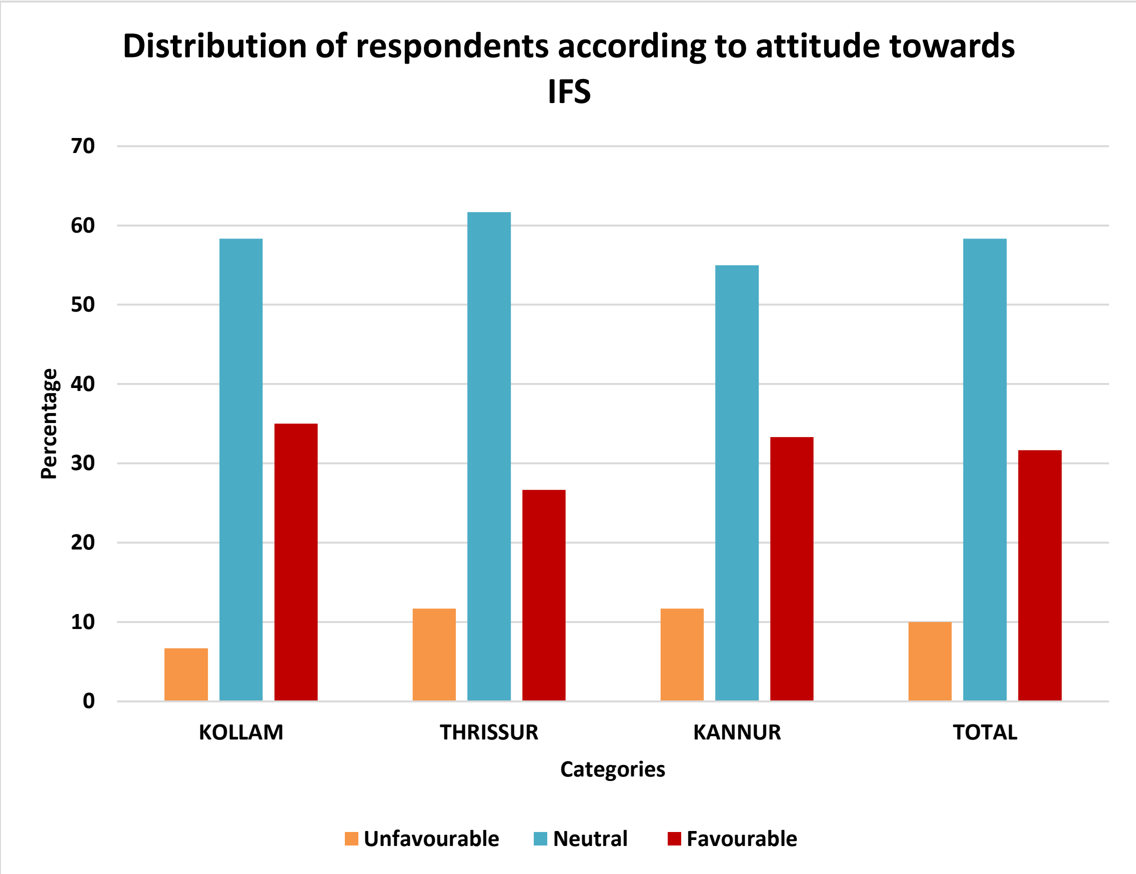


Fig. 4.36: Distribution of respondents according to attitude towards IFS

It was also discovered that less than one third of them had a favourable attitude toward IFS. IFS unit might have protected them from financial crisis due to crop failures as it contained various components. This might be the reason for developing a favourable attitude towards IFS. As majority of farmers had also realized that it was now more important to focus on various enterprises rather than focusing on just one. This could also be a factor for reaching this result. This result highlighted that, by implementing better strategies to overcome the constraints experienced by farmers in establishing and maintaining an IFS unit through more government assistance and by organizing more training and workshops to improve farmers' skills and knowledge for maintaining different components sustainably, the neutral category of farmers could be converted into a favourable category. The findings were similar to that of Bhoir *et al.* (2020), who made an attempt to identify the attitude of farmers towards different integrated farming system components and revealed that more than three fourth (76.67 %) of the respondents had medium level of attitude towards IFS, followed by high level (18 %) and low level (5.3 %) of attitude towards IFS.

4.4.2. Factors influencing attitude of farmers towards IFS

Various factors that influenced the attitude of farmers towards IFS were analyzed and ranked based on the mean total score. The findings were given below:

Table 4.51: Factors influencing attitude of farmers towards IFS

Sl No.	Statements	Mean Score			Mean Total Score	Rank
		Kollam	Thrissur	Kannur		
1	IFS offers multiple source of income	4.90	4.88	4.65	4.81	I
2	IFS guarantees supply of balanced and nutritious food to family	4.77	4.72	4.60	4.70	II
3	Farm with various enterprises leads to sustainable income throughout the year.	4.58	4.67	4.55	4.60	III
4	IFS reduces farm vulnerabilities on climate related hazards	4.60	4.62	4.47	4.56	IV
5	IFS ensures effective utilization of available land	4.45	4.58	4.50	4.51	V
6	It promotes better waste management through recycling of farm waste	4.50	4.48	4.30	4.43	VI
7	Adoption of IFS leads to the effective use of available natural resources.	4.43	4.45	4.33	4.40	VII
8	I feel today's need is to concentrate on multiple enterprises at a time.	4.38	4.43	4.17	4.33	VIII

9	IFS increases competition for resources among different components. (-)	4.33	4.27	4.35	4.32	IX
10	Farm mechanization is very difficult in IFS due to integration of various enterprises. (-)	4.00	4.25	4.12	4.12	X
11	IFS reduces soil, water and atmospheric pollution to a greater extent.	3.98	4.10	4.00	4.03	XI
12	IFS can be adopted by all categories of farmers.	3.85	4.00	3.70	3.85	XII
13	IFS is suitable only for skillful person (-)	3.72	3.61	3.85	3.73	XIII
14	The IFS concept is not compatible with the values and beliefs of the society (-)	3.53	3.6	3.65	3.59	XIV
15	Maintenance of an IFS unit is very difficult than conventional farms since it contains many components (-)	3.56	3.28	3.42	3.42	XV
16	Marketing of products is very difficult (-)	3.27	2.98	3.08	3.11	XVI
17	It helps to minimize cost of cultivation	3.03	2.93	3.32	3.09	XVII
18	Initial investment for IFS is very high (-)	2.18	2.28	2.13	2.20	XVIII
19	The social status of the IFS farmers is better compared to non IFS farmers	2.00	2.05	2.22	2.09	XIX
20	IFS demands less quantity of inputs than other farming systems	1.88	2.08	2.03	2.00	XX
21	Time management for all activities is very difficult (-)	1.97	2.03	1.93	1.98	XXI
22	The labor requirement is more in IFS compared to other farming systems (-)	1.55	1.50	1.62	1.56	XXII
Total mean score		**3.61**	**3.63**	**3.59**	**3.61**	

Table 4.51, showed that, among the various factors influencing farmers' attitudes toward IFS, the main reason for developing a neutral to favourable attitude toward IFS in Kerala was that it provides multiple sources of income (4.81) to the family. Furthermore, the possibility of ensuring the food and nutritional security (4.70) of the farm family influenced them to maintain the IFS unit. Since it provides a sustainable income throughout the year to their family (4.60) and helps to reduce the farm vulnerabilities on climate related hazards (4.56) also significantly influenced their attitude. Prior to implementing IFS, most of the farmers used to concentrate only on mono cropping. Due to unanticipated climatic change and crop failures farmers shifted to IFS. This might have protected them from financial crisis due to crop failures, since it contains various components. Although it would not make drastic changes in their family earning, it would provide a more stable income than mono cropping. The risk of crop failure was also lower in IFS, which could lead to more favourable attitude as, failure in any one component can be balanced by the other component. In an environmentally highly vulnerable state like Kerala, farmers frequently met with crop failures which be the reason for this attitude.

As IFS ensures effective utilization of available land (4.51) and better recycling of farm waste produced (4.43) as well as maximum utilization of available natural resources (4.40), these benefits also influenced farmer's attitude, because through IFS, farmers can overcome various constraints such as land constraints mainly occurred due to high population density, conversion of agricultural lands to nonagricultural activities, fragmentation of lands etc. (Kumar and Abraham, 2021) and difficulties in farm waste management, as well as inefficient use of various resources. Some farmers realized that rather than continuing the traditional farming, they should focus on multiple enterprises (4.33) at a time to maximize their profit, which resulted in a favourable attitude toward IFS among them because it includes multiple components at the same time. Since the competition for resources was low (4.32), which also contributed to favourable attitude. Besides these reasons, other benefits that IFS could provide, such as application of mechanization was not an issue (4.12), helps to reduce pollution (4.03) and all category of farmers can adopt (3.85) etc. also influenced the neutral to favourable attitude of farmers.

4.4.3. Relationship between attitude of farmers towards IFS with their profile characteristics

In order to find out the relationship between attitude of farmers with their profile characteristics correlation analysis was conducted and the details were given below (Table 4.52).

Table 4.52: Correlation of attitude of farmers towards IFS with their profile characteristics

Independent Variables	Correlation Coefficient
Age	0.011
Education	0.051
Family size	-0.069
Occupation	0.088
Farm size	0.228**
Experience in farming	0.239**
Mass media exposure	0.237**
Extension agency contact	0.134
Participation in extension programmes	0.228**
Market orientation	0.006
Irrigation potential	0.017
Economic motivation	0.226**
Innovativeness	0.003
Risk orientation	0.093
Social participation	0.186*
Training undergone	0.242**
Awareness towards IFS	0.059
Herd size	0.101

** Significant at 1 per cent level *Significant at 5 percent level

A glance at the above table (4.52) indicated that, attitude of the farmers towards IFS was positively and significantly correlated with profile characteristics such as farm size, experience in farming, mass media exposure, participation in extension programmes, economic motivation and training undergone at 1 % level of significance and social participation with 5 % level of significance.

As farm size increases, the chances for expanding the IFS units by adding more components also increasing. Thus, possibility of experiencing various aspects of IFS also increases, leading to a favourable attitude towards IFS. Since the number of components increased might have provided more income and diversified products to the farmers, could have led to a favourable positive attitude. The experience in farming provided more exposure to farmers to familiarizing with various practices and leads to favourable attitude. By participating in various extension activities, social programmes, trainings and through high exposure to mass media sources, farmers were exposed to various technologies related to different components and latest information regarding establishment and maintenance of an IFS units. This updation in their knowledge and skills helped them to maintain the unit in a better way. This might be the reason behind the relationship between attitude of farmers with exposure to mass media sources, extension and social participation and training undergone. The findings were in line with that of Sarjeet (2019) who analyzed the attitude of farmers towards different farming systems in Rajasthan and the factors influencing their attitude. He found that among various socio economical profile characteristics of farmers, education, landholding, social participation, source of information and annual income were positively and significantly correlated with attitude of farmers towards different farming systems.

CHAPTER –5

Summary and Conclusions

SUMMARY AND CONCLUSIONS

Kerala is rich in its diverse resource base. The highly diversified agroecosystems in Kerala support a multitude of crops and allied enterprises. However, the traditional agricultural system at present have come under great pressure from the dynamics of new agrarian structure, land reforms, increasing impacts of climate change and other change factors. The challenge of attaining self sufficiency in agricultural production in Kerala's peculiar situation of limited cultivable area can be achieved through promotion of Integrated Farming Systems (IFS). A number of programmes have been introduced in Kerala by various formal institutions to promote IFS, thereby increase the agricultural production and income of the farmers. As impact of climate change increased, knowledge progressed and new technology developed, the existing systems should go through various stages of evolution during which its scope expanded and its focus sharpened in accordance with newly acquired conditions. In this backdrop, the present study entitled **"Exploratory Analysis of Integrated Farming Systems of Kerala"** was undertaken with specific objectives as under:

1. To study the extent of adoption of various components of the IFS and their contribution towards annual household income.
2. To assess the technological needs of the farmers and the constraints faced by them for adopting IFS
3. To measure the attitude of farmers towards IFS.

5.1. RESEARCH METHODOLOGY

Kerala state was purposively selected and three districts (one district each from Southern, Central and Northern Kerala) were selected randomly. Kollam district from Southern Kerala, Thrissur district from Central Kerala and Kannur district from Northern Kerala were the selected districts for conducting the study. From each district, 2 Agro Ecological Units (AEU) were randomly selected. A list of panchayats in each AEU of study was prepared and two panchayats with potentially active and operational IFS units were selected randomly from each AEU. The respondent groups of the study comprised of farmers and extension personnel. Fifteen IFS units were selected in the study area randomly from each identified panchayat. In addition, 20 extension personnel from each district were selected purposively, thus making the total sample size of 240 respondents. The primary data were collected from the respondents by interview and focus group discussion. Relevant statistical tools were deployed for statistical analysis of data.

5.2. SALIENT FINDINGS

Important findings of the study have been summarized and presented as below:

5.2.1. Socio economic profile of the respondents

- Most of the IFS farmers in Kerala belonged to old aged category (48.33 %) followed by middle aged group (43.89 %). The per cent of youngsters were found to be very less (7.78 %). Most of the IFS farmers (32.78 %) had completed education up to higher secondary followed by more than one fourth were educated up to secondary level (27.22 %).
- The primary occupation of more than half of the respondents (61.67%) were farming alone. One fourth (25 %) of the sample size were involved in other business along with farming.
- Regarding farm size majority of the respondents (80 %) were marginal farmers with farm size of one hectare or less, followed by small farmers (19.44 %). In terms of family size nearly three fourth of the respondents had small family size (72.22 %), while one fourth belonged to medium family size.
- Majority of the farmers possessed small herd size (58.34 %) followed by medium (29.44 %) and large herd size (12.22 %). An analysis of species wise livestock population showed that, crossbred cows (56.90%) had the highest population among the IFS units of Kerala followed by goat (31.88 %) and buffalo (7.87 %). The per cent of indigenous cows was found to be quite low (3.35 %).
- Based on their experience in various IFS related activities, most of the farmers (47.22 %) fell into medium level category. That is, they had eight to twelve years of experience in IFS related activities. More than one third (38.34 %) of the total respondents belonged to low category.
- Most of the IFS farmers in the study area had high mass media exposure (40 %) and medium level extension participation (45 %) and extension agency contact (45.56 %). When the extent of use of various information sources was considered,

highest usage was noticed for mobile phones (internet/ social media) (94.44 %) followed by television (81.11 %) and newspaper (63.89 %). On the basis of frequency of participation in various extension programs highest regular participation was observed for group farm meetings followed by seminars.

- A perusal of the result indicated that most (42.78 %) of the respondents had medium market orientation followed by one third (33.33 %) belonged to high category. In case of economic motivation, the results showed that 41.67 per cent of the total respondents belonged to high economic motivation level followed by more than one third (34.44 %) of the sample had medium level economic motivation.

- According to the findings of irrigation potential, nearly two third (64.44 %) of the IFS farmers belonged to the category of "little or no water scarcity". Less than one third of the sample size (28.89 %) had felt "economic water scarcity" followed by 6.67 per cent reported to have "physical water scarcity".

- Nearly two third (65 %) of the IFS farmers were somewhat innovative in nature with a score of 2. The next higher percent was noted for less innovative category (21.11 %) followed by highly innovative (13.89%). In case of risk orientation, most of the IFS farmers had medium level risk orientation (40.56 %) followed by more than one third (34.44 %) of the sample had high risk orientation.

- In terms of social participation, most of the respondents had medium level (46.67%) participation followed by more than one fourth (28.89 %) had high level participation. With respect to the nature of social participation, both as an office bearer (12.78 %) as well as a member (87.22 %) highest participation was noticed in cooperative societies such as VIPANI, MILMA etc.

- More than half of the IFS farmers (51.11 %) had attended 1- 5 training over last three years followed by one fourth of the respondents (25 %) participated in 6 - 10 trainings. The result also highlighted that 12.78 per cent of the sample was not participated in any training yet. Most of the IFS respondents (41.11 %) were highly aware about various enterprises followed by more than one third (36.67 %) had medium level awareness.

5.2.2. Extent of adoption of various components and their contribution towards annual household income

- Nine IFS components were identified in the study area. Most (40 %) of the IFS farmers exhibited low level adoption of available components in their units, followed by medium level adoption (37.22 %). Among the available components crop, azolla, poultry and compost were the most widely adopted components in dairy based IFS units.
- Extent of adoption of available components were positively and significantly correlated with farm size, experience in farming, extension agency contact, participation in extension programmes, economic motivation at 1 % level of significance and risk orientation with 5 % level of significance.
- Dairy + Crop + Fisheries + Poultry (32.22%) and Dairy + Crop + Poultry (31.11%) were the most dominant dairy based integrated farming systems in Kerala. Most (41.11%) of the dairy based IFS units, medium level of integration was noticed among the components followed by low integration (32.78%) between components. Strong dairy to crop linkages were observed in all the farming systems.
- Most of the IFS farmers belonged to low income level (52.78 %) followed by medium income level (33.33%). Among the selected components the contribution of income from crop, dairy and poultry component was found to be low to medium, for fish component medium to low and for apiculture and mushroom component medium to high level income generation was noticed.

5.2.3. The technological needs and constraints faced by the IFS farmers

- Under crop component, highest need was noticed for processing technologies (414) followed by farm inputs and new varieties (411), plant protection related technologies (399), storing related technologies (387), product diversification (374) and climate monitoring and forecasting technologies (343). In case of dairy component, high degree of technological need was noticed in feed related technologies (402) followed by processing (343) and storing technologies (299).
- Processing and product diversification were identified as having the greatest need among the selected technologies for poultry and apiculture component. Regarding

fisheries component, a technology need was noticed for product diversification (245), processing (239), nursery and rearing management (221) and water quality management (201). For mushroom, technological need was noticed for various value addition technologies and sterilization and inoculation related technologies.

- In general, IFS farmers perceived the need for value addition technologies more than production technologies. Among value addition technologies, more need was reported for processing technologies (2.28) followed by product diversification storing (2.12) and storing (1.75).
- IFS farmers of Kerala generally prefer socially accepted low cost technologies with high income generation capacity. It should be efficient, flexible, sustainable with high local resource utilization and time saving capacity along with high availability of supplies and minimum skilled labour requirement. Ranking of various technological dimensions showed that, among the selected, economic dimension was found to be the most important dimensions.
- Lack of remunerative prices for farm produces (78.40), high cost of production (76.60), natural calamities and weather changes (68.77), high investment in the initial stage (58.16), non availability of quality inputs on time (55.17), marketing difficulties for the produce from different enterprises (54.27) were the top ranked constraints for establishing and maintaining an IFS unit.

5.2.4. The attitude of farmers towards IFS

- Majority (58.33 %) of the IFS farmers had a neutral attitude towards IFS followed by favourable attitude (31.67 %).
- IFS offers multiple source of incomes (4.81) and guarantees supply of balanced and nutritious food to family (4.70) which were the most important factors that influenced the neutral to favourable attitude.
- Correlation analysis showed that Attitude of the farmers towards IFS were positively and significantly correlated with profile characteristics such as farm size, experience in farming, mass media exposure, participation in extension programmes, economic motivation and training undergone at 1 % level of significance and social participation with 5 % level of significance.

5.3. CONCLUSION

Component analysis in terms of extent of adoption, integration of practices and contribution to household income revealed that, extent of adoption of identified components and contribution to annual household income varied from low to medium whereas extent of integration of available components varied from medium to low. Dairy and crop were the dominant component in all systems both in terms of adoption as well as integration. So more effort should be needed from government side in terms of training programmes, awareness programs, financial assistance through new schemes to maximize the adoption of all available components and improve the integration between them, which ultimately enhances the productivity and profitability of the unit.

Technology forecasting is essential for any planning process due to the quick advancement of technology and the escalating rate of technological depreciation. Technology need refers to a probabilistic prognosis of technical advancements based on prospective features of useful equipment, systems or procedures and customer's needs. The findings pointed out that for establishing and maintaining various components in a unit, farmers were experiencing different technological needs and constraints. Since IFS contains several components, it affects the overall productivity of the unit. Analysis of attitude of farmers towards IFS revealed that majority of them had a neutral attitude. Since, various needs and constraints of farmers for maintaining a unit, has a significant influence on their attitude, it is very important to address their needs and problems in a long term basis. The findings highlight the need for revamping of the existing policies, schemes, programs to support institutional strengthening and capacity building of the farmers. This will help the farmers to expand their existing units by adding more components and technologies to their units. Further, this would overcome many constraints faced, thereby improving the productivity and profitability.

5.4. IMPLICATIONS OF STUDY

The implications of the study, elaborated based on the findings of the investigation, would act as a benchmark for research and extension system. In an effort to improve the adoption of components and integration practices, assist farmers in meeting their technological needs, get around obstacles they may have encountered and foster favourable attitudes among IFS farmers, an effort was made to document the implications of the current study in the form of suggestions.

- The results of component analysis in terms of extent of adoption and integration, contribution towards household annual income, highlighted the need to adopt total systems approach for the development of entire IFS units. Government assistance in the form subsidies and convergence of various departments into one umbrella should be implemented to ensure the effective performance of existing units. It will aid to increase the adoption of more components as well as more integration practices. Thus, profitability from each unit can be increased.
- As the adoption of some components like fisheries (0.53), biogas (0.34), apiculture (0.31) and mushroom (0.06), was found to be low than that of other components, more effort is needed for designing new programmes with adequate incentive structures that would accelerate the adoption of least adopted components at farm level, which can influence the overall functioning and profitability of each unit.
- This study helped to identify some of the technological needs for maintaining various components in an IFS unit. The results pointed towards the need for strengthening the Research – Extension – Farmer - Market linkage for the development of farmers friendly technologies and the effective utilization of those technologies. Hence, Universities and KVK should give more thrust on collaborative research with IFS farmers to develop more farmers friendly low cost technologies. Since IFS has multiple components, there is more scope for value addition of diversified products, which will facilitate export demand.
- It is observed from the study that, attitude of farmers towards IFS varies from neutral to favourable. Organize more training and awareness programmes at the grassroot level to improve their skills and knowledge on various aspects of establishing and maintaining the components. Further improvement in the existing policies to mitigate the constraints faced by the farmers. It will help to develop more favourable attitude towards IFS.

The findings of the study would serve as a benchmark for the scientists, subject matter specialists other extension agents, to strengthen the existing polices and progrmammes as well as implementing new, that address the challenges of IFS farmers, thereby improving the overall performance of each unit.

5.5. SUGGESTIONS FOR FUTURE RESEARCH

The outcome of the investigation opens up new avenues for future research. Following are some of the possibilities:

1. An experimental or comparative study may be undertaken in different IFS models to evaluate the relative advantages and B:C ratio of each models.
2. Studies can be undertaken to find out the location specific ideal IFS models based on the socio- techno-economic analysis of the units.
3. It is feasible to examine the psychological attributes of IFS farmers including their level of motivation, risk orientation, scientific orientation, aspiration, entrepreneurial behaviour and scale of knowledge for each component.
4. A further research on assessing the training needs related to various components of IFS units may be conducted.
5. The current study was mainly concerned with the components identified in the study area. The diversification of each component was not taken into account. A more in-depth study might be carried out to investigate the diversity of each component in IFS units.
6. A gender analysis among the IFS farmers can be conducted.
7. The present investigation was carried out only in three districts. Further, substantial study with large sample size and by covering more districts and Agro Ecological Units might be carried out. Thus the inference drawn can be more broadly generalized.

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Appendices

APPENDIX I

Different combinations of major and supporting components of IFS in Kerala

Dairy based IFS	**Combination of supporting components**												
	No supporting components	**M**	**M+ Cm**	**M+Az+Bg**	**M+Cm+Az**	**Cm**	**Az**	**Bg**	**Cm+ Az**	**Cm+ Bg**	**Az+ Bg**	**Az+Bg+Cm**	**Total**
D + C									1	2		1	4
D + C +Ap		1				2	3	1					7
D + C +P					3	3	14	2	22	1	6	5	56
D + C +F				1					2	2		2	7
D + C + F+ P	1				1		10		24		6	16	58
D + C + Ap + P		1				1	3	1	6		4	2	18
D + C + Ap + F			1						1		1	1	4
D + C + Ap + F +P	1			1	2	1	7		7		1	6	26
Total	2	2	1	2	6	7	37	4	63	5	18	33	180

(D-Dairy, C–Crop, Ap–Apiculture, P–Poultry, F-Fisheries, M – Mushroom, Cm – Composting, Az – Azolla, Bg – Biogas

APPENDIX – II

DAIRY EXTENSION DIVISION

ICAR-NATIONAL DAIRY RESEARCH INSTITUTE

(Deemed University)

KARNAL-132001 (HARYANA) INDIA

Dr. Ritu Chakravarty

Senior Scientist

Date: 14/11/2021

Dear Sir/Madam

It gives me immense pleasure to inform you that **Ms. Vani Chandran** one of the Ph. D. Scholar of Dairy Extension Division, is working under the guidance of the undersigned. The topic of her proposed research work is "**Exploratory analysis of Integrated Farming Systems of Kerala"**. In this context, she needs to develop an 'Attitude scale' for measuring the attitude of farmers towards Integrated Farming System. For this, she has already developed some statements which need to be checked thoroughly for further improvement. Therefore, it is requested that kindly devote some of your precious time and energy for this cause, as it is assumed that the valuable suggestions provided by experts like you, who are the distinguished scientists/teachers in the discipline of Agriculture/Animal Husbandry, would go a long way towards further growth and development of our discipline. You may tick (√) any one from *Most Relevant*, *Relevant* and *Not Relevant.* Further, you may help us by either editing or modifying the given statements (enclosed herewith); or even you may add some or delete the irrelevant statements.

Thank you, in advance for sparing your valuable time for this purpose.

With regards,

Yours sincerely,

(Ritu Chakravarty)

APPENDIX – III

DAIRY EXTENSION DIVISION

ICAR- NATIONAL DAIRY RESEARCH INSTITUTE

(Deemed University)

KARNAL-132001 (HARYANA) INDIA

Dr. Ritu Chakravarty

Senior Scientist

Date: 30/11/2021

Dear Sir/Madam

It gives me immense pleasure to inform you that **Ms. Vani Chandran** one of the Ph. D. Scholar of Dairy Extension Division, is working under the guidance of the undersigned. The topic of her proposed research work is "**Exploratory analysis of Integrated Farming Systems of Kerala"**. In this context, she needs to develop an 'Adoption Index' for measuring the extent of adoption of various components in Integrated Farming System units. For this, she has already collected some indicators under various components, which need to be checked thoroughly from a scientific perspective for further improvement. Therefore, it is requested that kindly devote some of your precious time and energy for this cause, as it is assumed that the valuable suggestions provided by experts like you, who are the distinguished scientists/teachers in the discipline of Agriculture/Animal Husbandry, would go a long way towards further growth and development of our discipline. You may tick (√) any one from *Most Relevant, Relevant* and *Not Relevant.* Further, you may help us by either editing or modifying the given indicators (enclosed herewith); or even you may add some or delete the irrelevant indicators.

Thank you, in advance for sparing your valuable time for this purpose.

With regards,

Yours sincerely,

(Ritu Chakravarty)

APPENDIX – IV

INDICATORS SELECTED FOR RELEVANCY TEST

Sl No.	Indicators	Operational Definition	Measurement Unit	Relationship (+ or-)
I	**Common Indicators**			
1	Technology adoption (No. of technologies adopted/ no. of possible technologies that can be adopted)	It is operationalized as the adoption of various production and post-production technologies related to various farm enterprises by the respondent for maximizing production and income.	Ratio	+
2	Farm waste management (No. of waste management practices followed / traditional dumping)	It is operationalized as the practices followed by the farmers to manage or dispose the waste products of their farm.	Ratio	+
3	Organizational contact (No. of organizations contacted in one year)	It is operationalized as the acquaintance and frequency of contact by the farmer with the extension officials of the organizations such as Research Institutions, Animal husbandry and Dairy department, Agriculture department, cooperative societies, private dealers, input agencies, NGOs etc.	Number	+
4	Factors affecting adoption of enterprise under the IFS	It refers to the factors which facilitated the farmers to adopt a particular enterprise newly on his farm.	Score	+
5	Capacity utilization of resources	Capacity utilization is defined as the extent to		

		which the individual utilizes the potential resources such as land, installed capacity of the units etc. related to his enterprises.	Score	+
6	Quality of supply / services	Quality of supply / services refers to the extent to which the consumers approve and appreciate the product and services rendered by the farmers.	Score	+
7	Competition Orientation	It is operationalized as the degree to which a farmer is oriented to place himself in a competitive situation in relation to other farmers for projecting his excellence in IFS farming.	Score	+
8	Need for input supply and services	It is operationalized as the extension needs such as input needs, training needs, information needs and service needs of the respondents for the maintenance of various farm enterprises in his unit.	Score	+
9	Time utilization pattern of farmer (No of hours/day)	It is operationalized as the time spent in different farm and allied activities by the farmers per day.	No.	+
10	Natural resource utilization	It is the extent to which the available nature resources are being utilized for various	Ratio	+

	(No of resources used/ available resources)	enterprises in an IFS unit.		
11	Labour utilization pattern	It refers to the extent of utilization of labourers (both family and hired) for various enterprises in the unit.(women/men labour)	Score	+
12	Permanent asset creation (No of assets created)	Refers to the assets created in the farm over the period of time for adopting/ maintaining various enterprise in the IFS unit.	Number	+
13	Material possession (No of materials/ equipment)	It is conceptualizes as the number and type of various materials/ equipment used by the farmers in their unit in relation with various enterprises.	Number	+
14	Technical competency	Operationalized as the level of knowledge about different stages and activities related to various enterprises and ability of the farmer to use his knowledge in the operations of his enterprises.	Score	+
II	**Crop Component**			
1.	Dominance profile of crops No. of more crops added/annum	It refers to the addition of more crops to the existing cropping system.	Number	+
2.	Cropping intensity	It refers to the proportion of gross cropped area to the net cropped area.	Ratio	+

3.	Fertilizer usage (Fertilizer use (Kg)/ acre)	It refers to type and quantity of fertilizers (N, P2O5, K2O and others) used by the farmers for cultivation purpose.	Value	+
4.	Farm machinery and equipment possession (Use of modern farm equipment)	It is conceptualized as the number and type of modern farm equipment and implements used (owned or hired) by the farmers in their unit for crop production.	Number	+
5.	Area allocation for crops (Total area under crop cultivation in ha)	It refers to area requirement for crop component separately (ha/acre).	Value	+
6.	Area under fodder crop Area under fodder crops/ total cropped area	It refers to the proportion of the area under different fodder crops to the total cropped area.	Proportion	+
7.	Percentage of irrigated land (Area under irrigation/ total cropped area)	It refers to the proportion of the area under irrigation by dependable sources like wells, pump set and canals to the total area under cultivation.	Percentage	+
III	**Dairy Component**			
1.	Milk production (l/day) (Quantity of production /day)	It refers to the total quantity of milk produced by the lactating dairy animal, one day prior to investigation.	Value	+
2.	Milk consumption (l/day)	It refers to the total quantity of milk consumed in liters per day by the respondents family members, one	Value	+

	(Quantity of consumption / day)	day prior to investigation.		
3.	Milk marketing (l/day) (Quantity marketed /day)	It refers to the total quantity of milk disposed in liters from the household one day prior to investigation.	Value	+
4.	Area under fodder crop (Area under fodder crops/ total cropped area)	It refers to the proportion of the area under different fodder crops to the total cropped area.	Proportion	+
IV	**Apiculture**			
1.	Apiary size (Number of beehives)	Refers to the active beehives in IFS unit at the time of investigation.	Number	+
2.	Production per hive (Kg) (Quantity /hive)	It refers to the total quantity of honey produced per hive, one day prior to investigation.	Value	+
3.	Types of hive used	Refers to the extent to which the farmers utilized the availability of different type of hives in the market.	Score	+
V	**Mushroom**			
1.	Quantity of fresh mushroom production/ annum (Quantity /annum)	It refers to the total quantity of fresh mushroom produced in the unit in a year.	Value	+
VI	**Fisheries**			
1.	Pond size	It refers to the pond area owned or leased in by the individual respondent at the time of interview.	Value	+

2.	Feeding schedule (Frequency of feeding / day)	It refers to the schedule at which fishes are being fed.	Score	+
3.	Yield (Quantity produced/ha)	Refers to the actual fish yield obtained per hectare of water spread area of tanks or ponds by the farmers.	Value	+
4.	Duration of water availability (No of days)	Refers to the average water retention period in the tanks/ponds in which respondents are practicing fish culture.	Value	+
5.	Source of water	It refers to the main source of water for tanks or ponds possessed by respondents for practicing fish culture.	Score	+
6.	No. of fingerlings raised	Refers to the total number of fingerlings raised by the respondent at the time of investigation.	Number	+
VII	**Poultry component**			
1.	No. of Birds possessed	Refers to the total number of different birds (hen/duck/emu) owned by the respondent at the time of investigation.	Number	+
2.	Marketed egg (Quantity sold/month)	It refers to the actual quantity of eggs sold out by the respondent /month.	Value	+
VIII	**Compost Unit**			
1.	Type of composting	It refers to the different types of composting methods followed by the respondents in the	Score	+

		IFS unit for making compost.		
2.	Use of fertilizers types	It is operationalized as the type of fertilizers used by the farmers for meeting the nutritional requirement of crop production.	Score	+
3.	Opinion on compost efficacy	Refers to the opinion of farmers regarding the efficacy of composting in production and profit aspects.	Score	+
IX.	**Azolla**			
1.	Types of green manures used	It refers to the different types of green manures used by the respondents in the IFS units for crop production.	Score	+
2.	Feed Ingredients	It refers to the components used as a feed by the farmers in livestock and fish farming in a day.	Score	+
X	**Biogas Plant**			
1.	Source of energy	It refers to the sources of energy used by the respondents for household consumption.	Score	+
2.	Biogas awareness by households (No of practices about which farmers are aware/ Total no of practices)	It is operationalized as the extent to which the farmers are aware about various aspects of biogas production	Ratio	+
3.	Technical support availability	Operationalized as the extent of technical support given by the formal / private / NGOs	Ratio	+

	(Support Available/ Support Needed)	to the farmers for the establishment, and maintenance of biogas plant in the IFS unit.		
	Others, if any			

APPENDIX – V

A list of selected statements for final scale construction with their respective 't' values

Sl No.	Statements	't value'
1.	IFS reduces farm vulnerabilities on climate related hazards	5.27
2.	It promotes better waste management through recycling of farm waste	4.37
3.	Adoption of IFS leads to the effective use of available natural resources.	4.28
4.	IFS offers multiple source of income	4.14
5.	IFS guarantees supply of balanced and nutritious food to family	3.95
6.	IFS ensures effective utilization of available land	3.79
7.	IFS increases competition for resources among different components. (-)	3.61
8.	Farm with various enterprises leads to sustainable income throughout the year.	3.54
9.	I feel today's need is to concentrate on multiple enterprises at a time.	3.52
10.	Farm mechanization is very difficult in IFS due to integration of various enterprises.(-)	3.39
11.	IFS reduce soil, water and atmospheric pollution to a greater extent.	3.09
12.	Time management for all activities is very difficult.(-)	2.92
13.	IFS demands less quantity of inputs than other farming systems.	2.70
14.	Marketing of products from IFS unit is very difficult.(-)	2.51
15.	The social status of the IFS farmers is better compared to non IFS farmers.	2.45
16.	Maintenance of an IFS unit is very difficult than conventional farms since it contains many components (-)	2.26
17.	It helps to minimize cost of cultivation	2.24
18.	The labor requirement is more in IFS compared to other farming systems.(-)	2.11
19.	Initial investment for IFS is very high.(-)	2.01
20.	IFS can be adopted by all categories of farmers.	1.92
21.	The IFS concept is not compatible with the values and beliefs of the society.(-)	1.86
22.	IFS is suitable only for skillful person.(-)	1.79

APPENDIX – VI

INTERVIEW SCHEDULE

Section- I –Profile Characteristics

Sl.No…………..

Date…………….

1. **Name of the respondent:**……………………………..
2. **Spouse name:**………………………………………..**Mobile No:------------------------**
3. **Village:**…………………………………………………….
4. **Panchayat:**…………………………………………………
5. **Age:**………………………………………………………
6. **Education:**…………………………………
7. **Occupation:**
8. **Annual income (Rupees):**
9. **Family type:**
10. **Family size:**

Sl No.	Family member	Relation with Head	Age	Sex		Education
				M	F	

11. Farm Size

Land type	Area owned	Leased in	Leased out	Percentage of land
Agricultural land rain fed				
Agricultural land irrigated				
Pond area (if any)				
Other purpose				
Total				

12. Herd size:

Sl No.	Categories of livestock	Number
1	Cattle –in milk - indigenous	
	Cattle –in milk - cross breed	
2	Cattle - heifer - indigenous	
	Cattle - heifer - cross breed	
3	Dry adult cattle - indigenous	
	Dry adult cattle - cross breed	
4	Young cattle stock - indigenous	
	Young cattle stock - cross breed	
5	Oxen and bulls	
6	Buffalo – in milk	
7	Buffalo – in heifer	
8	Dry adult buffalo	
9	Buffalo bulls and working stock	
10	Goat/sheep/pig	
11	Poultry	
12	Others (please specify)	

13. Experience in farming and involvement of others in farming: Please indicate your response in the appropriate alternative by putting a tick mark (✓)

- Length of involvement in farming

Years	Response
1- 7Years	
8-12Years	
Greater than 12 years	

- Involvement of others in various Integrated farming practices:

Themselves ☐ Labour ☐ Family Members ☐

14. Mass media exposure:

Sl no.	Media	Frequency of exposure		
		Regularly	**Occasionally**	**Never**
1	Radio			
2	TV			
3	News papers			
4	Magazines/journals			
5	Mobile (Internet/social media)			
6	Any other			

15. Awareness about IFS:

Sl no.	Statement	Aware (yes)	Not aware (no)
1	IFS is a combination of crop and animal enterprises		
2	IFS promotes food security		
3	IFS helps in maximizing effective use of resources		
4	IFS improve human nutrition and provide source of local remedies		
5	Different combination of Enterprises helps in maximizing the annual income		
6	IFS is a best method for effective utilization of available land		
7	IFS helps to reduce environmental pollution		
8	IFS is a better option for reducing cost of production		
9	IFS improves production and productivity		
10	IFS ensures better waste management		

16. Irrigation potential:

- Whether the IFS is----------- irrigated / rain fed / combination
- What is the perception of the farmers on availability of water in the unit ------------ Physical water scarcity/ Economic water scarcity/Little or no water scarcity
- Source of irrigation water – Well/ Tube Well/ Canals/ Ponds/River/Taps/Other
- Capacity or period for which irrigation water is available -----------------
- Area irrigated ----------

- Do you pay for the water used? (Yes/No)

If yes, amount incurred for irrigation purpose (Rs/Month)

Amount incurred for home use (Rs/Month)

- Do you adopt any water harvesting methods /sustainable water management practices in your IFS Unit- Yes/No

If Yes, what is the method?

- How efficient it is-- Very Efficient/ Moderately Efficient/ Less Efficient

17. Market orientation: Market orientation : Please indicate your response in the appropriate alternative by putting a tick mark (✓) A-agree and DA-Disagree

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

18. Training:

No of trainings undergone	Subject	Organized by

19. Social participation: Please indicate whether you are a member or office bearer in any of the following organization. If so, indicate the frequency of the participation

Sl. No	Organization	Nature of participation			Frequency of participation in meetings		
		No membership	Membership	Office bearer	Never	Occasionally	Regularly
1	Panchayat						
2	Co-operative society						
3	Farmer's club						
4	Youth club						
5	Socio-cultural organization						
6	Any other (specify)						

20. Extension orientation : Please indicate your response in the appropriate alternatives by putting a tick mark (✓)

a. Extension contact

Sl.No	Extension personnel	Frequency of exposure		
		Regularly	Occasionally	Never
I	**Personal Localite**			
1	Progressive Farmers of own village			
2	Friends and relatives			
3	Neighbours			
4	Input dealers			
5	Family members			
II	**Personal cosmopolite**			
1	Agricultural scientist			
2	Agricultural officer			

3	Agricultural Assistant			
4	Veterinary Surgeon			
5	BTO			
6	Farmers of other villages			
7	Input dealers of nearby town			
8	Bank and insurance officials			
9	Other, specify			

b. Extension participation

Sl.No	Activities	Frequency of participation		
		Regularly	Occasionally	Never
1	Study tour			
2	Seminars			
3	Exhibition			
4	Group farming meetings			
5	Demonstrations			
6	Others, specify			

21. Economic motivation: Please indicate your response in the appropriate alternative by putting a tick mark (✓) SA- Strongly agree, A-agree, UD- undecided, D-Disagree, SD-Strongly disagree

Sl.No	Statements	SA	A	UD	D	SD
1	A farmer should work towards higher yields and economic profit					
2	The most successful farmer is one who makes more profit					
3	A farmer should try any new farming ideas which may help him to earn more money					
4	A farmer should includemore cash crops and other components to increase					

	monetary profits in comparison to growing of food crops for home consumption					
5	It is difficult for the farmer's children to make good start unless he provides them with economic assistance					
6	A farmer must earn his living but most important thing in life cannot be identified in economic returns.					

22. Risk orientation:

Please indicate your response in the appropriate alternative by putting a tick mark (✓) SA-Strongly agree, A-agree, UD- undecided, D-Disagree, SD-Strongly disagree

Sl.No	Statements	SA	A	UD	D	SD
1	A farmer should combine more components to avoid greater risks involved in monoculture					
2	A farmer should take more chance in making a big profit than to be content with smaller but less risky profit					
3	A farmer who is willing to take greater risk than the average farmer usually does better financially					
4	It is good for a farmer not to take risk when he knows his chance of success is fairly high					
5	It is better for a farmer not to follow IFS unless most others in the locality have used it with success					
6	Trying an innovative farming technique is beneficial even though an element of failure is involved in it.					

23. Innovativeness : Please indicate your response in the appropriate alternatives by putting a tick mark (✓)

Sl no.	Statements	Response
1	As soon as it is brought to knowledge	
2	After I have seen other farmers tried successfully in the farm	
3	I prefer to wait and take my own time.	

Part II

24. (A). Give details about various components in Integrated Farming Systems

a) Agriculture (Crop, Horticulture, Forage Crops and Forestry) – Dominance Profile

Crop	Variety	Related to which component	Area (cents)	Yield (qtl)	Price/unit	Total Income (Rs.)
Vegetables		Crop component				
Fruit crops						
Plantation crops						
Oilseeds						
Forestry						
Spices						
Others, if any						
Fodder crops		Dairy component				

b) Livestock (Dairy, Goatary, Poultry)

Animal	Breed	Number of birds/ animals	Yield/ day			Quantity marketed/ day	Total Income (Rs.)
			Milk/wool/ egg	Manure /litter	Animal sell		
Cow							
Buffalo							
Goat							
Poultry							
Others							

c) Other Enterprises

Enterprises	Area (m2)	Yield/ annum	Price/unit	Total Income (Rs.)
Fisheries				
Composting				
Mushroom				
Biogas				
Apiculture				
Azolla				
Others				

24 (B). Adoption of various components: Please indicate your response in the appropriate alternative by putting a tick mark (✔):

Common Indicators

1. Farm by-product and waste management:

S. No	Disposal pattern	Yes/No	If not followed reason
A.	**Dung**		
1.	Used as manure for agriculture a. Spread in heap b.Uniformly spread		
2.	Discharge as waste a. Direct to field b. To municipality pit/drain		
3.	Direct sale to others		
4.	Preparation of cow dung cake		
5.	Preparation of bio-fertilizers		
6.	Bio-gas plant		
7.	Others		
B.	**Urine and water**		
1.	Direct to the field		

2.	Around the manure heap		
3.	Discharge to municipality pit/drain		
4.	Others		
C.	**Disposal of carcasses or dead animal by:** Burial/incineration/others		
D.	**Left over feed disposed by:**		
E.	**Crop residues**		
1	Residue burning		
2	Preparation of manure		
3	Biogas		
4	Others		
F.	**Household waste usually disposed by:**		
G.	**Poultry litter:**		
H.	**Waste from mushroom unit:**		
I.	**Biogas slurry**		
	Specify, if any other		

2. Need of input supply and services – mention your needs of input supply and services for maintaining IFS.

Sl no.	Enterprises	Need of input supply and services	More needed	Needed	Not needed
1	Crop				
2	Dairy				
3	Apiculture				
4	Fisheries				
5	Composting				
6	Biogas				
7	Azolla				
8	Poultry				
9	Mushroom				

3. Farm machineries or implements

Components	Types of implements			Number possessed
	Production practices	Protection practices	Value addition	
Crop component				
Dairy component				
Fish component				
Poultry component				
Mushroom				
Apiculture				
Biogas				
Azolla				
Composting				

4. Available resource utilization

Available Resources	Purpose	Scarcely	Frequently	Very frequently
Plant resources				
Water sources				
Livestocks				
Land and soil				
Fisheries				
Human resources				
Apiculture				
Azolla				
Farm wastes				
Organic manures				

5. Permanent asset creation

Assets	Purpose	Yes	No
Processing unit			
Milking/ egg storing room			
Cattle shed			
Cow dung pit			
Compost pits			
Mushroom production rooms			
Biogas plant			
Bee hives			
Poultry shed			
Cocoon rearing units			
Others			

Component specific indicators

I. Apiculture

1. Types of hive owned and Apiary size:

Sl no.	Hive type	Yes/ No	Apiary size				Production per hive (kg)
			None	<6	6-10	>10	
1	Traditional						
2	Transitional						
3	Modern						
4	Others						

II. Azolla

1. Have you heard about azolla? Yes / No, if yes
2. Do you know the benefits of Azolla? Yes/ No
3. Have you ever used azolla as a green manure in your farm? Yes / No,
4. Have you ever used azolla as a feed to your cattle and poultry? Yes / No
5. Do you have azolla production unit in your farm? Yes / No, if yes
6. Number of units -------------

III. Bio gas

1. Have you heard about biogas fuel? Yes / No,
2. Have you ever used biogas energy at your home? Yes / No,
3. Currently do you have a biogas plant in your unit? Yes / No, if Yes,
4. No of years < 5 years 5- 10 years >10 years
5. Capacity of the plant -----------------------
6. Quantity of gas produced per annum -----------------------

IV. Composting

1. Have you heard about composting? Yes/No
2. Have you ever used compost as a fertilizer? Yes /No,
3. Do you have a compost pit in your IFS unit? Yes /No, if yes,

Type of composting followed	**No of compost pits/unit**

V. Mushroom

1. Do you have a mushroom production unit in your IFS? Yes/ No, if yes

1(a). Types of mushroom produced -----------

1(b). Type of bedding material or stuff used for the production----------------

VI. Crop component

Cropping intensity

1. Total annual cropped area --------------
2. Net cultivable area -----------

24 (C). Integration of enterprises in the farm: please indicate the following areas in which you integrate the enterprises/ enterprise included in your farm.

Integration practices	**Yes**	**No**	**If Yes, give details**
Crop included farm			
Cultivation of fodder crop as pure or mixed crop			
Using crop products as feed to livestocks			
Provide pollen for bees			

Using crop residue for composting			
Using crop products as feed to fisheries			
Using residue for mushroom production			
Dairy included farm			
Using cow dung and urine for crops as fertilizer			
Using cow dung in fish pond as feed			
Using cow dung for Azolla production			
Compost making from farm waste			
Installing biogas plant			
Provide pollen substitute			
Poultry included farm			
Application of poultry manure to crop			
Use of poultry litter to biogas plant			
Use of poultry litter to fish pond as feed			
Use of poultry litter to compost unit			
Fisheries included farm			
Water can be used for irrigation purposes			
Use of water resources for duck farming			
Pond dikes provide space for erection of animal housing units.			
Azolla production included farm			
Utilized as bio fertilizer			
Utilized as feed for poultry			
Utilized as feed for fish			
Utilized as feed for cattle			
Mushroom included farm			

Helps in the management of agricultural residues.			
Medicinal mushrooms are used as a substitute for antibiotics on the broiler and laying hens			
Use of mushroom supplemented food in fish culture			
Composting included farm			
Helps in the management of organic wastes generated in various enterprises			
Provides quality rich organic manure for crop production			
Compost as bedding material for mushroom			
Apiculture included farm			
Ensure good pollination to crops			
Biogas included farms			
Use biogas slurry to fish pond			
Use biogas slurry to compost			
Use biogas slurry to crops			

24 (D). Income generation in a year –

Does IFS generate income throughout the year? Yes/No……., if yes, mention total annual income and source.

Sl No.	Income source	Type of products	Investment per annum (in Rupees)	Quantity produced (per annum)	Quantity marketed (per annum)	Income per Annum (in Rupees)
I	**Crop cultivation**					
	Fruit crops					
	Vegetables					
	Oil seeds					
	Spices					
	Tuber crops					
	Plantation crops					
	Others					

II	**Livestock**					
	Dairy	Milk				
		Manure				
	Poultry /duck	Egg				
		Meat				
		Manures				
	Piggery	Meat				
	Gotary	Meat				
		Milk				
III	**Fisheries**	Fish				
		Fingerlings				
V	**Composting**	Compost				
VI	**Mushroom**	Mushroom				
		Mushroom spawn				
VII	**Biogas**					
VII	**Apiculture**	Honey				
IX	**Azolla**					
	Any other (please specify)					

Part III

25 (A). Technological needs for different enterprises in a farming system: Please indicate your response in the appropriate alternative by putting a tick mark (✓):

[Technology not available for adoption (4), Technology available but not applicable (3), Technology available but not sustainable (2), Technology available, applicable & sustainable (1)]

Technologies	**Extent of adoption of technologies**			**Technology need**			
	Fully	**Partially**	**Not adopted**	**4**	**3**	**2**	**1**
Crop							
Water management							

Inputs and varieties							
Plant protection related							
Soil management							
Climate monitoring and forecasting							
Waste management							
Harvesting related							
Farm mechanization							
Storing							
Processing							
Product diversification							
Dairy							
Housing management							
Breeding related							
Feed related							
Clean milk production							
Disease management							
Farm waste management							
Storing							
Processing							
Product Diversification							
Poultry							
Scientific housing techniques							
Nutrition and Feed management							
Health management							
Farm waste management							
Hatchery, Brooding and rearing management							
Storing							
Processing							
Product diversification							
Fisheries							
Pond Preparation							
Water Quality Management							

Nursery, Rearing and Seed Stocking/ breeding stock management							
Feeding management							
Pest & Disease management							
Harvesting							
Storing							
Processing							
Product Diversification							
Apiculture							
Seasonal Colony management							
Feeding management							
Harvesting related							
Storing							
Processing							
Product Diversification							
Mushroom							
Sterilization and inoculation technologies							
Substrate related							
Climate control technologies							
Waste management							
Harvesting							
Storing							
Processing							
Product diversification							
Azolla production							
Compost making							
Biogas							
Others, if any							

25. (B). Dimensions for Technology in IFS units:

The items for judgement are rated as very important, important and least important as perceived by the IFS farmers and officials

Dimensions	Very Important(3)	Important (2)	Least Important(1)
Economic Dimension			
Initial cost			
Income generation potential			
Employment generation potential			
Commercialization			
Regularity of returns			
Rapidity of returns			
Technical Dimension			
Physical compatibility			
Efficiency			
Trialability			
Complexity			
Predictability			
Flexibility			
Viability			
Desirability			
Availability of supplies			
Time saving			
Environment Dimensions			
Energy saving potential			
Local resource utilization/recycling capacity			
Sustainability			
Socio-Cultural Dimensions			
Social acceptability			
Social approval			
Cultural compatibility			
Psychological Dimensions			
Attitude			
Perceived social status			

Level of satisfaction			
Human Resource Dimensions			
Family labour			
Hired labour			
Skilled labour requirement			
Physical labour requirement			
Any other dimension, please specify			

25 C. Constraints experienced by the farmers in IFS: Please indicate your rank

SL NO.	CONSTRAINTS	RANK
Constraints in establishing and maintaining IFS unit		
1.	High investment in the initial stage	
2.	Marketing difficulties for the produce from different enterprises	
3.	High cost of production	
4.	Labour scarcity	
5.	Non availability of quality inputs on time	
6	Inadequate extension support and lack of proper access to training	
7	High labour charges	
8	Insufficient government incentives	
9	Difficulty in time management for multiple activities	
10	Inadequate storage and value addition facilities	
11	Natural calamities and climate change	
12	Lack of remunerative prices for farm produces	
13	Land constraints	
14	Lack of awareness and knowledge about improved practices	
I	**Crop component**	
1	Lack of training	
2	Insufficient government incentives	
3	Labour scarcity	
4	High labour charges	
5	Inadequate facilities for value addition	
6	High cost of production	
7	Marketing difficulties	
8	Non availability of quality inputs on time	

9	Price fluctuation	
10	Inadequate extension support	
11	Lack of remunerative price	
12	Natural calamities and extreme weather events	
13	Lack of storage facilities	
14	Crop damage due to animal attack	
15	Pest and disease incidence	
II	**Dairy specific**	
1	Diseases incidence	
2	Low price for the produce	
3	Insufficient government incentives	
4	Higher cost of feed	
5	High initial investment	
6	Unavailability of green fodder during lean season	
7	Problems of predators	
8	High transportation cost	
9	Lack of market for value added products	
10	Inadequate veterinary services	
III	**Fisheries**	
1	Irregular water supply	
2	High initial investment	
3	Marketing difficulties	
4	Insufficient government incentives	
5	The presence of pests (snakes, birds, toads)	
6	Price fluctuation	
7	Lack of extension support	
8	Lack of quality inputs	
9	Inadequate processing facilities	
IV	**Poultry**	
1	Mortality due to disease outbreak	
2	High cost of feed	
3	Attack of predators	
4	Low production performance	
5	Non availability of day old chicks round the year	
V	**Apiculture**	
1	Bad weather	
2	Inadequate skill and knowledge	

3	Pest and diseases	
4	Lack of processing facilities	
VI	**Mushroom**	
1	Non-availability of spawn in time	
2	Lack of infrastructure	
3	High microbial contamination due to improper post harvest handling	
4	Lack government incentives	
5	Lack of knowledge about value addition techniques	
VII	**Compost**	
1	Limited supply of organic wastes	
2	Bad weather	
3	Pests might get attracted(Rats, snakes and bugs)	
4	Lack of proper knowledge and expertise	
VIII	**Azolla**	
1	Bad weather	
2	Very poor growth of azolla	
3	Conserving the propagation of stock requires more care	
4	Difficulty in maintenance of the tank	
IX	**Biogas**	
1	Feedstock availability and other technical issues	
2	High installation and maintenance costs	
3	Inadequate government support	
4	Inadequate expertise and training	

25.D. Please furnish suggestions as per your opinion for overcoming the constraints

Sl no	Suggestions	MI	I	LI	NI
1	Establishment of separate market facility for sale of organic produce				
2	Participation of MGNREGS to agricultural sector				
3	Provide more subsidy facilities to IFS farmers				
4	Arrangements for supply of quality inputs in time through Cooperative system				
5	Production potential of breeds brought from other states should be given more attention				

6	Hasten the distribution of subsidies and support price				
7	Ensure the availability of quality feed and fertilizer at low price				
8	The market price of milk should be remunerative				
9	More training and demonstrations on integration in IFS units				
10	Power supply should be regular to increase the farm efficiency				
11	Increase farm mechanization				
12	Promotion of small scale value addition technologies and facilities				
13	Fill the vacancies of veterinary surgeons post				
14	More government organized market outlets for value added products of different components				
15	Inclusion of accessible and low cost technologies				

Part IV

26. Attitude towards IFS : Please indicate your response in the appropriate alternative by putting a tick mark (✓) SA- Strongly agree, A-agree, UD- undecided, D-Disagree, SD-Strongly disagree

SL NO.	STATEMENTS	SA	A	UD	D	SD
1)	IFS reduces farm vulnerabilities on climate related hazards					
2)	Time management for all activities is very difficult.(-)					
3)	IFS guarantees supply of balanced and nutritious food to family					
4)	IFS offers multiple source of income					
5)	Initial investment for IFS is very high.(-)					

6)	It promotes better waste management through recycling of farm waste					
7)	The labor requirement is more in IFS compared to other farming systems.(-)					
8)	Farm with various enterprises leads to sustainable income throughout the year.					
9)	Marketing of products from IFS unit is very difficult.(-)					
10)	IFS demands less quantity of inputs than other farming systems.					
11)	The IFS concept is not compatible with the values and beliefs of the society.(-)					
12)	It helps to minimize cost of cultivation					
13)	IFS increases competition for resources among different components. (-)					
14)	The social status of the IFS farmers is better compared to non IFS farmers.					
15)	IFS ensures effective utilization of available land					
16)	Maintenance of an IFS unit is very difficult than conventional farms since it contains many components (-)					
17)	IFS reduce soil, water and atmospheric pollution to a greater extent.					
18)	I feel today's need is to concentrate on multiple enterprises at a time.					

19)	Farm mechanization is very difficult in IFS due to integration of various enterprises.(-)					
20)	IFS can be adopted by all categories of farmers.					
21)	Adoption of IFS leads to the effective use of available natural resources					
22)	IFS is suitable only for skillful person.(-)					

APPENDIX VII

CUMULATIVE SQUARE ROOT OF FREQUENCY (CSRF) METHOD

Of the various methods available to determine stratum boundaries, Cumulative Square Root of Frequency (CSRF) method allows greater efficiency for setting stratum boundaries. CSRF methodology breaks down the population into intervals, which can be of equal or unequal width. The steps involved in its calculation are given below:

1. Evaluate the data and determine the units that can be reviewed on an actual basis.

2. Stratify the remaining data into ranges or classes. Number of classes and class interval are determined using the formulas given as below:

No. of classes = 2.5 x (number of samples) ¼

Class interval = $\frac{\text{(Largest figure–smallest figure)}}{\text{No.ofclasses}}$

4. Determine the frequency for each range. This is the number of units within the range.
5. Calculate the square root of the frequency for the first range. Then calculate the square root of the next range. Continue this process for each of the ranges.

Sum of the square root of the first and second range gives cumulative square root of the second range; sum of first, second and third gives the third range and so on for all the ranges.

The cumulative square root frequency value of the last class is divided by the number of sample strata desired (can vary 3-9) to get the cumulative square root value for each item.

Suppose, we desire to have 3 strata, then the upper limit of the first strata is determined using the formula as given below:

$$\text{Li} = \text{Yi-1} + \left(\frac{(\text{Yi} - \text{Yi}-1)}{\sqrt{f}}\right) * \{(\text{Sk/L})*1 - \text{Si-1}\} \text{ …………Value 1}$$

Where

Li	=	Upper limit of the ith strata (In this case first strata)
L	=	Number of strata
Yi	=	Upper limit of the class in which Li lies
Yi-1	=	Lower limit of the class in which Li lies
Sk	=	Cumulative square root frequency value
√f	=	Square root of the frequency of the ith class in which Li (Sk/L) lies

Si-1 = Cumulative square root frequency of the preceding class in which Li (Sk/L) lies

Yi – Yi-1 = Width of the class in which in which Li (Sk/L) lies

For the upper limit of second strata, the formula is:

$$Li = Yi\text{-}1 + \frac{(Yi - Yi{-}1)}{\sqrt{f}} * \{(Sk/L) * 2 - Si\text{-}1\} \; \ldots\ldots\ldots\ldots \text{Value 2}$$

For the upper limit of third strata, the formula is:

$$Li = Yi\text{-}1 + \frac{(Yi - Yi{-}1)}{\sqrt{f}} * \{(Sk/L) * 3 - Si\text{-}1\} \; \ldots\ldots\ldots\ldots \text{Value 3}$$

In this way, three strata are formed i.e., below value 1, between value 1 and value 2 and above value 2 up to value 3.

Plate 1: Interacting with respondents and officials in the study area

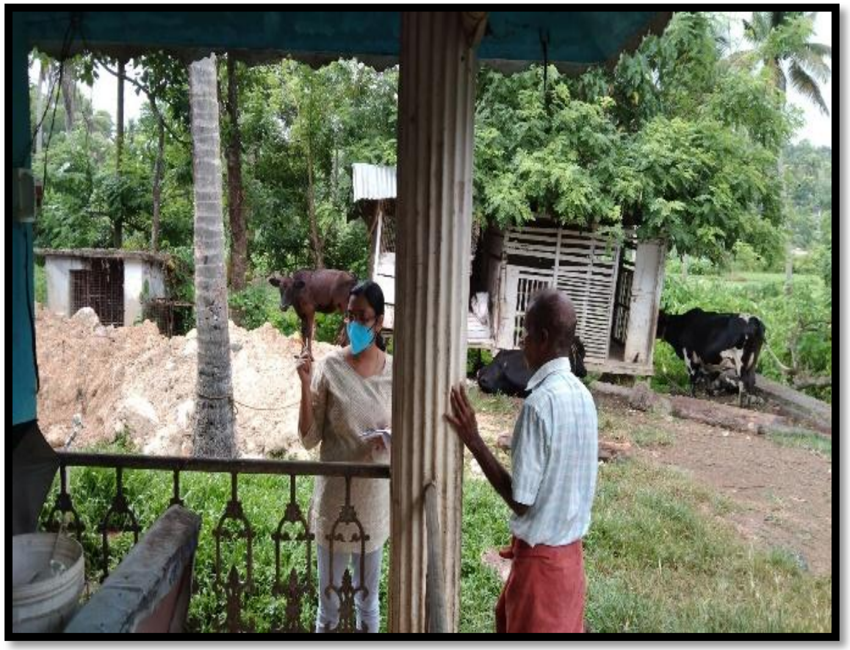


Plate 2: Dairy + Crop + Poultry system

Plate 3: Dairy + Crop + Fisheries + Poultry system

Plate 4: Dairy + Crop + Apiary + Fisheries system

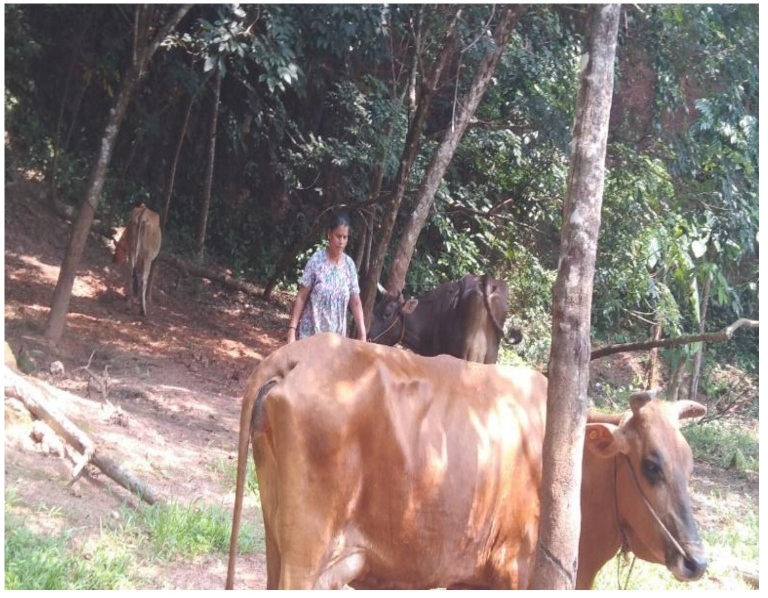

Plate 5: Dairy + Crop system

Plate 6: Dairy + Crop + Apiary system





Plate 7: Dairy + Crop + Apiary + Poultry system

Plate 8: Dairy + Crop + Fisheries system



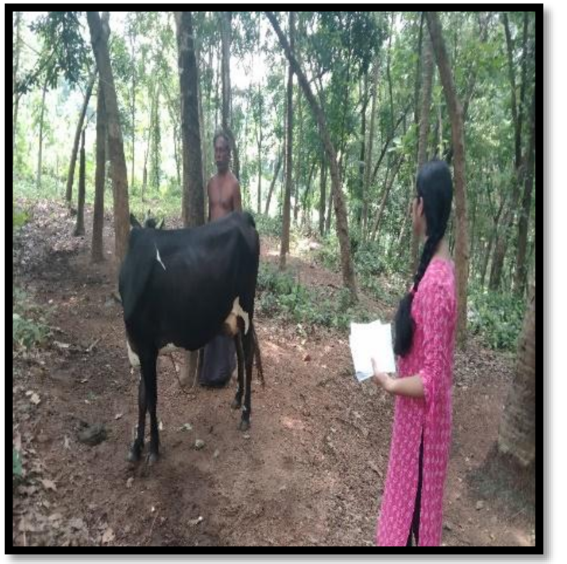


Plate 9: Dairy + Crop + Apiary + Fisheries + Poultry system