IMPACT OF AGRO MACHINERY SERVICE CENTRES ON MECHANISATION OF PADDY CULTIVATION IN KERALA.

By

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THESIS

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CERTIFICATES

CERTIFICATE

Certified that this thesis entitled **"Impact of Agro Machinery Service Centres on mechanisation of paddy cultivation in Kerala"** is a record of research work done independently by **Mrs. Salini R Chandran** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

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I, hereby declare that the thesis entitled "**Impact of Agro Machinery Service Centres on mechanisation of paddy cultivation in Kerala"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, fellowship or other similar title, of any other university or society.

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Salini R Chandran

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ADP : Agricultural Development Program

AIPA : Agro-Informatics and Precision Agriculture

AMOSE : Agro Machinery Operation Service Centres

AMSC : Agro Machinery Service Centres

AMSEC : Agricultural Mechanisation Services Enterprise Centre

ANOVA : Analysis of Variance

ARS : Agricultural Research Station

ASC : Agro Service Centre

ATMA : Agricultural Technology Management Agency

CAGR : Compound Annual Growth Rate

CDB : Coconut Development Board

DAP : Draught Animal Power

DBT : Direct Benefit Transfer

EL : Experiential Learning

EMI : Equated Monthly Installment

FAO : Food and Agriculture Organisation

FFTC : Food and Fertilizer Technology Centre

FMFC : Farm Machinery Facilitation Centre

FMTTI : Farm Machinery Training and Testing Institute

FSA : Food Security Army

FTLR : Fast Track Land Reform

GCA : Gross Cropped Area

GALB : Green Army Labour Bank

GCC : Green Cadet Corps

GSR : Gross Social Return

GSSR : Gross Social Rate of Return

Ha : Hectare

HYV : High Yielding Variety

ICAR : Indian Council of Agricultural Research

ICT : Information and Communication Technology

ITES : Information Technology Enabled Services

KAU : Kerala Agricultural University

KACET : Kelappaji College of Engineering and Technology

Kg : Kilo Gram

LGA : Local Government Area

LSG : Local Self Governments

MAMTU : Mobile Agro Machinery Training Unit

MGNREGS : Mahatma Gandhi National Rural Employment Guarantee Scheme

MIDH : Mission for Integrated Development of Horticulture

MKSP : Mahila Kisan Sasthaktikaran Pariyojana

MTL : Mechanisation Tools Level

NABARD : National Bank for Agriculture and Rural Development

NBFI : Non– Banking Financial Institution

NCAER : National Council of Applied Economic Research

NFSM : National Food Security Mission

NGO : Non-Governmental Organisation

NMAET : National Mission on Agricultural Extension and Technology

NMOOP : National Mission on Oilseeds and Oil Palm

NSSR : Net Social Rate of Return

PHTM : Post Harvest Technology and Management

PRA : Participatory Rural Appraisal

RBI : Reserve Bank of India

RKVY : Rashtriya Krishi Vikas Yojana

RRA : Rapid Rural Appraisal

RRB : Regional Rural Bank

RAWE : Rural Agricultural Work Experience

SCB : Scheduled Commercial Bank

SMAM : Sub-Mission on Agricultural Mechanisation

SHG : Self Help Group

SPSS : Statistical Package for Social Sciences

SRI : System of Rice Intensification

TNAU : Tamil Nadu Agricultural University

US : United States

WTO : World Trade Organization

INTRODUCTION

CHAPTER 1

INTRODUCTION

Agriculture is the backbone of Indian economy. It provides employment opportunities to nearly 60 per cent of the population. It is the means of livelihood of almost two - third of the workforce in the country (Census, 2001). The technological improvements in Indian agriculture from the sixties have brought about revolutionary changes in India's agricultural production. The growth rate of food grain production particularly in the case of wheat and rice was much higher than the growth rate of population. This has been made possible by the evolution of high yielding crop varieties, increased use of chemical fertilizers, development of irrigation facilities and plant protection measures accompanied by effective price support programmes of farm products. The unavailability of labour and rising wage rates make mechanisation stronger in the field of agriculture. Earlier, the notion was that mechanisation creates unemployment. That myth exists no more and it has been observed that, agricultural mechanisation besides increasing production and productivity also generates income and employment opportunities. Since the availability of draught animals are getting reduced, the shortfalls have to be met mostly through electro mechanical power sources.

1.1 Significance of the study

Agricultural mechanisation technology plays a key role in improving agricultural production and hence considered as an essential input to agriculture. The term 'mechanisation' is generally used as an overall description of the application of variety of mechanical inputs such as tools, implants, and machinery. Researchers have observed that proper use of mechanised inputs in agriculture has a direct and significant effect on labour productivity, profitability of farms and improvement in the quality of life of the people engaged in agriculture. Agricultural mechanisation

helps in increasing production, productivity and profitability in agriculture by achieving timeliness in farm operations, reducing available input losses, increasing utilisation efficiency of costly inputs like seeds, chemicals, fertilisers, irrigation and water, reduction of weather risk**,** reducing unit cost of production and enhancing profitability. It also helps in the conservation of the produce and byproducts from qualitative and quantitative damages, enables value addition and establishment of agro processing enterprises for additional income and employment generation from farm produce. The efficiency of mechanisation can be judged from the fact that modern plough is about 200 to 300 per cent more efficient than indigenous plough and efficient machinery helps in increasing productivity by about 30 per cent and make the Indian agriculture attractive (National Bank for Agriculture and Rural Development, 2014). Increased production requires more use of agricultural inputs, machines and protection of crops from biotic and abiotic stresses. But farmers in many part of our State are not in a position to undertake mechanisation in their field due to small size of land holding, inadequacy of farm power and machinery. This system should be changed and farmers should have easy access to farm power and machineries. Agro Machinery Services Centres (AMSCs) formed in the State gains more importance in such a scenario. The importance of AMSCs has been recognised and the Government of India has given emphasis to make it a success. Now banks and other financial institutions have been directed to provide loans for mechanisation in agriculture. Due to reduction in the size of the holdings, it is difficult for the farmers to hold the machinery on their own. As a result, only farmers having large land holdings enjoy the benefits of mechanisation. This problem can be solved by establishing Agro Machinery Service Centres. This will help in providing the machinery on custom - hire basis to these small and medium farmers as and when it is needed. Also a large number of farmers suffer due to lack of service and repair and maintenance facilities for their machinery. There is a need to have such facilities attached to the Agro Machinery Service Centre thus extending their services to the farmers. Therefore, ideally an Agro Machinery Service Centre should have all facilities to meet the crucial needs of the farmers

and at the same time become a self reliant and viable proposition. Hence the present study, as an attempt to examine the impact of AMSCs in the mechanisation of agriculture, especially paddy cultivation, is of contemporary significance.

1.2 Statement of the problem

Agriculture has always been India's most important economic sector. In order to undertake agricultural operations, labour is an inevitable input. But the availability and cost of agricultural labour is a major problem faced by the farmers of Kerala. Even though mechanisation of agriculture was recommended and adopted by many states in India years back, it was not implimented in Kerala, due to the small size of farm holdings. But now a situation has come where agricultural operations including harvesting have be abandoned in Kerala due to the lack and high cost of labour.

The service rendered by Agro Machinery Service Centres (AMSCs) in the mechanisation of farming operations assumes significance in this scenario. Agro Machinery Service Centres are service providers where, all agro machinery operation services with respect to crop production are rendered on contract basis. The service shall be either for operator or machine rental or altogether for operational service as such. The Agricultural Research Station (ARS), Mannuthy of Kerala Agricultural University introduced the concept of Food Security Army (FSA) and Agro Machinery Operation Service Centres (AMOSC) to provide the services of agro machinery with highly skilled workers. ARS has undertaken training programmes for the farmers, to acquaint them with available technology, sources of farm power and mechanisation. Systematic and scientific farming through KAU-ARS has enabled farmers to come across innovative techniques and technologies. AMSCs have been set up in many panchayats of the State and the process of mechanisation of farming operations is getting popularised among the farming community. Among the various crops, mechanisation is more popular in the case of paddy. Hence the present study is an attempt to examine how far

mechanisation through AMSCs has helped the farmers of Kerala, particularly with respect to Thrissur district, where AMSCs have been introduced first in the State. Mechanisation has been adopted first in the case of paddy in the State. Hence the impact of mechanisation on paddy farmers is enquired taking Thrissur district as the sample, which is the third highest paddy growing district in the State (Economical and Statistical Department, Kerala 2013-14). The factors determining mechanisation, and whether institutional credit has any role in the mechanisation of paddy farms, are also enquired into.

1.3 Objectives of the study

The objectives of the study are

(i) To assess the extent of farm mechanisation among farmers
(ii) To identify the determinants of paddy mechanisation through AMSCs
(iii) To study the impact of AMSCs on mechanisation of paddy cultivation, and
(iv) To examine the role of institutional credit in the mechanisation of paddy farms.

1.4 Utility, scope and limitations of the study

Farm mechanisation is considered as one of the most crucial technological innovations. It brings about significant improvements in agricultural productivity. The timeliness in operations has assumed greater significance in obtaining optimal yields from different crops, which has been possible by way of mechanisation. Apart from these, the challenges of scarcity of labourers and high cultivation cost can be addressed through mechanisation of agriculture. Mechanisation is therefore crucial to ensure that a farmer can earn maximum profit from his produce. In Kerala mechanisation is widely adopted in paddy and mechanisation needs of paddy especially the mechanised transplanting is undertaken through AMSCs.

The present study gives emphasis to the impact of AMSCs in the mechanisation of paddy cultivation. The scope of the study is restricted to paddy farmers who are using the services of AMSCs and farmers who are not using the

services of AMSCs. The major mechanised farm operations in cultivation, various machines used by farmers, services of AMSCs and economies of scale by using mechanical power in farm operations rather than human power are covered under the study. The constraints faced by farmers and AMSCs in obtaining credit for farm mechanisation are also included in the study, so that policy makers and institutions can take necessary actions with regard to credit for farm mechanisation.

The major limitation of this study is that, in the study area all the farmers are adopting mechanisation in paddy cultivation. Users of AMSCs adopt mechanisation for land preparation, transplanting and harvesting. The use of transplanting services of AMSCs determines whether a farmer belongs to users of AMSCs or non-users of AMSCs. Like users, non-users are also adopting mechanisation for land preparation and harvesting except mechanised transplanting service of AMSCs. They cannot adopt mechanised transplanting due to the water logged nature of their land. That is why they belong to non-users of AMSCs. Otherwise they are also be a user of AMSCs. Regarding the group users, farmers are undertaking paddy cultivation under a Padasekharam and payments are made individually. So the group users cover the details of Padasekharams only. No farmer in the study area is taking loans for farm mechanisation. Hence the analysis of the role of financial institutions in farm mechanisation among farmers could not be done. Although the area of operation of two AMSCs includes adjacent districts also, farmers under Thrissur district alone are selected for detailed study.

1.5 Organisation of the thesis

The report of this study is presented in five chapters. The first chapter deals with the significance of the study, statement of the problem, objectives, utility, scope and the limitations of the study. The second chapter reviews the available literature on mechanisation of agriculture which provides a theoretical support to the study. The third chapter details the methodology adopted in the process of investigation and for analysing the collected data. The fourth chapter presents the results and discussion of the study. The last chapter summarises the findings of the study and concludes the study, followed by references, appendices and abstract of the thesis.

REVIEW OF LITERATURE

CHAPTER 2

REVIEW OF LITERATURE

A literature review is a systematic, explicit, and reproducible method for identifying, evaluating, and synthesising the existing body of completed and recorded work produced by researchers, scholars, and practitioners. It is a text written by someone to consider the critical points of current knowledge including substantive findings, as well as theoretical and methodological contributions to a particular topic. Reviewing a literature enables the researcher to avoid duplication of research work and broadens the understanding of the research problem. A research problem is a general statement of an issue meriting research. Its nature will suggest appropriate forms for its investigation. The problem of research may be different for different studies. By reviewing the literature based on the research problem the researcher can undertake a better study using appropriate techniques and hence one can make the research perfect. According to Hart (1998) “literature review is the selection of available documents, both published and unpublished, on the topic, which contain information, ideas, data and evidence written from a particular standpoint to fulfill certain aims or express certain views on the nature of the topic and how it is to be investigated, and the effective evaluation of these documents in relation to the research being proposed." In a literature review a single source may be referred to numerous times depending on its importance in the field or its relationship to other sources.

A good literature review deals with the exact explanation of the research problem, how the researcher carried out the research and the gap in the research that intent to be filled. With these observations in mind, a review of available literature dealing with various aspects of the current research problem is presented in this chapter under two sub headings, viz.,

2.1 Extent and impact of mechanisation in agriculture

2.2 Determinants of farm mechanisation

2.1 Extent and impact of mechanisation in agriculture

Agricultural mechanisation is the process of applying machineries in agricultural operations. The major reason for adopting mechanization is the shortage of labour for agricultural activities. In the recent years mechanisation is gaining more importance among farmers with powered machinery replacing many jobs formerly carried out by men or animals. Since mechanization reduces time gap in farming activities, it is getting adopted in all types of crops like paddy, wheat, cotton, sugarcane and vegetables. The use of machines in farm operations increases production and productivity displaces unskilled farm labour and generates skilled employment opportunities. Besides improving production efficiency, mechanisation encourages large scale production and improves the quality of farm produce.

Many terms are in vogue to express the extent of farm mechanization in a farm, a region, state or a country. The terms include level of mechanization, degree of mechanization, mechanization indicator, etc. The level of mechanization is essentially the extent of use of mechanical power sources and equipment on a farm. The degree of mechanization, on the other hand, implies the extent to which a given operation in the crop production system is mechanized. Some of the studies conducted so far on the extent and impact of agricultural mechanisation are reviewed in this section.

Rochin (1978) made an attempt to assess the consequences of farm mechanisation research in American agriculture. For the conduct of study he collected three classes of data viz, data to measure the amount of work time and income of pertinent workers employed in the impacted areas, data to measure the costs of both research and development and extension efforts, and data to determine the potential returns or cost savings to society from the adoption of the innovation

and current costs of employing traditional technology. For assessing the consequences, the economist's approach was combined with the general approach of technology assessment, the result of which was used to rank various types of research projects. The three estimates made for the purpose of analysis included measures of the Gross Social Return (GSR), Gross Social Rate of Return (GSRR), and Net Social Rate of Return (NSRR) to society. The author found that projects with high NSRR could conceal large labour displacement effects, while projects with relatively low rates of social return have minimal labour impacts. The high positive returns to mechanisation research primarily indicated that a substantial income was saved from innovation - which was enough to compensate the losers and still leave society better off than before. However, the presence of savings neither assures that benefits would accrue to displaced workers, nor that compensation would actually occur.

Oshiro (1982) conducted a study on mechanisation of paddy cultivation in Japan and its effects on farm households. The primary objective was to observe the national household purchase patterns of farm machineries especially the paddy planter and its effect on the input of labour for rice farming covering 57 farm households. The author found that purchase of paddy planters among the intermediate and large farms was influenced by many factors such as farm machinery loans, availability of off- farm work and income, reduction of labour input required for different tasks, technical linkages between machines, changes in the appropriate time for the completion of tasks, social values and village dynamics. Mechanisation reduced the labour requirement for the rice crop as well as shortened the labour demand periods. The introduction of machinery to the Japanese farm and the perception of the importance of paddy planters by the farmers were creating significant changes in the social and economic aspects of the farm households. The burden of rice production shifted primarily to the younger family members from the heads of the households because of the faster pace of the machines. However, the

labour saved through the use of machinery was not being utilised on the farm; instead it led to increase in off- farm working hours.

Mike and Klerk (1983) made a study on the impact of farm mechanisation on employment, income and population distribution in South Africa. The specific objectives of the study were to determine the degree to which mechanisation has occurred on maize farms, changes in the labour process, changes in the level of employment and characteristics of farm workers, the causes of mechanisation, and whether any decline in employment due to mechanisation has led to a rise in the unemployment level. Data were collected from 61 maize farms in the district of Western Transvaal where maize production was higher than the other districts. In addition to the data from maize farmers, the data issued by local authorities during the periods of 1968, 1973, 1977 and 1981were also used. The results showed that mechanisation was accompanied by substantial reduction in employment mainly for seasonal workers. There were also indications of changes and deductions in the geographical distribution of the population and in the incomes of farm workers and their families.

Panin (1993) collected empirical evidence of mechanisation effects on small holder crop production systems in Botswana. The study used 1991 and 1992 farm management survey data of 127 randomly selected small- holder farmers from seven villages. A comparative economic analysis of Draught Animal Power (DAP) and tractor farming systems was done. Attention was also given to the impact and implications of 'tractorisation' on total crop output, crop income, cropping emphasis and resources utilization. Cobb-Douglas production function and regression analysis were employed for analysing the data. The study refutes any economic justification for the current use of tractors in the area by the small holdings farmers. In fact, the results showed that the DAP was a well established traditional farming technology of small holder farmers in Botswana but in later years, the use of tractor farm

technology was increasingly becoming important among small holder farmers in their crop production systems. The production function revealed that use of tractors has a significant negative impact on crop production, income and household labour economy.

In a case study on the mechanization of wheat cultivation in Bangladesh, Hossain and Callaghan (1996) found that in growing wheat, which was a relatively new crop in Bangladesh, the time available for seed-bed preparation was severely limited. In order to assess the prospects of mechanizing the planting phase, three proposals for seed-bed preparation based on oxen, tractors and power tillers were compared by estimating first the number needed to complete the task within a set period and then the cost of each proposal. Oxen were found to be the most expensive solution and power tillers the cheapest.

Guilhoto *et al.* (1997) studied the mechanisation process of the sugarcane harvest and its direct and indirect impact over the employment in Brazil. To study the impact, an interregional input-output model was constructed for the Brazilian economy at the level of its five macro regions, with specific details for the sugarcane, alcohol, and sugar sectors, employment level and qualification level of the workforce. It was found that one of the main concerns about the mechanization process of the sugarcane harvest was its direct and indirect impact over the employment. The results also showed a reduction of 52 per cent to 64 per cent in the number of the labour force being employed directly in the sugarcane production. The reduction in direct employment in the sugarcane harvest occurred among workers with a low level of qualification. As a consequence of the reduction in the direct employment in the sugarcane harvest, there was a decrease in the indirect and induced employment in the sectors producing sugarcane, alcohol, and sugar.

According to Sang (1999) traditional paddy cultivation was a labour intensive and back-breaking job. Introduction of appropriate mechanisation technologies is essential to replace many of the highly labour-dependent activities associated with paddy cultivation. Proper mechanisation helps the farmers to get high paddy yields. Mechanisation definitely has played an important role in large-scale paddy production with satisfactory completion of works in time. Farmers could achieve better cropping intensity through the progressive introduction of mechanization and other labour saving technologies. An important pre-requisite for successful adoption of mechanisation is careful planning and design of farm-lots layout which must facilitate efficient machinery movements and their effective use, proper irrigation and drainage system. Adoption of mechanisation technology also requires close cooperation between machinery suppliers or operators and farmers. Large-scale paddy cultivation can be made a profitable venture when the three major factors, viz., an efficient management system, mechanization and proper farm infrastructure design are concomitantly implemented.

Wegener (1999) observed that sugarcane is an important industrial crop in South China, where State farms produced about one-tenth of the nation's total cane. These sugar companies were integrated enterprises including farm and milling activities but, due to declining sugar prices, they were not particularly profitable. Under the "Responsibility System" which was used on State farms, a large number of small cane growers were allocated land with an average area of 1.6 hectares, on which to grow cane which they harvest and transport to a collection area for transport to the mill. Because of their small area and low work efficiency, these cane growers' average incomes were very low. Besides the economic problems flowing from lower sugar prices, the State farms were also suffering from labour shortages and many temporary workers had to be employed. The managers of some of the State farm companies found that the solution to their problems lies in mechanization of cane growing and harvesting operations. Economic analysis showed that mechanized

production would lead to cost reductions in the production of cane. Increasing yields from the mechanized system, keeping strict control over the cost of using machinery, and utilizing it effectively was expected to contribute to achieving a better outcome for the farmers

A study conducted by Singh (2001) on mechanisation of the agriculture sector in Laos was based on a survey of 48 farmers from 10 villages in four districts of Vientiane Municipality. The farms covered under the study were divided into two main categories, one using power tillers and the other, using traditional, animal drawn implements. The power tiller users were further divided into three sub – categories, viz., farmers owning power tillers and using them both in rainy as well as dry season; farmers who hired and used power tillers in rainy and dry season; and farmers who owned power tiller but used it only in rainy season. The author observed that mechanization of the agriculture sector in Laos started with the introduction of rice mills followed by the use of tractors imported from the former Soviet Union. Gradually, threshers and power tillers became popular among farmers. Vientiane Municipality was having the highest level of mechanization in Laos. Some of the farmers owning power tiller and farmers using animal drawn implements grew crops only in the rainy season due to lack of irrigation facilities. The main sources of farm power were human labour, draft animals and power tillers. The average holding size of the surveyed farmers was 2.15 hectare. The farmers owning and using power tillers in both rainy and dry season had the highest paddy yield. The cropping intensity of farmers having irrigation facilities and owning power tiller was the highest followed by those hiring power tillers. The family income of farmers using power tillers was higher than that of farmers using animal-drawn implements.

Srivastava (2001) is of the view that farm power is an essential input in agriculture for timely field operations for operating different types of farm equipment and for stationary jobs like operating irrigation equipment, threshers/ shellers /

cleaners / graders and other post harvest equipments. In India there had been a shift towards the use of mechanical and electrical sources of power from traditional manpower and animal power. The power - productivity relationship worked out by him among the Indian States reveals that those States having higher farm power availability / ha have higher productivity. According to the author, the additional requirement of food grains in future will be met, to a great extent, from Indo-Gangetic plains where the demand of tractors, power tillers and other machinery will continue to increase in future. For increasing productivity of dry land agriculture which constitute about 66 per cent of the cultivated area in India, timeliness in farm operations is essential especially for seedbed preparation and sowing operations intended for establishing good crop stand in deficient/ receding soil moisture content. In these areas also the demand of tractors/ power tillers, seed drills/planters and other farm machinery on custom service will increase in future. Seeing the present trend and considering the future demand of additional power sources, it was visualized by the author that by 2020 the average farm power need in India would be about 2 KW/ha of which the share of animate source would be only about five per cent and that of mechanical and electrical power about 70 per cent and 25 per cent respectively.

According to Singh (2002) commercialisation of agriculture is possible only through mechanisation. The technological improvements in Indian agriculture have brought about revolutionary changes in agriculture production. The higher wage rate for labour and increasing cost of other agricultural inputs has led to the adoption of mechanisation in farm operations. Mechanisation makes all farm operations easy and the farmer can earn better yield from their field. The quality and precision of the operations are equally significant for realising higher yields. The various operations such as land levelling, irrigation, sowing and planting, use of fertilizers, plant protection, harvesting and threshing need a high degree of precision to increase the efficiency of the inputs and reduce the losses. Farm mechanisation helps to increase

area under cultivation and also cropping intensity. Higher productivity of land and labour is another factor which clearly justifies farm mechanisation. The use of farm mechanization enlarges the employment opportunities both in farms and non-farm sectors. But the constraint of farm mechanization is that it leads to under utilisation of farm machineries among small and scattered holdings of farmers. Hence the author advocated for selective farm mechanization.

McCauley (2003) undertook a study on the effects of agricultural mechanisation on land tenure in Burkina Faso. The study explored the tensions emerging in Burkina Faso between mechanized agriculture and traditional land tenure policies in four main sections. The first section traced the changing land tenure policies in Burkina; the second considered the rise of agricultural mechanisation and the growing significance of tractors. The third section examined the tensions created by rising population. These tensions lead to the exploitation of labour, persistent land grabs and forcing of small farmers into an emptiness in which few market alternatives exist. The study found that there should be a harmonisation between land tenure policies and agricultural mechanisation. The adoption of mechanization has been very slow relative to the process in other African countries, followed by a shift in the identity of the farmers. In the last section, the author recommended that the country should promote smaller, more efficient machinery in the agricultural sector.

Saha *et al.* (2004) conducted a study on the status and prospects of farm mechanisation in Madhya Pradesh. The author observed the mechanised farming practices adopted by the farmers for different farm operations, identified the existing mechanisation gaps and suggested possible remedies to bridge those gaps. A total of 360 farmers were selected for collecting information through multiple stratified random sampling techniques. It was revealed that use of low capacity equipments, inadequate use of mechanical power sources and high capacity implements, and manual operations like weeding and plant protection in paddy cultivation consumed

more time and resulted in yield loss. He also suggested for improvement of certain existing machines such as bullock or tractor drawn planters, bullock drawn seed cum fertilizer drill for small seeds, rice transplanters and bullock operated potato digger already developed in various research organizations, and development of new machines like self propelled power weeder, spraying attachment to power weeder and small combine harvesters for meeting the mechanization requirement of farmers.

Sidhu (2004) made an attempt to develop a system dynamics model of energy use in crop production and relations for calculating the level of mechanization for the four major crops in Punjab. The crops covered under the study were wheat, paddy, maize and cotton. The data for the calculations were pertained to the period 1985 to 2003. The degree of mechanisation of a single operation in a crop for a particular year was calculated on the basis of the number of machines available per year to perform the various operations within the recommended time period. This value for a single operation was then multiplied by its energy consumption ratio for each operation and its weighted mean was computed to obtain the degree of mechanization for the crop for that year. Farm operations with mechanization index below 0.50 were taken to be less mechanized i.e. low level of mechanization and those with mechanization index above 0.75 were considered highly mechanized i.e. higher level of mechanization. In Punjab, almost all the operations for cultivation of wheat crop are mechanized and tillage and sowing are the most mechanized operation for wheat, followed by harvesting and threshing operations. The weeding and spraying operation are the least mechanized operation for wheat. The tractor sprayers are used only in the cotton crop. In the case of paddy, the major crop of kharif season, occupying nearly 60-65 per cent of the cropped area, the tillage operation is done using the abundantly available machines like the cultivators and plankers. As in the case of wheat, weeding and spraying in paddy is the least mechanized operation in Punjab.

The Report of the Food and Fertilizer Technology Centre (2005) pointed out that one of the main causes for the low agricultural productivity in most of the developing countries in the region is the lack of appropriate machineries that cater to and suit to the requirements of small-scale farms. Hence many small farms are deemed as unproductive and inefficient. Farm mechanisation is often misconstrued to mean modernisation, beneficial only to industrialised countries with highly mechanised agriculture. Asian agriculture is rapidly increasing with the rise in farm mechanisation support. Most developing countries in the region are in the transition from labour intensive to control intensive agriculture. Precision agriculture and automation is the current trend in agricultural mechanisation. Irrigation system machines, planting machines, powered sprayers, combine harvesters, dryers using biomass fuel, silo and storage handling, and advanced and high quality rice mill machines are likely to be adopted by Asian farmers in the near future. The Report also identified the barriers that impede the growth and sustainability of farm mechanisation industry which were classified into technological constraints, socio-cultural and behavioural barriers, financial and economic problems, and environmental issues. The Report concluded that each country's effort on small farm mechanisation must be anchored on a coherent strategy based on the actual needs and priorities of the small scale farmers.

Moradi *et al.* (2005) conducted research on agricultural mechanisation in the strategic crops of Iran. The researchers aimed to encourage the farmers to the cultivation and development of specific products and policy making in order to produce more products. A stratified sample of farmers was selected through a systematic approach for the purpose of study. The strategic agricultural products covered under the study include wheat, barley, corn, rice and potato. A comparison of cost of machinery and equipment with cost of land preparation and paddy production in Iran was also included in the study. Among the crops selected the production of wheat has not increased with the level of mechanisation as in the case of other crops.

Napasintuwong and Emerson (2005) studied the social and institutional structure that has influenced the direction of technological change in the United States (US) agriculture. In order to understand the determinants of technological development in the US, particularly farm mechanization in the context of immigration policy, the characteristics of the labour market and the role of government in the development of farm mechanization resulting from immigration policy were studied. A multi-output translog cost function model was adopted for the purpose of analysing the data collected. The authors observed that public expenditure on mechanisation had a significant impact on reducing the cost share of capital. The uncertainty of labour availability and difficulties associated with hiring foreign workers were argued to induce the development of advanced labour-saving technology such as mechanical harvesters in labour intensive agricultural production. However, the private expenditure on machinery increases the cost share of capital. Public expenditure on mechanization increases the revenue share of cereal, but decreases the revenue share of perishable crops and other outputs.

Verma (2005) opined that agricultural mechanisation implies the use of various power sources and improved farm tools and equipment, with a view to reduce the hard work of the human beings and draught animals, enhance cropping intensity, precision and timelines of efficiency of utilization of various crop inputs and reduce the losses at different stages of crop production. The end objective of farm mechanization was to enhance the overall productivity and production with the lowest cost of production. The contribution of agricultural mechanization has been well recognized in enhancing the production together with irrigation, biological and chemical inputs, high yielding seed varieties, fertilizers, pesticides and mechanical energy. The study indicated that there is significant increase in cropping intensity due to the use of tractors and irrigation as a consequence of mechanization. It also helped in the overall increase in the employment of human labour. He concluded that farm mechanization increased agricultural productivity and profitability on account of

timeliness of operations, better quality of work and more efficient utilization of crop inputs.

Vheremu *et al*. (2005) conducted a study on "Mechanisation: Panacea to Zimbabwe's Agricultural Productivity" with the objective of assessing the impact of Fast Track Land Reform (FTLR) Programme on mechanization. The study was carried out in Mashonaland West Province of Zimbabwe during the winter wheat production. Three farms in the Zvimba North District with a total of about 310 hectares under wheat were selected for the study. During the same period four farms in Makonde district with 200 hectares of wheat were also studied. The data were collected through informal interviews with farm managers and actual assessments of the availability and status of the farming equipments on the selected farms. Key agricultural production aspects such as tillage systems (primary and secondary), fertilizing units (spreaders and distributors), crop protection equipments (sprayers), planting equipments (drill seeders and planters) and harvesting equipments were assessed for the study. The study revealed that the status of mechanization on the farms in Mashonaland West is poor. Most of the equipments available on farms is either vandalized or is poorly maintained because of lack of relevant training and capital resources by the farm owners. The authors suggested that efforts should be made towards agricultural development in Zimbabwe; but unless parallel efforts are put in the improvement of agricultural mechanization by the government, agricultural productivity from the farms will remain low.

According to Alam (2006) agricultural mechanization is the interjection of improved tools, implements and machines between farm workers and the materials handled by them. Independent India is in a process of agricultural mechanization and revival of rural agro-processing which got acceleration during post Green Revolution period. Irrigation pump sets, power threshers, tractors, power tillers, seed and seed-cum-fertilizer drills, planters, mechanical rice transplanters, vertical conveyor

reapers, zero-till drill and raise bed planters have found good acceptance among the farmers. For increasing production and productivity at reduced cost of production, free of arduous labour, agricultural mechanization is essential. Introduction of electro-mechanical power units supplementing and substituting traditional animate sources of farm power, and shifts in agriculture leading to crop diversification towards horticulture, animal husbandry, fishery, forestry and on-farm agro-processing are going to bring in greater degree of mechanization. According to the author, though India dominated by small and marginal landholdings may not have the same trend of mechanization as the developed world, it would grow close to it with its own modifications.

Baofeng (2006) conducted a study on farm mechanisation and farm machinery service in the rural Shanxi Province of China with the objective of analysing the factors that influenced hiring of machinery service by farmers. The study was based on a sample survey of 821 farmers in Shanxi province, covering 75 Counties of 11 districts. A multivariate regression model was fitted for analysing the data collected. The study revealed that farmers' demand for agricultural machinery and their use to a great extent determine China's agricultural mechanization development. The analysis exposed that 66 per cent of the sampled farmers did not own farm machinery due to insufficient funds and low cost involved in hiring farm machinery services. It was also found that higher the land holding, higher was the utilization of farm machinery. Farmers' machinery service utilization are influenced by multi-factors, such as farmers' land size, degree of specialization in planting, and availability of agricultural machinery services. Increasing the number of farm machinery can bring to the farmers convenience and efficiency in utilizing the farm machinery services. According to the author expanding the scale of farmland and improving the degree of cultivation specialization are conducive to the efficient use of farmers' machinery service, which can be achieved through centralized farmland operation by means of two channels. One is to transfer the current surplus labour force in rural areas to

provide them with more employment opportunities in other industries and to create conditions for the farmland centralization; the other is to develop reasonable policies concerning farmland transfer to entitle the farmers with freedom of land transfer and gains.

According to Sims and Kienzle (2006) mechanisation is tools, implements and machinery applied to improving the productivity of farm labour and land. Mechanization is a key input in any farming system and farm power is an essential ingredient of agricultural productivity and livelihood strategies. The greatest demand for farm power is for land preparation. Agricultural mechanization will not be successful if the local economy is unable to deliver servicing, fuel and spare parts for both imported or domestically produced machines and implements. This failure often occurs when markets for these items are fragmented or unevenly developed, when transport infrastructure breaks down, or when new models or different makes of machine are imported without considering the need for spare parts. The main purpose of mechanization strategy formulation is to create an environment in which agricultural mechanization will develop from the existing situation to a desired future state.

Asoegwu and Asoegwu (2007) discussed the dynamics of Nigerian agriculture and the important role of mechanization in providing the needed boost. In their opinion Nigeria's agriculture requires a very strong boost because of increasing population and decreasing land resources due to environmental factors. The national agricultural policies and their impact on Nigeria's agriculture are highlighted emphasizing the previous and present roles of various organs of the Government. After discussing the assets and liabilities of Nigeria's agriculture, the authors pointed that the agricultural environment must be properly managed for sustainable agricultural productivity in view of emerging information technology. The future expectations and challenges facing the Nigerian agricultural engineers, agriculturists, scientists and environmentalists are also highlighted by the authors.

Berg *et al*. (2007) conducted a study with the objective of examining the impact of increasing farm size and mechanization, on rural income and rice production in Zhejiang Province, China, with the help of a survey. The authors tried to find out the diversity in agricultural technologies in the area, with the help of a simulation model of the farm household. It was found that economic growth in China's agricultural sector lags behind growth in industry and services, creating an ever widening rural - urban income gap. Development of the non-agricultural sectors offers new opportunities for farmers in China's more advanced provinces such as Zhejiang. Increased income in the urban sector creates markets for new products, and migrating farmers rent their land to those staying. The prevailing rice-based systems have been managed mainly using manual labour and animal traction, but the larger farms resulting from migration was expected to facilitate mechanization. It was exposed that farmers can generate incomes comparable to non-farm wages, only when they switch completely to production of more remunerative crops, such as vegetables. In large farms, however, labour constraints inhibit farmers from specialising in non-rice crops, rising per capita incomes and increasing rice production. Mechanization was found to be essential to allow substantial increases in farm size.

According to Yadav (2007), most of the cultural practices associated with sugarcane production in India are undertaken by using traditional tools, equipment and machinery. Mechanization of sugarcane cultivation was evolving as a shift from traditional practices to modern cultivation methods. These include appropriate mechanization of tillage, planting, weeding and inter-row cultivation, plant protection, harvesting, loading, transport and other post-harvest operations. The advantages include enhanced productivity, timeliness of operation, work quality, and utilization of inputs and resources such as seed, fertilizer and chemicals, along with reductions in total cultivation costs and human drudgery. In comparison to traditional practices, there was a cost saving of approximately 30 to 60 per cent under

mechanized farming systems. Mechanized sugarcane cultivation can reduce the cost of wages incurred for the various cultural operations and has economic benefits as well as timeliness and crop husbandry. The author also indicated that sugarcane growers are slowly adopting modern sugarcane machinery for selected operations such as tillage and planting, either on ownership or custom hire basis. According to the author, under Indian conditions, overall productivity of sugarcane could be increased by 10-15 per cent through appropriate mechanization. However, access to the equipments by the growers was a constraint.

Zug and Sebastian (2008) opined that transformation processes in the mode of agricultural production can significantly influence both, the farmers' and the labourers' social welfare. Active promotion of new methods of agricultural production through governments and Non-Governmental Organisations (NGOs) have to be in line with their policies. Through agricultural extension a short-duration paddy variety with early planting dates, and mechanization of the plantation process were being promoted. This resulted in the harvest of paddy one month ahead of the then current practice. This brought about major positive welfare changes for the farmers, especially since earlier plantation of subsequent crops led to higher yields. The expected change in social welfare of the farmers and the labourers was determined independently by applying cost benefit analysis. The results found that since mechanization was labour displacing, the overall employment was expected to decrease, leading to generation of high seasonality of employment opportunities in the region. Harvest will take place in the current agricultural lean season, which corresponds to the period of seasonal food crisis. Hence, harvest was shifted to that period, when labourers were most in need of it. Farmers were expected to be the winners, while the labourers' loss in seasonality cannot be compensated by the benefit from smoothened seasonality.

Manandhar (2008) focused on the challenges of agricultural machinery development in Nepal. In his opinion due to continuous fragmentation of land, the land holding per family across Nepal was found to be less than a hectare. The unavailability of the other employment opportunities, low investment capacity and lack of infrastructure and market opportunities compelled the farmers to undertake subsistence agriculture. Appropriate agriculture mechanisation was essential to achieve timeliness in field operations, increased productivity, and reduced cost of production, and to minimize farm drudgery. It also imparts dignity to farm work and make farming attractive to educated rural youth who otherwise tend to migrate to urban areas in search of job. The entry by Nepal into the World Trade Organization (WTO) has opened an avenue for the Nepalese farming community towards marketing opportunities of agro-based products in the international arena. Mechanised commercial farming has helped the Nepalese to compete in the world market for the sale of agricultural produce. Mechanised commercial farming is technically viable and economically feasible only when it is done for commercial-scale production. Commercial agriculture is possible with the consolidated effort of the cooperative farming community, quality input supply on time, developed infrastructure, supportive government policy, proper technical back up and well-established market link. Mechanisation has helped not only to reduce operational time and women drudgery, but also saved labour and energy. This reduced the cultivation cost creating conducive environment for competitive market price of the produced agricultural commodities. In Nepal, blacksmiths are the primary suppliers of manual and animal drawn implements for the small and marginal farmers of the country. So, blacksmiths could play an important role to help in rural mechanization of agriculture in the country. But small and fragmented land holding is one of the major constraints for the slow pace on adoption of agricultural mechanization in Nepal. Hence it was suggested that research and development of appropriate agricultural machinery, national, bilateral and multilateral collaboration of institutes related to agricultural

mechanization for sharing the experiences and technologies are crucial for the promotion of agricultural mechanisation in Nepal.

FAO (2009) made a study on the status of farm machinery in the Kyrgyz Republic and assessed the impact of agricultural mechanisation on agricultural productivity with special reference to wheat production. The constraints in the adoption of mechanization and the possible options for addressing these constraints were also examined. They chose wheat for the study since it is an important staple food in the country and plays a central role in food security. It was found that inadequate access to credit and small farm size are the main factors that constrain farm mechanization. Agricultural productivity, particularly in terms of grain yields, was low because of underinvestment. When the age of agricultural machinery was taken into account, this underinvestment appeared even more acute. The lack of agricultural machinery affects both the small and large farmers which is a consequence of several factors affecting both the demand for and supply of machinery. Demand is negatively affected by the small farm size, limited access and unsuitable conditions of credit, farmers' risk aversion, production farm inefficiencies, and government interference. As a solution for this FAO strongly recommend that the Government should remove the obstacles to private investment.

A study was conducted by Sharma (2009) entitled 'impact of mechanization on the employment of permanent farm servants in Indian Punjab: a comparison of cotton-wheat and paddy-wheat region'. In Punjab mainly three crops are grown - wheat, paddy and cotton. Two villages were selected at random on the basis of cropping pattern viz., one village in which cotton and wheat cropping pattern is dominant; and the second village, in which the main cropping pattern is paddy and wheat. The data were collected through primary survey. The critical variables of the study included information on farms hiring and not hiring permanent farm servants, cultivated area, extent of mechanisation, cropping pattern and family labour of

cultivators of the surveyed farmers. The collected data were analyzed using Binary Logit Model and Regression Model. It was revealed that the new agricultural technology completely changed the agricultural labour market in Punjab. With the mechanization of farm operations, demand for skilled and trained permanent farm servants, hired for the whole year, increased on Punjab farms. Tractorisation was found to be the most important factor in increasing the employment of permanent farm servants. The use of electric motor operated tube well had the potential of creating employment of permanent farm servants. The author also found a direct relationship between the number of adult male workers of farmer's family and number of permanent farm servants working on the farms in the cotton-wheat region.

Chisango (2010) undertook a research project on agricultural mechanisation for sustainable agriculture and food security in Zimbabwe with the aim of investigating the impact of mechanisation on agricultural productivity. The study focused on farmers in Bindura district of Zimbabwe who benefitted under the ongoing farm mechanization program. The farmers were categorised into adopters of mechanised farming and non adopters of mechanised farming. A multistage sampling technique was used to randomly select 90 farmers from the study area. The Cobb Douglas Approach and Logistic Regression Model were used to analyze data obtained from the respondents. The author observed that a cardinal development goal of the Zimbabwean government was agricultural mechanisation through the acquisition and use of tractors by arable crop farmers in communal and resettlement state land. The study revealed that the use of tractors by the farmers was positively influenced by household size, access to extension services and crop output equivalent. Education and land area cultivated negatively influenced the probability of adoption of mechanized farming. Furthermore, the technical efficiency estimate of adopters and non adopters of mechanized farming showed no difference in their level of technical efficiency in agricultural productivity which was 64 per cent on average. The level of observed inefficiency was increased by slope, stoniness and household size while age

reduced technical inefficiency. The author recommended that government should consolidate the present gains arising from extension services, and environmental factors such as slope (topography) and stoniness, which constituted major disincentives in communal areas, could be overcome if government and farmers can identify and open up new areas of farmland for occupation by farmers.

The objective of the paper by Huffman (2010) was to examine the status of labour-saving mechanization in U.S. fruit and vegetable harvesting. Fruit and vegetable harvest mechanization has several potential advantages such as reduced harvest costs, eliminate problems associated with finding good quality harvest labour, permit longer harvesting days, and reduce exposure of harvest to human bacteria. Commercial mechanical harvesters for tomatoes, cucumbers, pepper, carrot, tart cherries, apples, grapes, peaches, plums and grapes were available with the growers. Lack of availability of labour for harvest or sudden increase in the harvester wage or piece rate could rapidly accelerate adoption of the best mechanical harvesting technologies by growers and processors, in the opinion of the author.

Singh (2010) reported that Indian farmers used bullock-drawn implements and hand tools like watering buckets and bullock carts for their farm needs. Later there was a shift to machines like irrigation pump sets, tractors and engines using petrol, kerosene, and diesel, for post harvest processing like floor making, rice milling, grinding, etc. Manufacturing of tractors started in the year 1961. The Government of India also expanded its rural electrification programme significantly and farmers installed 3 - 10 hp electric motors driven pumps. As the volume of crop harvested increased on irrigated farms using High Yielding Variety (HYV) seeds these farmers started to invest in purchasing threshers, mainly for wheat crop, powered by the same engine or motor used for water pumping. With adoption of HYV seeds the number of tractors doubled and 96 per cent of the tractors were privately owned on farms of over 10 ha in size. India is the largest producer of tractors in the world at annual

production of 500,000 units with export of over 50,000 tractors. The number of electric motor operated pumps increased from four million in 1981 to 20 million in 2010 and is expected to increase to 25 million by the year 2015. The number of diesel operated irrigation pumps has also increased from 3.3 million in 1981 to 6.7 million in 2010 and is expected to reach seven million by 2015. The tractor population is expected to stabilize at around seven million units by 2050 and available farm power will then stabilize at around 4.5 KW/ha. The draft animal population will decrease drastically whereas power tillers, diesel engines and electric motors are expected to register significant increases during the period 2010 to 2050.

According to Uprety (2010) Nepalese agriculture depended on manual labour and animal power. Use of machines was very limited even for land preparation and threshing. As a solution to labour shortages and to reduce the production costs of rice farming, mechanised rice production was introduced. High production costs together with continuing low productivity had made rice farming less profitable and less attractive. Despite rapid population growth and considerable unemployment, in many rural areas labour shortages contributed an additional constraint to expanding agricultural production. To overcome some of the problems confronting rice farmers, and to raise factor productivity and reduce water requirements the System of Rice Intensification (SRI) was introduced. But, even though SRI raised labour productivity, its labour requirements often limited its adoption. In this situation, labour-saving mechanisation was introduced in conjunction with SRI practices. Farmers who introduced mechanization into their rice farming could reduce production costs by 27 per cent and increase their profits per ha by 36 per cent. Those who employed mechanization together with SRI methods achieved 55 per cent higher production per ha and earned 58 per cent more profit. Mechanisation with SRI methods, helped in doubling plant-to-plant spacing, reducing seedling age by half and cut farmers' seed requirements by 50 per cent. Labour requirements decreased by 60 per cent, and the time required for all of the main rice-farming activities by 70 per

cent. Thus, rice farmers in Nepal found mechanisation as a solution for labour shortages.

Rahman *et al.* (2011) analysed the effect of mechanization on labour use and profitability in wheat cultivation. Based on area and production of wheat, three major wheat growing northern districts of Bangladesh namely Thakurgaon, Panchagarh and Dinajpur were purposively selected for the study. The farms to be selected were classified into two groups such as mechanized and traditional farms in order to quantify the effect of farm mechanization. Mechanized farms were those where the farmers generally used agricultural machineries such as power tiller and thresher for farm operations. On the other hand traditional farms were those where farmers did not use any farm machinery. They generally carry out the activities by using animal power and human labour. The study was mainly based on primary data collected from a total of 150 sample taking randomly 25 from each group of each location. For analysing the data, tabular method of analysis, independent sample t-test and multiple regression models were used. It was revealed from the study that agriculture of Bangladesh is characterized by overwhelmingly small holdings due to higher population density with nearly 80 per cent of its population residing in the rural areas. Compared to traditional farms, mechanised farms require only less number of labours per hectare to complete the production process. Family labour is mostly affected by mechanization. Animal power and output have positive effect on labour requirement, while power tiller and input costs have adverse effect on labour requirement for wheat cultivation. The yield of wheat under mechanization is higher than that of traditional farms. Total variable cost is significantly higher for traditional farms. Gross margin is found to be higher for mechanized farm compared to traditional farm. High price of power tiller parts was mentioned as a major problem of mechanization in the study area. The authors concluded that mechanization has adverse effects on family labour and more research need to be conducted to develop

appropriate technology to increase the production of wheat without substituting labour.

Yohanna *et al.* (2011) tried to find solutions to the mechanisation problems of small scale farmers in the middle belt of Nigeria. The small-holder full time farmers in some selected areas in the country were reached by the authors, especially through the assistance of an agricultural extension worker and some agricultural students of the University of Agriculture, Makurdi. Questionnaires were designed and administered to both literate and illiterate farmers to extract information from them. For the illiterate, an assistant was used to interpret and fill the questionnaires. A Mechanisation Tools Level (MTL) was developed to analyse the data. It was observed that food shortage problem is increasing day by day among the developing nations. Many farmers who are having small land holdings do not have enough production; their farm sizes have not increased over the years due to the absence of relevant mechanization machinery. Mechanization is very far from the small scale farmers, who are the major food producers of the region. In the opinion of the authors, no country's agricultural mechanization has ever started from the small scale level and without the leadership of the concerned government. The farmers could do better if simple improved tools, both manually operated and motorized, are made available to them.

Agro Machinery Operation Services Centre (AMOSC) promoted by Kerala Agricultural University (Jaikumaran *et al*., 2012) acts as a service provider in agricultural mechanization. The AMOSCs are working on individual mode, Self Help Group (SHG) mode or co-operative mode. It is generally established at panchayat level. The members of these societies are the persons trained by Agricultural Research Station (ARS), Mannuthy under the Food Security Army Training Programme. There are about 25 AMOSCs already registered in Kerala. Through AMOSCs, the ARS tries to model the agricultural sector as a service sector.

Fazlollahi *et al.* (2012) investigated about agriculture mechanization with the objective of evaluating the quantitative agricultural mechanization and environmental challenges in Marand Township, Iran. Through a field survey the authors studied the power resources, agricultural products, climatic conditions, cropped area and environmental capacity of the township. A three tier mechanization index was employed for the purpose of analysis. It was found that use of suitable tractor and agriculture instruments is one of the essential requirements in agriculture sector. Environmental issues such as pollution and soil erosion are the important problems in agricultural development and mechanization of the region.

The objective of the study by Konduru (2012) was to assess the competitiveness of Indian cotton producers and potential implications for India as a competitor in the world cotton market. Data were collected from two cotton producing states of India namely Gujarat and Maharashtra. Rapid Rural Appraisal (RRA) methodology was adopted to collect information, wherein a multidisciplinary team conducted focus group discussions in various villages to get information and develop hypotheses. From both States, information was collected from focus groups of different villages and the information were aggregated. There were a total of six focus group discussions conducted, consisting of three each from Gujarat and Maharashtra. Stochastic simulation models were used to analyze the collected data. The author observed that technological advances and trade liberalization have made India a major player in international cotton markets. The net income of the cotton farmers would increase considerably with the mechanization of cotton harvesting. But, the adoption of mechanical cotton harvesting practice is possible only if efforts from many private and public agencies come together. In such a scenario, cotton production in India would increase considerably which would impact the international markets.

Khobragade (2012) opined that in the context of increased commercialisation of agriculture, mechanisation is very important. There is an increase in the use of farm machinery in Indian agriculture as it is contributing to increase in output due to timeliness of operations and increasing precision in input application. The study exposed the availability of machinery in India, for the mechanization of cotton cultivation for operations like seedbed preparation, sowing and planting, inter-culture, plant protection and harvesting. Energy requirement for different operations for cotton cultivation in conventional and using improved practices were found out. Evaluation was carried out using traditional method of cultivation in comparison with improved practices on cost of operation and energy requirement. It was revealed that improved machines consume less energy as compared to its traditional counterpart.

Musa *et al.* (2012) studied the effect of mechanisation on arable crops in Edu and Patigi local government areas of Kwara State where the majority of the farmers are beginning to adopt the use of modern technology in their agricultural activities. The Investigative Research Approach Method was employed to retrieve information from farmers through the use of structured questionnaire. The farmers were randomly selected and a total of one hundred farmers were interviewed in the two local government areas. Percentage analysis, arithmetic mean and frequency distribution were employed to present the results of the study. It was observed that majority of the farmers are small farm holders with most of their land fragmented and major part of their labour coming from manual source. With the introduction of mechanisation, there is a positive impact on farm productivity and income, where farmers accept the use of tractor in their farming activities. It was found that the capital of the farmer should be improved, in order to acquire or to hire tractors, so as to satisfy the demand of production. There is a need for the government and other organizations to provide a forum for education to the rural farmers on how to adopt and accept modern technology in agriculture. Application of modern agricultural technology enables the cultivation of more lands and ensures timeliness in operation and better tillage. It was

also found that modern technology in agriculture in the study area has high potentials in increasing farm productivity. Mechanisation has also an effect on the roles and task patterns of men and women on the farm. Hence the authors suggested that gender issues have to be taken into account when discussing mechanization and formulating policies.

Okorobia (2012) argued that agricultural mechanization was not attractive to the pre-colonial Africans due to ecological and economic reasons. Using Tanzania, Nigeria, Algeria and South Africa as examples, he assessed the impact of agricultural mechanization on Africans and found that it has been a mixed blessing. While in some cases, it increased productivity by bringing larger areas under cultivation, it had equally led to the alienation of the peasantry in most parts of the continent. Again, while mechanization reduced some of the grueling tasks on the farm, it also contributed to the deterioration of the quality of the soil and accelerated soil erosion. Similarly, while mechanization increased the profit of the capitalist farmers, it denied the poor peasants of their economic independence and sentenced many peasant societies to hunger. He proposed that if mechanized agriculture was to have the desired positive impact on the African peasantry, the planners and executors should organize it along people-oriented lines, so that the need to satisfy human needs rather than the mere quest for profit will be the dominant goal.

One World Foundation India (2012) explained about the Yantradoot Village Scheme of farm mechanisation initiatives in Madhya Pradesh which seeks to increase agricultural productivity through dissemination of information and know-how on improved agricultural technologies among farmers in the State. Under this Scheme the District level agricultural officers in Madhya Pradesh periodically demonstrate the use of farm implements to farmers in 25 villages spread across 25 districts in the State and make these implements available on hire by the farmers at nominal prices. As a result, farmers in these villages are using modern farm tools for each stage in the

production of their crops. Such mechanization is not only reducing the drudgery faced by farmers under traditional manual practices but also quickening agricultural processes, saving time, reducing costs and enhancing productivity. With Yantradoot, each of these 25 villages is being turned into complete models for agricultural mechanization. Such increased mechanization has resulted in a 40 per cent increase in the agricultural productivity of farmers since their crops are being sown, irrigated, treated and harvested adequately and on time. Farmers' income has also increased almost two-fold during a period of two years since the Scheme has become operational. As a result of these outcomes, many nearby villages are being inspired to switch over to the Yantradoot model of farm mechanization. By implementing the Yantradoot Scheme, the Government of Madhya Pradesh is creating access to advanced agricultural technologies and machinery among farmers in the rural areas, increasing the overall agricultural productivity of the State and empowering its farming community. Inspired by the success of the Scheme, the Government of India has proposed to launch a National Mission on Agricultural Mechanization.

Sidhu and Vatta (2012) evaluated the contribution of co-operative Agro Machinery Service Centres (AMSC) towards improving the economic viability of farming in Punjab. It was found that the operations of the AMSCs were economically viable as the service centres have been generating profits to the extent of 2-30 per cent of the annualised costs. The hiring-in of the machinery services from the machinery centres has been found comparatively cheaper by 16 per cent and 35 per cent when compared to the hiring-in from private operators and self-owning of machinery, respectively. The successful AMSCs have brought a significant reduction in the burden of capital investments of the farmers on farm machinery and implements. The study highlighted the need to strengthen the existing AMSCs, establish new AMSCs and increase government support in the form of subsidies to address the issues of timely non-availability of services during the peak season and to reduce price differentials between AMSCs and private operators. According to the

authors, the success of the AMSCs in the State would help in reducing the debt burden of the farmers by bringing down the costs of operations and improving economic viability of farming.

Tewari *et al.* (2012) analysed the effect of farm mechanisation in West Bengal among the farmers belonging to the poor farm mechanised region. The State is being divided into four agro-climatic zones. The availability of human resources and cultivable areas of different productivity groups of paddy and potato cropping systems in villages of each of the agro climatic zones were considered for the study. Ordinary graphs and percentages were used for analysis. The results indicated that a suitable cropping pattern of crops like paddy and potato helped to increase the productivity of the crop yield in the State. The nationalised banks came as a stimulant for adoption of farm mechanisation and establishment of Agro Service Centre (ASC) through their provision of liberal credit loans. Government, as a donor organisation increased funding for agricultural research. It was observed that the average cropping intensity is 182 per cent in 18 agricultural districts of West Bengal, which is 33.8 per cent higher than the country average. Farm mechanisation enhanced the production and productivity of different crops due to timeliness of operations, better quality of operations and precision in the application of the inputs.

Thorat and Kulkarni (2012) assessed the impact of farm mechanisation for drudgery reduction related to potato crop and growth of women. The authors attempted to introduce proper mechanisation practices in order to reduce the drudgery of women and increase the productivity of potato crop in Randullabad Watershed of Satara District of Maharashtra. The authors reported that women played an important role in agriculture and rural economics. Due to sufficient availability of water for irrigation, crop diversification and intensification practices have been adopted in the watershed. The women made a crop calendar and crop - wise calendar activities are discussed in the focus group. Women in the village of Randullabad spend maximum

time on potato cultivation. Tractor mounted potato planter and harvester are the major agriculture implements used which are introduced to save the time of cultivation. The implements are purchased under the apex body of SHGs called "Sanyukta Mahila Samitee". The authors also found that drudgery has been reduced by 84 days of physical work instead of the earlier 120 days. Time saved due to mechanisation is being utilised for other activities like maintaining health, recreational activities, SHG meetings, income generation and for overall well-being of the family.

Akande *et al*. (2013) investigated the level of mechanization in the production and processing of oil palm in Oyo and Osun States so as to determine the research needs towards the development of appropriate machines. Questionnaires were administered and on-the-field assessments were made to obtain the necessary information. The data collected from eight selected local government areas where oil palm production was high were analyzed with descriptive statistical tools. The study revealed that pre-planting, planting and post planting operations involving crop protection, weeding and fertilizer application employ low level of mechanization. Harvesting is carried out completely by manual operations and threshing of fruits is semi- mechanized. Palm oil extraction processes has approximately 30 per cent of mechanization while kernel cracking and palm kernel oil extraction has 50 per cent level of mechanisation. The study concluded that the level of oil palm mechanization in Oyo and Osun States is very low especially in the pre-planting, planting and harvesting operations and agricultural engineers should be encouraged and rise up to the challenges of providing the required machinery. The productivity of oil palm could be enhanced using mechanical means for the removal of drudgery from the entire production processes.

Ayoade and Adetunbi (2013) conducted a study on impact of mechanized farming on agricultural production in Afijio Local Government Area of Oyo State, Nigeria. The broad objectives of the study were to identify the socio-economic

characteristics of the farmers, and to determine the level of awareness of technologies, extent of use of mechanised farming and the production level of farmers. The farmers were categorised into two groups - mechanised farmers and non - mechanised farmers. Data were collected from 120 farmers selected through stratified sampling technique, 60 from each category, belonging to ten wards of Oyo State. The collected data were analysed using frequency count, percentages, mean values, Pearson Product Moment Correlation and ANOVA. As far as the socio – economic characteristics are concerned, it was found that the mean age of the sampled mechanised farmers is 47.57 and majority of the mechanised and non – mechanised farmers are male. The farmers are using tractors very often than other farm implements. The major crops cultivated by the farmers are cassava and maize. The authors also observed a significant relationship between monthly income, cultivated farm size and level of production of the mechanised farmers. Also a significant difference was found between cassava productions of mechanised and non – mechanised farmers. High cost of repair was recorded as the most serious constraint faced by farmers. The authors also recommended that government should help in subsidising the cost of repair for the mechanised farmers so as to further boost cassava production.

A paper presented by Houssou *et al.* (2013) at International Food Policy Research Institute discussed about providing of subsidised agricultural machines to private enterprises established as Agricultural Mechanisation Services Enterprise Centres (AMSEC), since 2007, by the Government of Ghana to scale up tractor-hire services to smallholder farmers. The farmers demanded tractors for land preparation and plowing services. Using the firm investment model and available data, the paper quantitatively assessed whether AMSEC as a private enterprise is a viable business model attractive to private investors. Even though the intention of the Government is to promote private sector - led mechanisation, the study revealed that the AMSEC model is unlikely to be a profitable business model attractive to private investors even

with the current level of subsidy. The low tractor utilisation rate as a result of low operational scale is the most important constraint to the profitability of tractor-hire services. The tractor rental service market is advocated as a proper way of mechanising agriculture in a smallholder-dominated agricultural economy like Ghana. The paper concluded that the development of such a market depends crucially on a number of factors, including increased tractor use through migration across the two very different rainfall zones - north and south - increased tractor use through multiple tasks, and use of low-cost tractors. According to the authors, the Government of Ghana can play an important role in facilitating the development of a tractor service market; however, the successful development of such a market depends on the incentive and innovation of the private sector, including farmers who want to own tractors as part of their business portfolio, traders who know how to bring in affordable tractors and expand the market, and manufacturers in exporting countries who want to seek a long-term potential market opportunity in Ghana and in other west African countries.

Lairenjam (2013) viewed mechanisation as the substitution of human labour activities with machines or tools/implements to enhance the efficiency and timeliness of working. Farm mechanisation has become an integral and major component of modern agriculture. The main objective of mechanisation is to increase production by timely operations and effective work. Sometimes due to lack of labour, a particular operation cannot be done at the stipulated time, which in turn affects the growth, ultimately leading to decline in production. The use of machines and implements saves labour, reduces the time of operation and increases the area under cultivation. The introduction of machines has not only made agriculture more acceptable but also provided opportunities for the use of higher intelligence, skill and initiative. Success of mechanisation depends on the degree of seriousness attached to the demonstration, training and after - sale services by different agencies, and Government policies.

Lamidi and Akande (2013) studied the status, challenges and prospects of agricultural mechanisation in Osun State of Nigeria. The study was based on both primary and secondary data from nine Local Government Areas (LGAs) in Osun State. Personal observation, oral interview, past records and questionnaire were used to collect data from various establishments. Data were analysed using percentages. The study identified shortage of capital, land tenure, small farm holding and fragmented land, poor infrastructural facilities, poor attitudes toward adoption of new innovation and non- availability of storage means as problems faced by farmers. The authors also found that, the low rate of adoption and utilisation of appropriate mechanisation technologies has remained one of the major factors against agricultural production in Nigeria. Majority of the non-settlers/local farmers' believe that use of farm inputs has negative side-effect on crops and soil. Only 52 per cent of the respondents have mechanised their agricultural production and that too partially. The authors recommended that farmers should be encouraged to come together and form farming cooperatives so as to attract incentives for farming and to be able to provide the needed financial aids and farm inputs when and where necessary.

Nagaraj et *al*. (2013) analysed the extent of adoption of farm mechanization practices by paddy growers in Sindhanur and Manvi Taluks of Raichur District with a sample size of 120 paddy growers in Tungabhadra project area. Percentages and frequencies were used to analyse the data collected from the farmers. The authors observed that, majority of the respondents belonged to medium level of knowledge regarding farm mechanization practices in paddy cultivation giving vast scope for the developmental departments to intervene and improve the knowledge level of farmers about farm mechanization practices. Even though paddy is cultivated by all the farmers in the study area, their scientific knowledge about the farm mechanization in paddy crop and scientific adoption of the farm implements is not satisfactory in the case of certain implements. According to the authors, one of the best ways to overcome this is to vigorously utilize the scientific expertise of Krishi Vigyan

Kendras for organizing Field and Farmers' Day and agriculture machine exhibitions which will help and encourage farmers to know about the advantages of mechanization.

Sarkar *et al.* (2013) studied the effect of farm mechanisation on agricultural growth and the comparative economics of labour and machinery in West Bengal. The specific objectives of the study were to assess the impact of mechanisation on agricultural growth, pattern of mechanisation at the crop level and the effect on production and productivity, and to assess the comparative economics of labour and machinery in West Bengal. Based on the density of tractors, one district from the highest density and the other from the lowest density was selected randomly for collecting primary data. At the next stage, one block in each district was selected. Fifty farmers were selected based on probability proportional to size from each of these districts. Thus a total 100 farmers were selected to form the ultimate sample size of the study. The selected farmers were sub-divided into three categories based on size of holdings i.e. marginal, small and medium. Tabular analyses along with econometric analyses were adopted to analyse the various objectives of the study. The authors found that except for potato, costs of machinery have grown much faster than costs of bullock labour, human labour as well as value of production. This acted as a major constraint in the spread of mechanisation of farming in the cultivation of crops like paddy, wheat and mustard. Ownership of expensive machines like shallow tube wells, tractors, etc. was fairly limited in numbers owing to involvement of higher capital cost, but they were extensively used on hiring basis to perform various farming operations in the study region. The authors recommended that the government should form users' cooperatives and link them to Self Help Groups and Micro Finance Schemes to overcome the problem of finance and investible capital to purchase expensive farm equipments and also ensure effective maintenance of expensive equipments and promote mechanisation among farming community. The

subsidies should be granted not to individual farmers, but to cluster of farms for better mechanisation services.

Tawanda and Fortune (2013) measured the levels of agricultural mechanisation with respect to degree, level and capacity index of agricultural mechanisation of some farms in two wards of Bindura North District of Zimbabwe. Interviews, observations and a structured questionnaire were used to collect the data from respondents. The data were analysed with the help of mechanisation index and Gross Margin Analysis. The productivity of each of the surveyed farms was analysed separately. The study revealed that low production efficiency, drudgery, under utilisation of mechanical power, and uses of old tractors with their constant breakdown during operation, contributed to the low level of mechanisation. The result of Gross Margin Analysis on productivity indicated that purchased inputs such as seeds and fertilizer strongly influence gross income in the farming systems of farmers.

Bagheri and Bordbar (2014) made a descriptive survey research and assessed the challenges facing development of agricultural mechanization in Iran. The research population included agricultural mechanization experts, managers and specialists in private and governmental sectors. Using proportional stratified sampling, a sample of 119 was constituted out of a total population of 809 based on the Cochran formula. Data were collected using questionnaire for which the statements were made after literature review of research and interviews with mechanization specialists. The questionnaire was validated by a panel of experts and its reliability index was established by Cronbach's Coefficient. A pilot study was conducted with 30 questionnaires, not included in the sample population, to determine the reliability of the questionnaire. A five-point Likert Scale was used to measure the perception of respondents. All survey data were analyzed using the Statistical Package for Social Sciences (SPSS 16.0). Results revealed that the most important challenges facing development of agricultural mechanization in Iran include, inefficiency of subside

payment methods for buying agricultural machinery, large number of time-worn agricultural machinery, incomplete collection of agricultural equipments for power generator machinery, namely, tractor, slow trend of beneficiaries in accepting new technologies, financial weakness of agricultural beneficiaries, inefficiency of agricultural extension and education methods, and weakness of agricultural machinery producers and operators in protecting their guild benefits.

The rice portal of Tamil Nadu Agricultural University (2014) reported that it is expecting massive support for mechanization of agriculture in the State both from the Central and the State governments because of the acute scarcity of agricultural labour in the State, due to the implementation of the Mahatma Gandhi National Rural Employment Guarantee Scheme that ensures 150 days of employment in a year. The State has adequate machinery for two major crops - paddy and sugarcane. For popularising mechanization, the University has suggested that uneducated youth and engineers may be given loan from the National Bank of Agriculture and Rural Development (NABARD) with subsidy for purchase of tractors, transplanters, weeders, etc., which they can give for lease to the farmers. For mechanizing farming operations, farmers need uniform maturity of crops; then only the State can achieve better production and productivity in their farm operations.

Scarcity of labour, high cultivation cost and time consuming farm operations are some of the major factors that demotivate the farmers to undertake agriculture. In such a scenario, mechanisation of agriculture is assuming more and more importance. As per the review, the main crops in which mechanisation are adopted are paddy, wheat, cotton, vegetables and oil seeds. In Kerala mechanisation is widely adopted in paddy whereas in India it is in wheat cultivation. Land preparation, planting, some intercultural operations and harvesting are the major mechanised areas of different crops.

Many authors have studied the impact of mechanisation of agriculture on different aspects such as income level, cost of cultivation, production, productivity and employment generation. Some of them have come with the conclusion that agricultural mechanization has played a major role in increasing agricultural production and productivity, reducing cost of cultivation and creating employment opportunities. But the mechanised area under cultivation is less compared with that of non mechanised area. Some researchers have suggested that governments, banks and other financial institutions should concentrate on providing loans to farmers with subsidy for mechanising their farms. Some of the authors have also observed that even though mechanisation is adopted by farmers in their field, many of them are not fully aware about its advantages and uses. Hence, researchers, agriculture scientists and experts should provide necessary awareness to the farmers in this respect.

2.2 Determinants of farm mechanisation

Adoption of a technology by people is always based on certain criteria which may be generated from their own experience or from the opinion of others. This part of literature review deals with studies conducted in India and abroad, with respect to the factors or determinants of farm mechanisation.

Dibertin *et al*. (1982) in their study on 'Determination of farm mechanization in Kentucky: An econometric analysis', measured the relative importance of some social, economical and physical determinants of farm mechanization in Kentucky where agriculture is the main occupation of the people. The data were collected from the farmers of Kentucky. A derived demand function for mechanization was used to formulate the estimation equation. The equation was estimated using country level cross sectional data from Kentucky. The economic model was based on the neo classical theory of the firm and the usual assumptions of perfect competition and profit maximization. Factors such as labour, farm size, education level of farmers,

topography and age of the farmers were included in the analysis. The study found that during the period of study United States was having the most mechanised agriculture in the world. Approximately one third of world's tractors were found in United States. With regard to the factors, it was revealed that farm size, labour availability, age and education of farmers acted as the major determinants of mechanisation adopted by the farmers of Kentucky.

Agwara and Hezekiah (2005) tried to identify the determinants of choice and profitability of farm mechanization in Kenya. The study concentrated on the tillage choice behaviour among seventy-seven farmers from Bungoma District of Kenya. The authors also investigated the profitability of using the tillage methods in maize production. Using 2001 production data, the study fitted a discrete choice model to analyze factors influencing farmers' tillage choices in maize production. It applied estimation of a multinomial logic model for the effects of a set of technology attributes and their interactions with farmers' socio - economic and demographic characteristics on the tillage choice probabilities. The study used Gross Margins from maize production to analyze profitability. The results of empirical estimation of the model showed that farmers considered cost and time as the most important tillage attributes in their choices. i.e., high cost and longer tillage time significantly reduced tillage choice probabilities. The choice of both tractors and manual tillage was more sensitive to cost increments than animal traction. Among the farmer-specific characteristics, larger households, lower off-farm incomes, and high orientation to market, make tillage time an important choice attribute. Farmers with high marginal propensities to consume are more concerned with tillage cost. However, group membership and high off-farm incomes make cost less important in the choice of tillage methods. The main conclusion of the study was that farmers' perceptions of observable tillage attributes influence their tillage choices. The unit costs and time of tillage exert greater influence on choices but their importance change depending on farmers' socio -economic and demographic characteristics. Thus, improving tillage

attributes and proper targeting of farmers was important in the formulation of mechanization strategies.

In a case study on determinants of farm mechanization among arable crop farmers in Ibarapa Zone, Oyo State, Nigeria, Adewuy *et al.* (2006) assessed the determinants of machinery use, and the differential farm productivity of users and non-users of farm machinery in the Zone. The farmers were divided into two groups i.e. users and non-users of farm machinery. One hundred and twenty five arable crop farmers were interviewed using two stage stratified simple random sampling technique while information from sixty users and forty non-users of farm machinery was used for analysis. Data collected were analyzed using descriptive statistics, logit regression analysis, budgetary analysis and test of difference of mean. The study revealed that, among the non-users of farm machinery majority of the farmers using machinery are youngsters and educated. They have larger cultivated area of farmland and have more exposure to extension agents. The logit regression results revealed that farm size, farm income and farming experience significantly affected the use of farm machinery in the study area. The test of hypotheses revealed that users of mechanisation significantly made more profit than non-users. The authors recommended that farmers should be encouraged to cultivate large farm holdings through collective or cooperative effort and they be more enlightened to use farm machinery as an avenue for improved farm productivity and profitability.

Wanjiku *et al*. (2007) analyzed the factors influencing the choice of mechanization technologies in Nyanza Province, Kenya using multinomial logit analysis. The results showed that although farmers are aware of the attributes of mechanization technologies, animal traction is still most commonly used. Gender, formal and informal training of the household head and technology attributes influence the choice of mechanization technology. The study recommended for increased formal and informal training, extension activities, credit, tractor hire

services to facilitate tractor availability and enactment of laws that increase women's access to and control of productive resources.

Ranjitha *et al.* (2009) conducted a study on the significance of agricultural commercialization for rural development, and analyzed the factors determining agricultural commercialization and mechanization in the hinterland of an urban centre in Morang district, Nepal. The data needed for the study was collected through a questionnaire survey, covering 120 farm households, group discussion and key informant interviews. Regression analysis was applied for the purpose of analysis. The study revealed that determinants of agricultural commercialization had four significant variables, namely, the amount of inorganic fertilizer used, area under tractor ploughing, area under pump-set irrigation and landholding size. The regression model related to the area under pump-set irrigation predicted the degree of agricultural commercialization and the distance from the city as significantly influencing factors. The analysis of determinants of the area under tractor-ploughing found only the degree of commercialization as a significantly influencing factor. In both instances of farm mechanization, the degree of commercialization was the most influential factor, indicating the significant role of mechanization in agricultural commercialization.

Rasouli *et al.* (2009) conducted a study with the objectives of determining the major factors affecting the implementation of National Agricultural Mechanization Programme in Iran and assessing the agricultural mechanization level practised by farmers. The study consisted of two phases. In the first phase, Delphi Technique was used to gather experts' points of view on opinions regarding variables affecting implementation of agricultural mechanization programmes in Iran. The second phase was designed to assess the agricultural mechanization level practised by farmers cultivating sunflower seeds. The investigation by means of Delphi Technique showed that the main constraints for farm mechanization are small farm size and

fragmentation of holdings. Multivariate linear regression indicated that 46.9 per cent of the variance in the level of agricultural mechanization practiced could be explained by variables such as income, total farming land, and land holdings under sunflower seed cultivation.

Amadi *et. al* (2010) examined the factors that influence the adoption of mechanized farm technology and farm size increase among rural farmers in Adamawa State of Nigeria. Data on method of farmland preparations, farm size and the infrastructure provided by the Adamawa State Agricultural Development Program (ADP) were collected from rural farmers and ADP management using questionnaires and focus group discussion on availability of tractors, cost of tractors hiring and the need to increase farm size between 2006 and 2009. The data generated were analysed with the help of t-test and regression analysis. The t- test was used to find whether there is significant difference in farm size ownership and use of mechanized farm technology between the periods under review. Regression Analysis was used to identify the conditions that favour mechanized agricultural practices of the region. Descriptive statistics such as tabular presentation and percentages were also employed for the purpose of analysis. The authors observed that agricultural extension services in Nigeria have been making concerted efforts to make farmers adopt improved technology in their farm operations. The results of statistical analysis showed that there is a significant difference in total farm size ownership and use of tractors for land preparation among farmers, between 2006 and 2009. The regression analysis for farm size showed that farm size was negatively related to road construction and maintenance, wash bores and extension agents, and positively related to culvert, tube wells, water pumps and loan. The implication is that increase in irrigation facilities and loan, lead to increases in farm size of rural farmers, which in turn motivates farmers to adopt mechanized farm technology. Regression analysis for farm technology showed that tube wells, loan and extension were positively related to farm technology use. Non adoption of mechanized farm technology might

not be attributed to farmers' unwillingness, but due to relative high cost of hiring tractors. The study strongly recommended that sustained efforts should be made to provide and improve irrigation facilities for rural farmers, and make credit facilities easily accessible to farmers in Nigeria. These not only encourage farmers to adopt mechanized farm technology but also motivate them to take up dry season farming resulting in increased food production for the growing population.

Chi (2010) attempted to study the factors affecting mechanization in rice harvesting and drying in the Mekong Delta of South Vietnam. The study covered both primary and secondary data. Secondary data was collected from Departments of Agriculture and Rural Development of 13 provinces of the Mekong Delta. A survey of 2000 farmers consisting of 250 per village, randomly selected from eight villages comprising of two rain fed areas and six irrigated area was done. Participatory Rural Appraisal (PRA) was used to know the information related to mechanization in rice harvesting and drying in the Mekong Delta. The staff from extension centres and knowledgeable farmers in 13 provinces participated in the PRA. Data were summarized in the forms of mean, frequency and percentages. Probit analysis was used to determine the factors affecting farmers' use of machinery in harvesting and drying at household level. It was found that the use of rice harvester and dryer in the Mekong Delta is low and the number of the machines and their performance do not meet farmers' demand. The important factors determining farmer's usage of rice harvester and dryer include farmer education, perception on machinery, and capital. The farmers with younger age, larger land, attending training, knowledge of extension staff, methods of organization and extension, number of extension personnel and information system, infrastructure, market price and advertisement are the major factors affecting farmers' use of machinery. Training and knowledge are the two important factors which are significantly and positively affecting the use of harvester and dryer by farmers. Intermediate agent is important in providing information regarding farm mechanisation.

Based on a primary field survey in the Burdwan District of the State of West Bengal in India, Ghosh (2010) tried to identify and analyze the effects of factors such as irrigation, access to institutional credit, government extension support services and experience of the farmers on the level of farm mechanization using logit model of analysis. It was found that mechanization of agriculture is an important factor promoting higher output in agricultural farm and thereby increasing the profitability of the farming practices. The study also revealed that mechanization of farm was determined by a set of inter-related factors such as size of farm, irrigation, access to institutional credit, government extension support services and experience of farmers. The author found that younger generation was more apt for farm mechanization than the old block, i.e., age-old customs act as a hindrance to mechanize the farming practices.

The objectives of a research by Ayandiji and Olofinsao (2014) were to identify the socio economic characteristics, constraints in the adoption of farm mechanization and factors affecting the adoption of farm mechanization by cassava farmers in Ondo State of Nigeria. The data was drawn from a sample of 93 farmers in the study area using a multi stage sampling technique and a structured questionnaire was prepared to identify the socio - economic characteristics of the farmers i.e. age, gender, marital status, educational level, farm size and type of crops grown in the study area. Tables, percentages, frequencies, logistic regression analysis and paired t-test were used to analyse the data. Results of the study revealed that access to extension workers had a positive relation with adoption of mechanisation by the farmers. The lack of accessibility to spare parts, absence of skilled manpower, problem of maintenance of farm machines and non -availability of machines in time acted as the major constraints faced by the farmers in the study area. It was recommended that attention should be devoted for increasing the level of access to extension agents for increasing farmers' awareness about benefits of mechanization. Also there should be proper access to credit by farmers to increase the adoption attitude to mechanization.

The major determinants of agricultural mechanisation identified by different authors include size of farm, age of farmers, education level, labour availability, farm income, farming experience, types of crops grown, irrigation facilities, productivity, cost of cultivation, and availability of institutional credit. Some authors have identified the constraints faced by the farmers in the adoption of mechanisation in their farming operations. Lack of access to extension agents and credit from financial institutions is the major constraints faced by the farmers. Provision of formal and informal training especially to the household head, proper access to institutional credit, and creating awareness about the benefits of farm mechanisation can encourage mechanisation among farmers.

MATERIALS AND METHODS

CHAPTER 3

MATERIALS AND METHODS

Agricultural mechanisation implies the use of various power sources and improved farm tools and equipment, with a view to reduce the drudgery of the human beings and draught animals, enhance the cropping intensity, precision and timelines of efficiency of utilization of various crop inputs and reduce the losses at different stages of crop production (Verma, 2002). The scarcity in the availability of labour for agricultural operations and their increased wage rate leads to the adoption of mechanisation in the field. Through mechanisation labour requirement in the farm can be reduced. Farmers mainly use mechanisation for the purpose of land preparation, transplanting and harvesting, which are considered as the three major labour oriented operations in traditional agriculture. Different researchers' have concluded that farm mechanization enhances the production and productivity of different crops due to timeliness of operations, better quality of operations and precision in the application of the inputs. According to National Council of Applied Economic Research (NCAER) (1980) survey covering 815 farming households in 85 villages, the increase was 72 per cent in the case of sorghum, and seven per cent in the case of cotton as compared to traditional bullock farms. Information Technology Enabled Services (ITES), Madras (1975) found that the productivity increase on tractor owning and hiring farms ranged between 4.1 and 54.8 per cent. The percentage increase was comparatively low on custom hiring farms as compared to tractor owning farms due to higher level of inputs and better control on timeliness of operations. As productivity increased, these were attributed to higher doses of fertilizer, irrigation and mechanisation

The study entitled “Impact of Agro Machinery Service Centres on mechanisation of paddy cultivation in Kerala” was conducted with the main objectives of assessing the extent of farm mechanisation among farmers; to identify the determinants of paddy mechanisation through Agro Machinery Service Centres (AMSCs); to study the impact of AMSCs on mechanisation paddy cultivation and to examine the role of institutional credit in the mechanisation of paddy farms. This chapter deals with the methodology and data sources adopted in conducting this study, which are presented as follows:

3.1 Concepts used in the study

3.2 Selection of locale and sample of the study

3.3 Selection of the sample

3.4 Critical variables for the study

3.5 Statistical tools used for the study

3.1 Concepts used in the study

The major concepts used in the study are given below:

3.1.1 Farm mechanisation

Farm mechanisation refers to the development and use of machines that can take the place of human and animal power in agricultural processes.

3.1.2 Agro Machinery Service Centres (AMSCs)

AMSCs are service centres where all agro machinery operation services with respect to crop production are rendered on contract basis. The service shall be either for operator or machine rental or altogether for operational services as such. AMSC is generally located at panchayat level. It is a registered society under Charitable Societies Act, 1955”.

3.1.3 Users of AMSCs

The paddy farmers who are using the mechanisation services of AMSCs are termed as users of AMSCs.

3.1.4 Non users of AMSCs

The paddy farmers who are not using any of the services of AMSCs but may be adopting mechanisation in their fields through private agencies are termed as non-users of AMSCs.

3.1.5 Tenant farmers

Those farmers, who do not own paddy land of their own, but undertakes agricultural operations on land owned by others taken on lease, and pays rent either in cash or in share of produce, are classified as tenant farmers.

3.1.6 Marginal farmer

Farmers having paddy land holdings of less than one hectare are termed as marginal farmers.

3.1.7 Small farmers

Those farmers having paddy land holding of one hectare to two hectares are categorised as small farmers.

3.1.8 Large farmers

Farmers, who hold paddy land of more than two hectares, are classified as large farmers.

3.2 Selection of locale and sample of the study

The impact of Agro Machinery Service Centres (AMSCs) on mechanisation of paddy cultivation in Kerala is examined by taking the paddy farmers of Thrissur District as the sample. A multi stage sampling design has been adopted for conducting the study. In the first stage, three taluks with the highest number of AMSCs, viz, Wadakkanchery, Mukundapuram and Thrissur were selected from the five taluks under Thrissur district. The AMSCs in Kerala are working in different modes, viz, individual, Self Help Group (SHG), co-operative or group mode. Out of the 27 registered AMSCs in Kerala (Agro-Informatics and Precision Agriculture, 2012) three successful AMSCs based on the criteria of serving the mechanisation needs of the highest number of farmers, and representing three different modes of functioning were selected for the study. These include Green Army – a co-operative model of AMSC promoted by the Peringandoor Service Co-operative Bank and functioning at the block level with entire Wadakkanchery Block as its area of operation, Sivasakthi – an individual model of AMSC, promoted by a female leader with its office in Tholur Panchayat, but area of operation covering the entire Thrissur District, representing Thrissur taluk, and Parijatham a SHG model formed at the Panchayat level, with its area of operation mainly confined to Alagappanagar Panchayat of Mukundapuram taluk. But some of these AMSCs also undertake mechanisation operations outside Thrissur District.

In the second stage, from each of the three taluks, six panchayats which are using the services of the selected AMSCs were purposively selected, thus constituting 18 panchayats. In the third stage, five farmers each from the selected 18 panchayats who are obtaining the services of the concerned AMSC of the Panchayat were identified to constitute 90 sample respondents. The farmers in each panchayat were divided into two categories, viz. farmers who do agricultural operations on individual basis and on group basis/ Padasekhara Samithies. The samples were designed in such a way that from each taluk, there are 15 farmers who do agricultural operations on individual basis and 15 farmers who do agricultural operations on group basis / Padasekhara Samithies. Other than the six panchayats, one panchayat each from the

selected taluks, which are not using the services AMSCs and 15 farmers each from these three panchayats, were randomly selected as a control group for comparison. Thus the total sample size is 135 farmers, comprising of 90 users and 45 non – users, covering 21 panchayats, i.e., 18 for users and three for non – users of AMSCs.

3.3 Sources of data

The study is based on primary data. For the purpose of the first three objectives viz., extent of farm mechanisation among farmers, determinants of paddy mechanisation through AMSCs and impact of AMSCs on mechanisation of paddy cultivation primary data were used. The data regarding socio economic indicators, cropping pattern of farmers, extent of mechanised area of farmers, ownership and usage of farm implements by farmers, details of cost of cultivation, production, income from paddy etc. were collected from a total of 135 farmers i.e., farmers who are using the services of AMSCs (90 farmers) and farmers who are the non-users of AMSCs (45 farmers) through a pre-tested structured interview schedule. The last objective, role of institutional credit for paddy farm mechanisation was collected from the websites of various commercial banks and panchayats. The secondary data regarding area, production and yield of paddy from the period 2001-02 to 2012-13 was collected from the website of Directorate of Economics and Statistics. Data on usage of farm machinery by operational holdings (www.inputsurvey.dacnet.nic.in), gross cropped area, net cropped area, cropping intensity in Kerala and paddy area under the districts of Kerala (www.ecostat.kerala.gov.in) were also collected for the purpose of study.

3.4 Critical variables for the study

Critical variables for the study include socio economic details of individual and Padasekhara samities, paddy farm size, cropping pattern, mechanised land holding, ownership and usage of farm implements, details of cost of cultivation, production and evaluation of AMSCs, role of credit in farm mechanisation etc.

The Interview Schedule has included all these variables for the purpose of data collection and the Schedule was pre-tested among farmers before actual data collection.

3.5 Statistical tools used for the study

The data collected were analysed with the help of simple percentages, Compound Annual Growth Rate (CAGR), one way ANOVA test, independent sample t- test, Fisher's exact test and indices.

3.5.1 Compound Annual Growth Rate

The Compound Annual Growth Rate is a useful measure of growth over multiple time periods. It is the mean annual growth rate of an investment over a specified period of time longer than one year. It is useful in measuring the change in parameters which follow non-linear pattern and helps in comparing investment across the spectrum. In the study CAGR has been used for calculating the growth in area, production and productivity of rice at National level, State level (Kerala) and District level (Thrissur) from 2000 – 01 to 2013 - 14. It has also been employed for calculating the growth in the usage of agriculture implements by operational holdings at National level, State level (Kerala) and District level (Thrissur) from 1996-97 to 2006-07. The formula for calculating CAGR is

$$CAGR = \left(\frac{\text{Ending Value}}{\text{Beginning Value}}\right)^{\left(\frac{1}{\#\text{ of years}}\right)} - 1$$

3.5.2 One way Analysis of Variance (ANOVA)

The study has applied ANOVA test for the comparison of the extent of mechanized area by individual, group users of AMSCs and non-users of AMSCs, adoption of mechanisation among the users and non-users of AMSCs, analysis of the

service quality of different AMSCs and farmers' evaluation regarding the benefits received from AMSCs.

One way Analysis of Variance (one-way ANOVA) is a technique used to compare means of two or more samples. This technique can be used only for numerical data. ANOVA tests the null hypothesis that samples in two or more groups are drawn from populations with the same mean values. To do this, two estimates are made of the population variance. These estimates rely on various assumptions.

a) Response variable residuals are normally distributed
b) Samples are independent.
c) Variances of populations are equal.
d) Responses for a given group are independent and identically distributed normal random variables

The ANOVA produces an F-statistic, the ratio of the variance calculated among the means to the variance within the samples. If the group means are drawn from populations with the same mean values, the variance between the group means should be lower than the variance of the samples. The basis of ANOVA is the partitioning of sums of squares into between-class and within-class. It enables all classes to be compared with each other simultaneously rather than individually. A higher ratio therefore implies that the samples are drawn from populations with different mean values.

$$F = \frac{Variance\ due\ to\ difference\ between\ groups}{Error\ variance}$$

If F>1 then it is likely that differences between class means exist. These results are then tested for statistical significance or P-value, where the P-value is the probability that a variate would assume a value greater than or equal to the value observed strictly by chance. If the P-value is small then this implies that the means differ by more than would be expected by chance alone. If value of F leads to the

rejection of null hypothesis multiple comparison tests are used to prove the relationship.

3.5.3 Post-hoc test for multiple comparisons

When the ANOVA test result leads to the rejection of null hypothesis, i.e., the population means are not equal, then multiple comparison tests are applied to find out in which variables the difference exist. Tukey's Honest Significant Difference (HSD) Test, which honestly states the significant differences are used in the study for this purpose.

3.5.4 Independent sample t- test

The independent sample t-test, also called the two sample t-test or student's t-test, is an inferential statistical test that determines whether there is a statistically significant difference between the means in two unrelated groups. In the present study t- test has been employed for examining the difference between users and non - users in the extent of mechanised area, adoption of mechanisation, cost of cultivation and paddy production. The formula for calculating independent t test is

.

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{S^2_{x_1}}{n_1 - 1} + \frac{S^2_{x_2}}{n_2 - 1}}}$$

Where

$\overline{X}_1$ = Mean of first samples

$\overline{X}_2$ = Mean of second samples

S = Sample variance

n_1, n_2 = Number of samples

3.5.5 Chi-square test

Chi-square is one of the very popular methods for resting hypotheses on discrete data. Generally, Chi-square test has three applications, viz., Chi-square test for goodness of fit, Chi-square test for homogeneity and Chi-square test of independence. To examine the independence of relationship between two attributes, Chi-square test for independence is used. The Chi-square test for goodness of fit determines if the sample under investigation has been drawn from a population, which follows some specified distribution, while the test for homogeneity investigates the issue whether several populations are homogenous with respect to a particular characteristic.

Chi-square test of independence is used to test the hypothesis that two categorical variables are independent of each other. A small chi-square statistic indicates that null hypothesis is correct and that the two variables are independent of each other. At a time the independence of relationship between two variables only be tested.

The study employed Chi-square test to identify the determinants of adoption of mechanisation by farmers through AMSCs.. The test is calculated between mechanisation index and variables like, education level of farmers, experience in farming, paddy production, cost of cultivation of paddy and income from paddy of users of AMSCs and non users of AMSCs. To identify the determinants, the values are presented in a 2x2 contingency table. Normally, contingency table presents the data in RxC table where, R is the number of rows and C is the number of Columns. A 2x2 contingency table has two rows and two columns. The formula for computing Chi-square value in a 2x2 contingency table is

$$\chi^2 = \frac{N\,(ad-bc)^2}{(a+b)\;(a+c)\;(b+d)\;(c+d)}$$

Where a, b, c, d are cell frequencies and N is the total of cell frequencies.

Critical values of X^2 are tabulated for various levels of degrees of freedom ([r-1] x [c-1]) at different levels of significance level. If the observed value is greater than the table value, the null hypothesis of 'attributes are independent' can be rejected.

3.5.6 Yates' correction for continuity

Chi- square is a continuous distribution. Hence, the continuity criterion should be obtained. In a contingency table of order 2x 2, if any values of the cell frequency are small, or less than five, the continuity is disturbed. In such cases Yates' correction for continuity is applied to compute the Chi-square value. The correction is that, add 0.5 to the small cell frequency and add or subtract 0.5 from other cell frequencies in such a manner that the marginal total remains the same. The determinants of adoption of mechanisation by non-users of AMSCs are found out with the help of Yates' correction for continuity. The formula used is

$$\chi^2_{\text{Yates}} = \frac{N\,(|ad - bc|) - N/2)^2}{(a+b)\ (a+c)\ (b+d)\ (c+d)}$$

Where a, b, c, d are cell frequencies and N is the total of cell frequencies.

3.5.7 Indices

Four types of indices have been found in the study:

3.5.7.1 Benefit index of AMSCs

3.5.7.2 Service quality index of AMSCs

3.5.7.3 Mechanisation index

3.5.7.4 Usage index of farm implements by farmers

3.5.7.1 Benefit index of AMSCs

The benefit index of Agro Machinery Service Centres has been calculated by summarizing the scores obtained for the benefits received by farmers from AMSCs. For each of the benefits, an index has been constructed using a five point scale and allotted scores ranging from five to one for the response of farmers viz., Very Good, Good, Moderate, Poor and Very Poor. The opinion Very good' was assigned a score of '5' and rest of them in descending order with 'Very Poor' rated as '1'. The scores of the benefit indices have been summarised to form the Overall Evaluation Index. The index is calculated using the formula:

$$\text{AMSCs Evaluation Index} = \frac{\text{Total score obtained by benefits/ farmer}}{\text{(Maximum score x Number of benefits per farmer x Number of farmers)}} \times 100$$

3.5.7.2 Service quality index of AMSCs

The Service quality index is calculated using the score obtained by each of the services of AMSCs. As stated earlier, the response of the farmers have been recorded in a five – point scale ranging from five to one for Very Good, Good, Moderate, Poor and Very Poor respectively. The formula used is:

$$\text{Service quality index} = \frac{\text{Total score obtained by services of AMSC}}{\text{(Maximum score x Number of service provided by AMSC x Number of farmers)}} \times 100$$

3.5.7.3 Mechanisation index

There are two types of mechanisation index used in the study. One is the overall mechanisation index which includes land preparation, transplanting and harvesting, and the other is the mechanisation index for usage of transplanting services of AMSCs, which is termed as mechanisation index for usage of AMSCs.

3.5.7.3.1 Overall mechanisation index

The overall mechanisation index studies the relationship of mechanisation costs to sum of labour cost, animal usage cost and machine usage cost.

$$MI = CM/ (CH+ CA+ CM)$$

Where

MI = Mechanisation index

CM = Cost of use of machinery

CH = Cost of use of human labour

CA = Cost of using animal power

3.5.7.3.2 Mechanisation index for usage of AMSCs

This index was calculated to understand the effect of using service of AMSCs in replacing the overall labour cost incurred in farm operations.

$$MI = CS/ (CH+ CA+ CM)$$

Where

MI = Mechanisation index

CS = Cost of AMSCs

CM = Cost of use of machinery including AMSCs cost

CH = Cost of use of human labour

CA = Cost of using animal power

3.5.7.4 Usage index of farm implements by farmers

The usage index was calculated for analyzing the frequency of usage of farm implements by the farmers in their farm operations. The extent of usage of farm implements is analysed through a three point scale of frequency of usage i.e. Always, Occasional and No usage and each scale is allotted with scores ranging from two to zero respectively. The index was calculated separately for each of the AMSCs and for each implement used by farmers. An overall usage index was also worked out to understand the level of usage among individual users of AMSCs, group users of AMSCs and non-users of AMSCs.

$$\text{Usage index of farm implements by farmers} = \frac{\text{Scores obtained by each implement}}{\text{Maximum score} \times \text{Number of farmers}} \times 100$$

$$\text{Overall usage index} = \frac{\text{Total score obtained by all implements}}{\text{(Maximum score} \times \text{Number of implements used} \times \text{Number of farmers)}} \times 100$$

Apart from these tools, simple percentages are also computed to find the share of each variable to the concerned total while presenting Tables.

3.7 Conclusion

Impact of Agro Machinery Service Centres on mechanisation of paddy cultivation have been investigated with a sample size of 135 farmer respondents selected through multi stage sampling technique from three panchayats and three AMSCs of Thrissur district. Study region, sources of data, sample selection and critical variables have been determined according to the requirements of objectives of study. Statistical tools used were in accordance with the availability and reliability of data to analyse the problem under study.

RESULTS AND DISCUSSION

CHAPTER 4

RESULTS AND DISCUSSION

Rice is one of the most important food crops of India in terms of area, production and consumer preference. India is the second largest producer and consumer of rice in the world. Rice production in India accounted for 21.30 per cent of global production in the year 2013-14 (Food and Agriculture Organisation, 2014). The area and production under paddy cultivation shows a declining trend over the years. Among various reasons, shortage of agricultural labourers coupled with high wage rates has demotivated farmers from undertaking rice cultivation. Mechanisation of agricultural operations is the only panacea to this alarming problem, where farmers can do most of the labour oriented works with the help of machines, including land preparation, transplanting and harvesting, with the added advantage of timeliness in farm operations. One of the major limitations of mechanisation is that it cannot be applied in small landholdings which have paved the way for the formation of Padasekhara Samithies which pool landholdings of member farmers, making it possible for adoption of mechanisation.

The establishment of Agro Machinery Service Centres (AMSCs) is a landmark with respect to the mechanisation of agricultural operations in Kerala. In the year 2008, a group of farmers and agricultural labourers were given formal training for using agricultural machines and equipment, by the Agricultural Research Station (ARS), Mannuthy of Kerala Agricultural University which led to the formation of Green Army – the first agricultural labour bank in Kerala - at the initiative of Peringandoor Service Co-operative Bank in Thrissur District. The Green Army started functioning as both a labour bank and Agro Machinery Service Centre providing both human labour and mechanisation services including repairing of machines to farmers. Along with Green Army, other AMSCs also came up, but providing only farm mechanisation services, especially to paddy farmers.

In this context, the study is undertaken with the objective of examining the impact of AMSCs on mechanisation of paddy cultivation in Kerala.

The study has been organised under seven sections. As a prelude to the study, an overview of the present status of farm mechanisation in India, Kerala and Thrissur district is presented in the first section. A study about rice farming demands basic details about area under cultivation, production and productivity of rice which are summarised under section two. The detailed analysis of the four objectives of the study is covered under sections three to six. Kerala Agricultural University (KAU) has played an important role in forming AMSCs in the State through its trainings on farm mechanisation conducted at the Agricultural Research Station, Mannuthy. Hence an attempt is made in the last section of this chapter, to examine the role of KAU in farm mechanisation through Green Army, one of the most successful AMSCs, serving the mechanisation needs of the highest number of farmers in the study area. Hence this chapter is presented as follows.

4.1 Status of farm mechanisation: An overview

4.2 Area, production and productivity of rice

4.3 Extent of farm mechanisation among paddy farmers in Kerala

4.4 Determinants of farm mechanisation through AMSCs

4.5 Impact of AMSCs on mechanisation of paddy cultivation

4.6 Role of institutional credit in the mechanisation of paddy farms.

4.7 Role of KAU in mechanisation of paddy farms

4.1 Status of farm mechanisation: An overview

Even though mechanisation is widely accepted, the small size and scattered holdings of the farmers stand in its way of mechanisation. As a result, farm machinery generally remains underutilised. The farm machinery have large

turning radius and thus require comparatively larger farm for economic use. Majority of small cultivators are poor who are not in a position to purchase costly machinery like tractors, combine harvesters etc. Lack of proper knowledge of farmer to purchase farm machinery, operate and maintain properly leads to wrong choice, makes it uneconomical and risky too. The lack of repair and replacement facilities especially in the remote rural areas is another hindrance in efficient small farm mechanisation. Above all, due to the seasonal nature of the agriculture, the farm machinery remains idle for much of the time.

With all these limitations, the extent of use of machines for agricultural operations by different categories of farmers at present is worth probing into, while studying the impact of mechanisation through AMSCs. In India as per the land holdings, farmers are grouped into marginal farmers (land up to one Ha), small farmers (land between 1 to 1.99 Ha), and large farmers (land more than 2 Ha). The agricultural implements used by farmers are classified into three categories - hand operated implements, animal operated implements and power operated implements. Among these hand operated and animal operated implements are also called traditional farm implements. The usage of implements is different for these three categories of farmers. This section covers the extent of use of agricultural implements by these three categories of farmers. The discussion begins with the extent of mechanisation in India, followed by that in Kerala, and in the study area of Thrissur District.

4.1.1 Farm mechanisation in India

Ever since independence, Indian agriculture has continuously provided structural support to the economy. It also ensures food security in the nation. The advancements in food grain production, besides other things, were brought in by agricultural mechanisation in the form of irrigation pumps, tillers, tractors, transplanters, sprayers, chaff cutters etc. The changes brought in by Green Revolution have further catalysed acceleration of farm mechanisation across various agricultural activities in the country. The usage of farm implements by

farmers at all – India level on the basis of their operational holdings with a gap of ten years is depicted in Table 4.1.

Table 4.1 Usage of agricultural implements by farmers in India: Category - wise

(Number in '000 units)

Farmer category	**Agricultural implements**					
	Hand operated		**Animal operated**		**Power operated**	
	1996-97	**2006-07**	**1996-97**	**2006-07**	**1996-97**	**2006-07**
Marginal	2325.51	2680.4 (0.01)	108619	106967.6 (-0.001)	11344.3	37339.05 (0.11)
Small	88747.44	84390.25 (-0.004)	53166.32	47098.77 (-0.01)	6748.64	15108.45 (0.08)
Large	108462.24	82621.62 (-0.02)	88962.12	46462.42 (-0.06)	16185.54	19198.57(0.02)
All groups	197209.68	169692.3 (-0.01)	250747.5	200528.8 (-0.02)	34278.49	71646.1 (0.07)

Source: Input Survey, Department of Agriculture and Cooperation, Various issues
Note: Figures in parenthesis represent CAGR

Table 4.1 makes it clear that power operated implements are replacing traditional farm implements, leading to increased mechanisation in agriculture over the years. The CAGR is negative for all categories of farmers and for all groups together for both hand operated and animal operated implements with the exception of marginal farmers for hand operated implements alone. On the other hand, CAGR is positive for power operated implements for all categories of farmers. The marginal farmers are showing the highest growth rate in the use of power operated implements, even with a marginal positive growth in the use of hand operated implements. The number of marginal farmers who shifted to power operated implements increased more than three times during the ten year period, while there is only a marginal increase in the case of large farmers. But researchers Baofeng (2006), Manandhar (2008) and Yohanna *et. al* (2011) have found that higher the land holding, higher will be the utilisation of farm machinery services among the farmers and such services are very far away from small scale farmers. It is to be noted here that out of the total farmers in India, 67

per cent are marginal and 15 per cent are large farmers (Agriculture Census, 2010-11). Although it cannot be inferred that marginal farmers are more amenable to mechanisation than large farmers, it can be concluded that marginal farmers in India are also switching to mechanised farming on an increasing scale inspite of their limitation of small holdings.

4.1.2 Mechanisation of agricultural operations in Kerala

Mechanisation is widely accepted in rice in Kerala, which is one of the major crops cultivated in the State. But mechanisation of rice farming is constrained by the lack of appropriate machinery systems suited for varying field situations of the State, even though commercial brands of machines proven elsewhere are available in the market. Rice cultivation requires very high labour input, as much as 1000-1200 man-hours per ha in the State compared to only 800 man-hours per ha in other States in India (Pillai, 2004). Considerable reduction in labour requirement can be achieved through selective mechanisation with appropriate machinery systems to make rice production economically viable. At present, tillage operations in rice cultivation are almost fully mechanised using tractor and power tillers. Other labour-intensive operations such as transplanting and harvesting are getting mechanised but in many of the cases of small holdings it is still performed manually. Commercial rice farming machines like mechanical rice transplanter, vertical conveyor reaper and rice combines are yet to be adopted widely in the farms of the State mainly due to their high investment cost and sophisticated technology for operation and maintenance. Table 4.2 gives the details of usage of agricultural implements by the farmers of Kerala.

Table 4.2 Usage of agricultural implements by farmers in Kerala: Category - wise

(Number in '000 units)

Farmer category	Agricultural implements					
	Hand operated		Animal operated		Power operated	
	1996-97	2006-07	1996-97	2006-07	1996-97	2006-07
Marginal	8178.67	7977.05 (-0.002)	287.97	118.84 (-0.07)	604.03	684.35 (0.01)
Small	1043.51	403.98 (-0.08)	75.64	13.46 (-0.15)	122.71	96.53 (-0.02)
Large	692.75	181.4 (-0.11)	39.19	7.67 (-0.13)	77.58	53.55 (-0.03)
All groups	9914.93	8562.43 (-0.01)	402.82	139.9 (-0.09)	804.3	834.45 (0.003)

Source: Input Survey, Department of Agriculture and Cooperation, Various issues
Note: Figures in parenthesis represent CAGR

Table 4.2 reveals negative growth in the use of traditional agricultural implements by all categories of farmers. It is noteworthy that this reduction has not resulted in a corresponding increase in the use of power – operated implements by the farmers of Kerala. Only in the case of marginal farmers, there is a positive CAGR with respect to power operated implements. This supports the findings of Table 4.1 where also it was found that marginal farmers are showing the highest growth rate in the use of power operated implements at all – India level. As far as Kerala is concerned, 96 per cent of the farmers are marginal. There is a reduction in the number of large and small farmers and hike in the number of marginal farmers during the periods under discussion, in Kerala (Agriculture Statistics, 2011). This has led to a positive growth in the usage of power operated implements by marginal farmers which reinstate the finding that marginal farmers in Kerala are also adopting increased mechanised farming as in the case of India (Table 4.1).

4.1.3 Mechanisation of farming in Thrissur District

Although mechanisation is adopted in many crops like rice, maize, cotton, sugarcane etc., in Thrissur district, paddy is the main crop which is getting mechanised in the recent years, especially due to lack of adequate and timely labour, and high wages. Mechanisation is widely adopted in the paddy lands of the District except the Kole lands. Kole is a unique wetland lying in Thrissur district. It gives 40 per cent of the Kerala's rice requirement and acts as a natural drainage system for Thrissur city and Thrissur District. (http://www.corporationofthrissur.net/agriculture). The Kole Wetland is one of the largest, highly productive and threatened wetlands in Kerala. Very recently farmers of Kole lands have also started mechanizing their field operations. The farmers of Thrissur District are adopting tillage operations in paddy cultivation with the help of tractors and power tillers; mechanised transplanting using the services of AMSCs and mechanised harvesting through private agencies. Tractors, tillers, cono weeder, harvesters and power sprayers are the major mechanised tools used by the farmers. Table 4.3 reveals the extent of use of traditional and power operated implements by the farmers of Thrissur District.

Table 4.3 Usage of agricultural implements by farmers in Thrissur District: Category - wise

(Number in '000 units)

Farmer category	**Agricultural implements**					
	Hand operated		**Animal operated**		**Power operated**	
	1996-97	**2006-07**	**1996-97**	**2006-07**	**1996-97**	**2006-07**
Marginal	1123.97	934.72 (-0.02)	41.31	4.05 (-0.19)	234.09	160.97 (-0.03)
Small	172.74	23.33 (-0.06)	3.52	0.4 (-0.18)	28.32	10.72 (-0.08)
Large	44.97	6.2 (-0.16)	1.01	0.2 (-0.13)	10.13	3.23 (-0.09)
All groups	1341.70	964.25 (-0.03)	45.84	4.65 (-0.19)	272.56	174.92 (-0.04)

Source: Input Survey, Department of Agriculture and Cooperation, Various issues
Note: Figures in parenthesis represent CAGR

It is interesting to note from Table 4.3 that there is a reduction in the usage of all types of implements, traditional and mechanised, by the farmers of Thrissur district. The CAGR of all the groups shows a negative growth between 1996-97 and 2006-07. Due to lack of adequate and timely availability of labour, farming operations could not be conducted in time. Moreover, the high cost of labour made rice farming non-remunerative. The farmers left their land unutilised engaging in non – farm activities, as a result of which the actual cultivated area of rice came down. This led to the decline in the usage of traditional implements. Mechanisation in the present form commenced in Thrissur District only in the year 2008. Hence the power operated implements are also showing a negative growth in Thrissur District during the period 1996-97 to 2006-07.

4.2 Area, production and productivity of rice

The introduction of high yielding varieties in agriculture leads to intensive cultivation with higher energy inputs and better management practices. Land preparation, harvesting, threshing and irrigation are the major energy utilised operations in agriculture. Among the agricultural crops rice is the most important human food crop. It is produced in a wide range of locations under a variety of climatic conditions, using thousands of rice varieties in the world. But the farmers are facing many agro ecological, technical and socio economic constraints in rice cultivation. As a result the average size of farm holdings gradually reduced over the years. The productivity of rice also varies due to multiplicity of factors, including climatic conditions and varieties used. Hence as a background to the study on mechanisation of rice farming, the trend in area under cultivation, production and productivity of rice is analysed at all India level, State level and District level, and presented in this section.

4.2.1 Area, production and productivity of rice in India

Rice is fundamentally a kharif crop in India and the country has the biggest area under rice cultivation, as it is one of her principal food crops. India is one of the world's largest producers of white rice and brown rice, accounting for

20 per cent of world rice production (Food and Agriculture Organisation, 2014). Rice flourishes comfortably in hot and humid climate. It is also grown through irrigation in those areas that receives comparatively less rainfall. The regions cultivating rice in India is distinguished as the western coastal strip and the eastern coastal strip. India, being a land of eternal growing season, and the deltas of Kaveri, Krishna, Godavari and Mahanadi Rivers with a thick set-up of canal irrigation, permit farmers to raise two, and in some pockets, even three crops a year. Table 4.4 depicts the trend in the area, production and productivity of rice in India.

Table 4.4 Area, production and yield of rice in India, 2000-01 to 2012-13

Year	Area (Million Ha)	Production (Million Tons)	Yield (Kg/ Ha)
2000-01	44.71	84.98	1900.7
2001-02	44.90	93.34	2079.0
2002-03	41.18	71.82	1744.0
2003-04	42.59	88.53	2077.0
2004-05	41.91	83.13	1984.0
2005-06	43.66	91.79	2102.0
2006-07	43.81	93.36	2131.0
2007-08	43.91	96.69	2202.0
2008-09	45.54	99.18	2178.0
2009-10	41.92	89.09	2125.0
2010-11	42.86	95.98	2239.0
2011-12	44.01	105.30	2393.0
2012-13	42.41	105.24	2469.0
CAGR	-0.004	0.016	0.020

Source: Directorate of Economics and Statistics, 2012-13

The CAGR reveals negative growth in the area under cultivation of rice, but positive growth for production and productivity in India. The year 2009-10 is showing a steep decline in area, production and productivity of rice compared to other years, which can be attributed to the severe drought during the year which adversely affected almost half of the country. The impact of a good monsoon in

the year 2011-12 is evident from the increased values for all the three indicators. It is a welcoming feature that the productivity of rice is increasing in the recent years even though it is still much below the world productivity of rice.

4.2.2 Area, production and productivity of rice in Kerala

Rice, a staple food crop of Kerala is cultivated mainly in fragmented fields of varying sizes both in irrigated and rain fed conditions under different agro-climatic regimes. Rice contributes a major share in the total amount of food grain produced within the State. Over the past several decades the State government initiated and implemented numerous intensive and extensive measures to increase domestic rice production. Table 4.5 exhibits the status of area under cultivation, production and yield of rice in Kerala during the twelve year period from 2002-03 to 2013-14.

Table 4.5 Area, production and yield of rice in Kerala, 2002-03 to 2013-14

Year	Area (Million Ha)	Production (Million Tons)	Yield (Kg/ Ha)
2002-03	31.10	68.90	2218
2003-04	28.70	57.00	1984
2004-05	29.00	66.70	2301
2005-06	27.60	63.00	2285
2006-07	26.40	64.20	2435
2007-08	22.90	52.80	2308
2008-09	23.40	59.00	2520
2009-10	23.40	59.80	2557
2010-11	21.32	52.28	2452
2011-12	20.82	56.89	2733
2012-13	19.72	50.82	2577
2013-14	19.90	56.40	2827
CAGR	-0.035	-0.015	0.019

Source: Directorate of Economics and Statistics, 2013-14

As seen in the case of India, area under cultivation of rice and rice production in Kerala is also showing a negative growth over the period 2002-03 to 2013-14, while productivity is on positive growth. It is noteworthy that while the area under cultivation had a negative CAGR of only 0.004 in the case of India (Table 4.4), it is as high as -0.035 in the case of Kerala. Conversion of paddy lands for housing purposes and for cultivation of commercial plantation crops along with the practice of leaving them fallow due to high labour cost, shortage of labour, and very low market price of rice are the major reasons for the drastic decline in the area under cultivation of rice in Kerala. Even with the steep and continuous decline in the area under cultivation of rice, production of rice over the years has shown a lesser intensity of decline, due to the increased yield per Ha. It is to be noted that productivity of rice in Kerala is higher compared to that of India (Table 4.4).

Having analysed the trend in area, production and productivity of rice in Kerala in general, for a period of twelve years, an attempt is made to examine the district – wise area under paddy cultivation during the year 2011-12. Table 4.6 presents the details of district – wise area under paddy along with Gross Cropped Area (GCA) and proportion of paddy area to State total and GCA of each district.

Table 4.6 Paddy area and Gross Cropped Area of Kerala: District – wise

District	Paddy area (Ha)	Percentage of paddy area to State total	GCA	Percentage of paddy area to GCA
Thiruvanathapuram	2395	1.15	155065	1.54
Kollam	2097	1.01	157343	1.33
Pathanamthitta	2802	1.35	102385	2.74
Alappuzha	36251	17.41	107389	33.76
Kottayam	21410	10.29	209452	10.22
Idukki	1264	0.61	276493	0.46
Ernakulum	7731	3.71	172449	4.48
Thrissur	21172	10.17	181287	11.68
Palakkad	83998	40.35	302348	27.78
Malappuram	7528	3.62	240877	3.13
Kozhikode	2920	1.4	206971	1.41
Wayanad	8995	4.32	172355	5.22
Kannur	5740	2.76	226570	2.53
Kasaragod	3857	1.85	150773	2.56
Total	208160	100	2661757	-

Source: Directorate of Economics and Statistics, Government of Kerala, 2011-12

The share of paddy area to State total is the highest for Palakkad followed by Alappuzha, while the proportion of paddy area to GCA is the highest for Alappuzha followed by Palakkad. GCA represents the total area cultivated under all food and non-food crops including the area sown more than once during a year. More than 40 per cent of the paddy area in Kerala belongs to Palakkad. Thrissur is having the fourth position with respect to area under paddy, with a marginal difference from Kottayam, which occupies the third position. Detailed analysis of the trend in area, production and productivity of rice over the last thirteen years in Thrissur District which is the study area is given in the following section.

4.2.3 Area, production and productivity of rice in Thrissur district

In the field of agriculture, Thrissur district is known for its diversity and vastness. More than half of the income of the people of the District is generated from agriculture and allied activities. (http://www.corporationofthrissur.net/). The main agricultural crops of the District are rice, coconut, rubber, arecanut, banana, pepper, nutmeg, vegetables and tapioca. The most important crop of the District is paddy. Major contribution to the total paddy production of the District comes from the wetlands called Kole lands, which are unique in every respect. The Kole lands are lying in the coastal plains of the District and are below the mean sea level. Kole lands extend over an area of 13129 Ha along Thrissur, Chavakkad and Mukundapuram taluks of Thrissur district. In Kole lands production is high compared to other fields. Table 4.7 gives the details of area, production and productivity of rice in Thrissur district.

Table 4.7 Area, production and productivity of rice in Thrissur District

Year	Area (Million Ha)	Production (Million Tons)	Yield (Kg/ Ha)
2000-01	39.38	82.10	2080
2001-02	37.02	84.28	2280
2002-03	37.27	87.27	2340
2003-04	34.15	79.84	2340
2004-05	36.35	87.46	2410
2005-06	31.07	72.95	2350
2006-07	27.31	65.04	2380
2007-08	24.42	59.38	2430
2008-09	27.92	71.90	2570
2009-10	25.43	63.85	2510
2010-11	20.30	53.08	2620
2011-12	21.17	62.32	2943
2012-13	23.10	67.57	2925
CAGR	-0.040	-0.014	0.027

Source: Directorate of Economics and Statistics, 2012-13

With respect to area under cultivation, production and yield, Thrissur also follows the same trend of India and Kerala, but with varying intensity (Tables 4.4 & 4.5). Both area and production shows negative growth and productivity, positive growth over the thirteen year period. But, as revealed by the CAGR, the decline in the area is more severe in the case of Thrissur (-0.040) compared to the picture of Kerala (- 0.035) and India (-0.004). Productivity is the highest for Thrissur District compared to the National and State average for the same, resulting in the highest CAGR for Thrissur. The area under rice has drastically reduced in Thrissur due to high cost of cultivation, conversion of paddy lands for non-farm purposes and severe labour shortage. It is heartening to note a continuous increase in the area and production from 2010-11 to 2012-13, which can be attributed to the use of power drawn implements in cultivation.

Scarcity of labourers, high wage rate, conversion of paddy lands for other purposes and low procurement price of paddy have played an important role in the reduction of paddy cultivation in Kerala. As a result there always exist a gap between the demand and supply of rice which leads to food insecurity in the State.

4.3 Extent of farm mechanisation among paddy farmers in Kerala

The use of improved farm implements / machines constitutes the level of mechanisation adopted by farmers. Farm mechanisation plays a key role in improving agricultural production and productivity in Kerala. Mechanisation not only increases the mechanical advantage, but also helps to reduce drudgery while performing the different agricultural operations. In Kerala among the various crops cultivated, mechanisation is mostly adopted in paddy, which is provided mainly through AMSCs. They play a critical role in mechanising the activities involved in paddy cultivation. AMSCs provide all agro machinery operation services with respect to crop production on contract basis. The service shall be either for operator or machine rental or altogether for operational services as such.

The present study is an investigation of the impact created by AMSCs on paddy cultivation based on data drawn from a sample of 135 paddy farmers through multi stage sampling technique. The sample farmers are categorised into two viz., users of AMSCs and non-users of AMSCs. Out of the total sample, 90 farmers are using the services of AMSCs and 45 are not using the services of AMSCs and they are selected as a control group for the purpose of comparison. The users are again grouped into 45 individual users and 45 group users /Padasekharams. As per 2012 data there are 27 AMSCs registered in Kerala (Agro-Informatics and Precision Agriculture, 2012), out of which three AMSCs namely Green Army, Sivasakthi and Parijatham are selected for the study. These three AMSCs are continuously providing mechanisation services to the highest number of farmers in the District and hence become eligible for the study. Out of the 90 users, 30 each belong to Green Army, Sivasakthi and Parijatham.

The first objective of the study is to assess the extent of mechanisation adopted by farmers in their farm operations. The term 'extent' measures the farm size of farmers, different crops cultivated by them, purposes of mechanisation, area of mechanised land holdings of the farmers, farm implements used and owned by the farmers. The details are collected through a pretested structured questionnaire. A brief picture about the AMSCs covered under the study and the socio- economic profile of the respondents are given as a prelude to the discussion of the objectives. Hence the analysis is structured under the following nine heads:

4.3.1 Agro Machinery Service Centres: A prelude
4.3.2 Socio- economic profile of the respondents
4.3.3 Paddy landholdings of individual farmers
4.3.4 Cropping pattern of farmers
4.3.5 Status of mechanisation adopted by farmers
4.3.6 Extent of mechanised area in paddy farming
4.3.7 Ownership of farm implements by farmers and
4.3.8 Extent of usage of farm implements by farmers
4.3.9 Measurement of mechanisation by farmers

4.3.1 Agro Machinery Service Centres: A prelude

Paddy cultivation needs appropriate mechanisation to cope up with the increased cost of cultivation due to high wages and scarcity of labourers. The farm workers are largely migrating to works offered under the Mahatma Gandhi National Rural Employment Guarantee Act, 2005 thereby causing a shortage of labour for labour-intensive crops such as paddy. Purchase of machines is not affordable to the farmers. Thanks to the escalation of labour costs and short supply of farm workers, paddy growers are showing interest in adopting technologies such as mechanised paddy seedling planting for minimising investments on the cultivation, especially on labour and seeds. In such situation Agro Machinery Service Centres (AMSCs) assist the farmers for obtaining machineries on hire and also provide mechanised transplanting at an economical rate.

AMSCs are generally located at Panchayat level. It is a registered society under “Charitable societies Act, 1955”. There are three models of AMSCs, viz, co-operative model, individual model and SHG model. The initial members of the AMSCs established in Thrissur District were trained by the Agricultural Research Station (ARS), Mannuthy of Kerala Agricultural University, under the Food Security Army Training Programme. Food Security Army (FSA) is a programme of Kerala Agricultural University, through which trained labourers are made available for mechanised operations in farms, including repairing and servicing of farm machinery. The training is for a period of 15 to 20 days, at ARS. The operation, repair and servicing of machinery, as well as field operations using farm machinery, are covered under the training programme. After completion of training, some of the skilled labourers joined together to form AMSCs. A brief outline of the selected AMSCs for the study viz., Green Army, Sivasakthi and Parijatham are given in the ensuing paragraphs.

4.3.1.1 Green Army

Green Army is a co-operative model of Agro Machinery Service Centre located in Wadakkanchery Block Panchayat. Nearly 800 persons have been trained by ARS under FSA and deployed as members of Green Army (Jaikumaran *et. al*, 2012). The Army is managed by a Management Committee comprising of members from the Block Panchayat and those who were trained under the Food Security Army Training Programme. The functioning of Green Army is overseen by the Peringandoor Service Cooperative Bank. The Army charges fixed rate for its operations. The members of Green Army are paid weekly through their bank accounts. Members have been divided into 10 groups comprising of five teams. Each team consists of four members including the team leader. Apart from the weekly payment members also get Rs. 75/- extra per day as travelling allowance and food. A team has to transplant 2.5 acres per day. The required machinery is provided free of cost to the Green Army by the Block Panchayat. Service charge for mechanised paddy transplanting is Rs. 2500/- per acre within the Block and Rs. 3000/acre, outside Wadakkanchery Block area. An office secretary is appointed to look after day to day affairs of the Army.

4.3.1.2 Sivasakthi

There are several individual - based models of AMSCs in the State. Sivasakthi is an example of an individual - based AMSC. Leaders and members of Sivasakthi are trained by Food Security Army of Kerala Agricultural University. It has 43 members and is currently able to contract agro machinery operations worth more than Rs. 50 lakhs per annum. Sivasakthi has fixed service charge for every farm machinery operation, as decided by the leader and approved by the members of AMSC. The service charge is fixed at Rs. 3000 per acre. They pay wages at the rate Rs. 600 per day to the driver of transplanter, Rs. 500 to men and Rs. 300 to 400 to the women who assist in operations. Food and travelling costs are also provided to the leader. A team of five members transplant a minimum of 2.5 acre per day. Occasionally they take machinery on rental basis. Some of the

machines are purchased by the AMSC from the profit generated. They are also getting machines from Grama panchayat at free of cost for their operations. Currently the Centre has seven transplanters and one cutting harvester in its ownership.

4.3.1.3. Parijatham

Parijatham AMSC was established in the year 2011 in Alagappanagar Panchayat. It is a SHG model of AMSC. It is also registered under the Charitable Society Act, 1955 and managed by the officials of SHG. Currently the Centre has 10 members. The members are females who got training from ARS, Mannuthy under Food Security Army. The major service provided by the Centre to the farmers is transplanting. The members also go for manual harvesting and weeding. The service charge is fixed at Rs. 4000 per acre within Alagappanagar Panchayat and Rs. 4500 per acre outside the Panchayat for transplanting. All the required machineries are provided by the Panchayat at free of cost. Each member gets Rs. 400 as wage and is also provided with travelling allowances for reaching the work place outside their Panchayat. The AMSC collects a machine deposit of Rs 10 for every Rs. 100 from their wages for meeting the repairs and maintenance of machineries owned by them. If the machines are working properly, the members can transplant 4 acre per day. At the end of each financial year they prepare the balance sheet and distribute profit equally among all members.

4.3.2 Socio-economic profile of the respondents

The socio economic profile covers the economic and social status of individuals in terms of education, income and occupation. As stated earlier, the sample respondents of the study consist of 135 paddy farmers. Out of the 135 farmers, 45 farmers are individual users of AMSCs, 45 are group users of AMSCs and the rest 45 are individual non-users of AMSCs. The socio economic profile of both individual users and non-users are put under one Table (Table 4.8) and the profile of Padasekhara Samities comprising group users is presented separately. Hence the profile is presented under two sub - headings.

4.3.2.1 Socio economic profile of individual respondents

4.3.2.2 Profile of Padasekhara Samities

4.3.2.1 Socio economic profile of individual respondents

Socio economic profile of individual farmers is analysed using variables like gender, age, educational qualification, family size, occupation, experience in farming, annual income from paddy, annual income from agriculture and annual family income, and presented in Table 4.8. The annual income from paddy is based on the production of paddy from all the seasons. In a year farmers may cultivate paddy in one season i.e. virrippu or two seasons - virrippu and mundakan. The profile is given separately for farmers under each AMSC. Out of the 45 individual users 15 farmers are from Green Army, 15 from Sivasakthi and the rest 15 from Parijatham.

Table 4.8 Socio- economic profile of individual farmers

Sl. No	Variables	Unit	Users of AMSCs			Total users	Non users	Total
			Green Army	Sivasakthi	Parijatham			
1	**Gender**							
1.1	Male		11	15	12	38 (84)	39 (87)	77 (86)
1.2	Female		4	0	3	7 (16)	6 (13)	13 (14)
2	**Age level**	**Years**						
2.1	35-50		2	3	1	6 (13)	15 (33)	21 (23)
2.2	50-65		4	11	9	24 (54)	17 (38)	41 (46)
2.3	65-80		9	1	4	14 (31)	10 (22)	24 (27)
2.4	Above 80		0	0	1	1 (02)	3 (7)	4 (4)
3	**Educational level**							
3.1	Up to SSLC		10	7	11	28 (62)	30 (67)	58 (64)
3.2	Plus two		5	1	3	9 (20)	8 (18)	17 (19)
3.4	Graduation		0	6	1	7 (16)	7 (15)	14 (16)
3.5	Post-graduation		0	1	0	1 (02)	0	1 (1)
4	**Family size**	**Type**						
4.1	Joint family		2	5	3	10 (22)	14 (31)	24 (27)
4.2	Nuclear family		13	10	12	35 (78)	31 (69)	66 (73)
5	**Occupation**							
5.1	Agriculture		9	5	11	25 (56)	28 (62)	53 (59)
5.2	Private sector		4	4	2	10 (22)	9 (20)	19 (21)
5.3	Retired		0	4	1	5 (11)	6 (13)	11 (12)
5.4	Others		2	2	1	5 (11)	2 (05)	7 (08)
6	**Experience in farming**	**Years**						
6.1	10 to 25		4	1	0	5 (12)	17(38)	22(25)
6.2	25 to 40		2	6	12	20 (44)	10(22)	30(33)
6.3	40 to 55		9	8	3	20 (44)	18(40)	38(42)

Table 4.8 continued

Sl. No	Variables	Unit	Users of AMSCs			Total users	Non users	Grand Total
			Green Army	Sivasakthi	Parijatham			
7	**Annual income from paddy**	**Rs.**						
7.1	Less than 1 lakh		14	5	9	28 (62)	43(96)	71(79)
7.2	1 lakh to 2 lakh		1	3	4	8 (18)	1(02)	9(10)
7.3	2 lakh to 3 lakh		0	5	2	7 (16)	1(02)	8(09)
7.4	Above 3 lakh		0	2	0	2 (04)	0	2(02)
8	**Annual income from agriculture**	**Rs.**						
8.1	Less than 1 lakh		12	5	9	26 (58)	38 (84)	64 (71)
8.2	1 lakh to 2 lakh		3	3	4	10 (22)	3 (07)	13 (14)
8.3	2 lakh to 3 lakh		0	5	2	7 (16)	1 (02)	8 (09)
8.4	Above 3 lakh		0	2	0	2 (04)	3 (07)	5 (05)
9.	**Annual family income**	**Rs**.						
9.1	Less than 1 lakh		8	1	4	13 (29)	15 (33)	28 (31)
9.2	1 lakh to 2 lakh		3	5	7	15 (33)	15 (33)	30 (34)
9.3	2 lakh to 3 lakh		3	2	4	9 (20)	2 (05)	11 (12)
9.4	Above 3 lakh		1	7	0	8 (18)	13 (29)	21 (23)

Source: Compiled from primary data
Note: Figures in parenthesis represent percentage share of each to total

Table 4.8 reveals that respondents in the study area consist of both male and female. Among the farmers engaged in paddy cultivation majority (86 per cent) are male, depicting continuation of male domination in paddy cultivation.

Most of the farmers (46 per cent) are aged and fall in the category of 50 to 65 years. Twenty seven per cent of the farmers fall in the age category of 65 to 80 years. Only less than one- fourth of the respondents fall under the age group of 35 to 50 years. The lowest age of the farmer respondents is 35 years. Out of 135 farmer respondents only three of them are below the age of 40. This clearly shows that the younger generation is not attracted towards paddy farming and to agriculture as a profession, which is a threat to the food security of Kerala.

Education enables farmers to sensitise avenues available for solving their problems, experimenting and adopting new technologies, schemes and support. Majority of the respondents (64 per cent), both in users (62 per cent) and non-users (67 per cent) have completed their matriculation. There is only one post graduate and only 16 per cent of the farmers have completed their graduation. Hence it is inferred that educated people do not consider agriculture as an attractive profession. Adoption of Information and Communication Technology (ICT) tools and market intelligence services in agriculture is possible only if educated people are attracted to this profession.

As seen in the present era nuclear families (73 per cent) are common in the study area than joint families.

Fifty nine per cent of the respondents are engaged in agriculture as their primary occupation and rest of them undertake paddy farming as a subsidiary activity. It is observed that income from agriculture alone is insufficient to support their families and hence primary importance is given to other professions by the farmers.

Experience in farming is considered as the period for which paddy cultivation has been carried out by an individual. In the study area 42 per cent of the respondents have an experience of more than 40 years in farming. The farmers with more experience undertake farming as their primary occupation and have mostly inherited the land holdings from their ancestors. A few of the educated, retired and government employees find time to undertake paddy cultivation and

are having an experience of 10 to 30 years. It is a welcoming feature that a tendency is seen among people to come back to paddy cultivation and spend some of their leisure time for agriculture.

With respect to the income from paddy, 79 per cent are having annual income of less than Rupees one lakh since majority of the respondents are marginal farmers considering their land holding under paddy cultivation. Only two per cent are having annual income of more than Rupees three lakh from paddy farming. Paddy contributes major share to the total agricultural income of farmers. The agriculture income of majority of the respondents (71 per cent) is less than Rupees one lakh per annum. Only five per cent of the farmers get an income of more than Rupees three lakh from agriculture and these belong to large farmers.

Annual family income of the respondents consists of income from agricultural income plus income earned from other sources by the family members of respondent. Since the main occupation of the respondents is agriculture, income from agriculture contributes major share to the annual family income. So majority of the respondents (64 per cent) have annual income within Rupees two lakh. Only 13 per cent of respondents have annual family income less than Rupees one lakh.

Having discussed the socio – economic characteristics of the farmers who do paddy farming on individual basis, the next section is devoted for the discussion of the socio – economic characteristics of the farmers who do paddy cultivation on group basis or through Padasekhara Samities.

4.3.2.2 Profile of Padasekhara Samities

Group farming is the process of doing agricultural operations not individually, but in groups. In Kerala, group farming is more popular in paddy cultivation. Farmers create Padasekhara Samithies for this purpose. It is formed by individual farmers. Padasekharam means large land holdings by a group of farmers and there is no limit to the maximum number of farmers. All the farm

activities and payments for the same are jointly made in a Padasekharam. Every Padasekharam should have a President and a Secretary. It is easy for the farmers to get all the necessary services for paddy cultivation and avail technology inputs by forming groups.

Group farmers of Padasekharams who are using the services of AMSCs are also included in the sample frame of the study. The profile of the Padasekharams includes variables such as area, member strength and income from paddy cultivation. The income from a Padasekharam is calculated by multiplying the per Ha production with area under cultivation. The details of Padasekharams covered are depicted in Table 4.9.

Table 4.9 Profile of Padasekhara Samities

Sl. No	Variables	Unit	Users of AMSCs			Total
			Green Army	Sivasakthi	Parijatham	
	Area	**Ha**				
1.1	1 to 8		3	3	14	20 (44)
1.2	8 to 15		2	4	1	7 (16)
1.3	15 to 22		5	1	0	6 (13)
1.4	Above 22		5	7	0	12 (27)
1.5	Average area (Ha)		21.57	103.85	4.56	43.33
2	**Member farmers**	**Number**				
2.1	Less than 30		6	3	14	23 (51)
2.2	30 to 60		5	4	1	10 (22)
2.3	Above 60		4	8	0	12 (27)
3.	**Annual income from paddy**	**Rs.**				
3.1	Less than 5 lakhs		0	1	8	9 (20)
3.2	5 lakhs to 10 lakhs		4	3	7	14 (31)
3.3	10 lakhs to 15 lakhs		2	2	0	4 (09)
3.4	15 lakhs o 20 lakhs		1	2	0	3 (07)
3.5	20 lakhs to 25 lakhs		3	0	0	3 (07)
3.6	25 lakhs to 30 lakhs		2	0	0	2 (04)
3.7	Above 30 lakhs		3	7	0	10(22)

Source: Compiled from primary data
Note: Figures in parenthesis represents percentage share of each to total

Table 4.9 indicates that with a few exceptions the Padasekharams under the study are of small areas within the classification of 1 to 8 Ha having the highest number. The users of Parijatham AMSC have the smallest Padasekharams, with an average area of 4.56 Ha. The average landholding of Sivasakthi is too high at 103.85 Ha, since there are five very large Padasekharams with one up to 1040 Ha.

Regarding the member strength, 51 per cent of padasekharams are found to have less than 30 farmers and only 27 per cent are having farmer members more than 60. In the case of Parijatham AMSC majority of the surveyed Padasekharams (93 per cent) are formed with less than 30 farmers. But under Sivasakthi 53 per cent of the Padasekharams are with more than 60 farmers, since the size of the Padasekharams are also large as already seen.

The higher income earning Padasekhara Samithies are found to be from Sivasakthi and Green Army. This is because of the large landholdings of these Padasekharams. There are five and seven Padasekharams with more than 22 ha getting the services of Green Army and Sivasakthi respectively. These 12 Padasekharams come in the category of having annual income exceeding Rs 25 lakh.

4.3.3 Paddy landholdings of individual farmers

Normally farmers are classified on the basis of their land holding as tenant farmers, marginal farmers, small farmers and large farmers. Here, only the paddy land holdings of the farmers are taken into account for the purpose of classification. Tenant farmers are those who undertake paddy cultivation on land owned by a landlord or on leased lands. Marginal farmers are those farmers having paddy land up to one Ha. Those farmers having paddy land exceeding one Ha and up to two Has come under the category of small farmers. Farmers with paddy land exceeding two Has are classified as large farmers. There is no tenant farmer among the farmer respondents selected for the study and hence the classification not given in the Table. The classification of the farmers selected for the study based on their farm size under paddy is illustrated in Table 4.10

Table 4.10 Paddy farm size of individual farmer respondents

Type of farmer	Number of respondents					Grand Total
	Users of AMSC			Total users	Non-users of AMSC	
	Green Army	Sivasakthi	Parijatham			
Marginal farmers	13	8	10	31 (69)	43 (96)	74 (82)
Small farmers	2	2	4	8 (18)	2 (04)	10 (11)
Large farmers	0	5	1	6 (13)	0	6 (07)
Total	15	15	15	45 (100)	45 (100)	90 (100)

Source: Compiled from primary data
Note: Figures in parenthesis represent percentage share of each to total

As evident from Table 4.10 marginal farmers are predominant (82 per cent) among the sample respondents which points out to the prominence of marginal paddy farmers in the study area. The existence of small and large farmers is very few in the study area as revealed from the limited number of small and large farmer respondents. Among the three AMSCs, Green Army provides services to more number of marginal farmers. In the case of non-users, a still higher proportion than users of AMSCs is represented by marginal farmers.

4.3.4 Cropping pattern of farmers

Cropping pattern is the proportion of area under various crops at a point of time. The cropping pattern of a region is closely influenced by the geo-climatic, socio-economic, historical and political factors (Hussain, 1996). Patterns of crop land use of a region are manifestation of combined influence of physical and human environment. Weather plays a decisive role in determining the existing cropping pattern. Cropping pattern also depends on terrain, topography, slope, soils, and availability of water for irrigation, pesticides, fertilisers and mechanisation. The cropping pattern of farmers in the surveyed area is as depicted in Table 4.11.

Table 4.11 Cropping pattern of farmers

AMSC	Number of respondents				
	Rice	**Coconut**	**Banana**	**Arecanut**	**Others**
Green Army	15 (100)	8 (53)	2 (13)	1 (07)	2 (13)
Sivasakthi	15 (100)	4 (27)	1 (07)	1 (07)	1 (07)
Parijatham	15 (100)	7 (47)	4 (27)	2 (13)	1 (07)
Total users	45 (100)	19 (42)	7 (16)	4 (09)	4 (09)
Non-users	45 (100)	24 (53)	16 (36)	13 (29)	25 (56)
Grand Total	90 (100)	62 (69)	23 (26)	21 (23)	33 (37)

Source: Compiled from primary data
Note: Figures in parenthesis represent percentage share of each to total

The cropping system of farmers consists of paddy, coconut, banana, arecanut and other crops. Other crops include vegetables, nutmeg, pepper, cashew, cocoa, tapioca and rubber. Since the study is conducted among paddy farmers, there is cent per cent paddy farming among all farmers. It can be observed from the Table that after paddy, coconut, arecanut and banana are the major crops cultivated by farmers in the order of prominence. The other crops including vegetables are also cultivated in the study area but their share in the cropping pattern of farmers is less. But the picture is different with respect to non – users. In the case of non-users of Avanoor Panchayat prominence is for vegetables, while in Pazhayannur Panchayat it is for vegetables and rubber after paddy.

4.3.5 Status of farm mechanisation adopted by farmers

Farm mechanisation is an important element of modernisation of agriculture. Farm productivity is positively correlated with the availability of farm power together with efficient farm implements and their careful utilisation. Farm mechanisation not only enables efficient utilisation of various inputs such as seeds, fertilizers, plant protection chemicals and water for irrigation, but also

helps in poverty alleviation by making farming an attractive venture. In India 85 per cent of the land holdings belong to marginal and small farmers (Mehta, 2014). Mechanising such farms is against the 'economies of scale' for individual ownership of farm machinery. So farmers go for AMSCs and private agencies for their mechanisation needs. The status of farm mechanisation adopted by the farmers is analysed by taking into account the mechanised farm operations of the farmers either through AMSCs or through private agencies. The details are presented in Table 4.12.

Table 4.12 Status of mechanisation adopted by farmers

Sl. No	**Farm operations**	**Users of AMSCs**			**Total users**	**Non-users**	**Grand Total**
		Green Army	**Sivasakthi**	**Parijatham**			
1.	Land preparation	30	30	30	90	45	135
2.	Transplanting	30	30	30	90	0	90
3.	Harvesting	30	30	30	90	45	135

Source: Compiled from primary data

Table 4.12 represents the major farm operations involved in farming. It can be seen from the Table that farm operations by the farmers are not fully mechanised. Among the various farm operations mechanised till now elsewhere, viz., tillage, sowing, irrigation, plant protection, threshing and harvesting, mechanisation is adopted only for land preparation, transplanting and harvesting in Kerala and in the study area. In the case of users of AMSCs, mechanisation is adopted in all the three farm operations. But it to be noted that in the case of all the users, they depend on AMSCs only for transplanting; the mechanisation needs for land preparation and harvesting are met through private agencies. As far as land preparation is concerned mechanisation for land preparation has not yet been started by AMSCs. Due to the increased hiring charges of AMSCs for harvesting, the farmers depend on private agencies. But non-users of AMSCs are still following manual transplanting instead of mechanised transplanting and adopting mechanisation only for land preparation and harvesting. The water- logged nature of the land held by non-users hinders them from adopting mechanised transplanting in their land.

4.3.6 Extent of mechanised area in paddy farming

Agricultural mechanisation is an inevitable process of social development and an important phase of agricultural modernisation. Among the crops cultivated by the farmers mechanisation is widely practiced in paddy. So the mechanised area of farmers covers only the area under paddy cultivation. The land under paddy cultivation is considered as mechanised if any one of the agricultural operations is mechanised by the farmer. The extent of mechanised area of the respondent farmers including the individual users, group users and non – users of AMSCs is analysed by taking the percentage share of paddy land to total land holdings of farmers and presented in Table 4.13

Table 4.13 Extent of mechanised area of respondent farmers

Sl. No	Mechanised area (in %)	Users of AMSCs		Total users of AMSC	Non-users of AMSC	Grand Total
		Individual users	Group users			
1.	0 to 25	00	00	00	2(4)	2(1)
2.	26 to 50	2	00	2(2)	15(33)	17(13)
3	51 to 75	7	00	7(8)	12(27)	19(14)
4.	76 to 100	36	45	81(90)	16(36)	97(72)
5.	Average mechanised area (%)	81.49	100	90.74	62.80	81.43

Source: Compiled from primary data
Note: Figures in parenthesis represent percentage share of each to total

As evident from Table 4.13, 81.43 per cent of the total land holdings of the farmers are mechanised. The mechanised land holding is more for users of AMSCs (90.74 per cent) than for non-users (62.80 per cent). The vast difference between mechanised land holding among users and non-users is due to two factors. One is that group farmers pool their paddy land to form Padasekharams and the area under a Padasekharam is fully mechanised. Since Padasekharam as a single unit is selected, there is no question of any other land. Secondly, it is already seen that 96 per cent of the non – users are marginal farmers based on

their paddy land holdings (Table 4.10). But their total landholding is much more than the paddy landholdings. The non - users from Avanoor and Pazhayannur panchayats give prominence to other crops as well (Table 4.11). Mechanisation is available at present only for paddy. Hence their mechanised land is less compared to the users of AMSCs.

In order to find out whether there is any significant difference in the mechanised land holding of users and non – users of AMSCs, t-test has been done and results given in Table 4.14.

Table 4.14 Independent sample t-test of mechanised area: Farmer category - wise

Sl. No	Variables	Mean	F	t statistics	p- value
1.	Users of AMSCs	90.7651	214.603**	6.100	0.000**
2.	Non- users of AMSCs	62.1178			

The t- statistic is significant at one per cent level which implies that there is significant difference between mechanised land holding of users and non-users of AMSCs. It is evident that, users of AMSCs has more mechanised land holdings than the non users. ANOVA test has been performed to identify whether there is any significant difference between mechanised land holdings of each farmer category, viz., individual users of AMSCs, group users of AMSCs and non-users of AMSCs.

Table 4.15 Analysis of Variance of mechanised area: Farmer category - wise

Sl. No	Particulars	Sum of Squares	Mean Square	F	Sig.
1.	Between Groups	31140.361	15570.180	67.906	0.000**
2.	Within Groups	30266.148	229.289		
3.	Total	61406.508			

ANOVA result observed a significant difference at one per cent level in the mechanised land holdings of individual users of AMSCs, group users of AMSCs and non-users of AMSCs. As indicated in Table 4.13 group users of AMSCs have more mechanised land holdings than individual users of AMSCs

and non users of AMSCs. So Post- hoc test was performed to find out the groups between which there is significant difference.

Table 4.16 Result of Post-hoc test of mechanised area: Farmer category - wise

Sl. No	Type of farmers		Sig.
1.	Group	Individual users	0.000**
		Non-users	0.000**
2.	Individual	Group users	0.000**
		Non-users	0.000**
3.	Non-users	Group users	0.000**
		Individual users	0.000**

The post hoc test reveals that there is significant difference in the mechanised land holding of group users and individual users of AMSCs, group users and non- users of AMSCs and also between individual users and non-users of AMSCs. It means that as the size of paddy land holding increases, the mechanised area also increases.

4.3.7 Ownership of farm implements by farmers

The traditional farm tools and implements mainly relied on use of animate and human power. Improved farm tools and implements which use mechanical power were devised from time to time. The major farm implements used by farmers include tractor, transplanter, power tillers, pumpsets and sprayers. Farmers may purchase it by themselves or take it on rent as per their needs. It is more economical to take implements on rent rather than purchasing. Table 4.17 deals with the details of ownership of farm implements by the sample respondents. The total column represents the total number of farmers in each category.

Table 4.17 Ownership of farm implements by farmers

Sl. No	Farm implements	Users of AMSCs		Total users of AMSC	Non-users of AMSC	Total
		Individual users	Group users			
1.	Tractor	1	0	1 (01)	0	1 (0.8)
2.	Transplanter	0	0	0	0	0
3	Power tiller	0	3	3 (03)	0	3 (02)
4.	Pumpsets	4	21	25 (28)	7 (16)	32 (24)
5.	Sprayers	16	30	46 (51)	19 (42)	65 (48)
	Total of each group	45	45	90	45	135

Source: Compiled from primary data

Note: Figures in parenthesis represent percentage share of each to total

It can be observed from Table 4.17, that majority of the farmers do not own farm implements. The reasons for lack of ownership of farm implements are small land holdings and high investment required. It is not economical for individual farmers to own agricultural implements for their use alone. But it can be affordable to the group farmers and AMSCs. So farmers seek the help of Agro Machinery Service Centres for their mechanisation needs. Among the total sample respondents only one farmer owns tractor which is used for own purpose and also rented out. Sprayers are the most commonly purchased farm implement followed by pumpsets. Farmers have purchased sprayers for their own use since it is affordable to the farmers. Pumpsets are purchased by individual farmers for irrigating crops other than paddy. Normally paddy is irrigated with water stored in bunds and canals. In the case of non-users also, sprayers are the major mechanised equipment owned by farmers. It is inferred that farmers are not in a position to buy huge farm machines and if mechanisation has to take place, the machines should be available on rent. This calls for the need for Agro Machinery Service Centres or similar institutional set up for the provision of machines and implements on hiring basis to the farmers.

4.3.8 Extent of usage of farm implements by farmers

Traditionally, land preparation and transplanting of paddy was done manually and also by animals. The system of manual operations is becoming increasingly expensive and farmers also face the difficulty of lack of transplanting distance which can be avoided by adopting mechanised transplanting. Mechanised transplanting can cover more area with less labour thus reducing the burden of high labour cost with the advantage of uniformity in spacing and density of plants. This also helps the seedlings to have better growth. .

Paddy harvesting activities include cutting, stacking, handling, threshing, cleaning and hauling. These can be done individually or a combine harvester can be used to perform the operations simultaneously. It is important to apply good harvesting methods to be able to maximise grain yield, and minimise grain damage and quality deterioration. Feasibilities and opportunities for harvesting and post-harvest processing operations through combined harvesters have reduced the cost of risks involved in paddy cultivation. Traditionally farmers seek the help of manual labour for harvesting the crop. In order to harvest an acre of land, a minimum of 20 labourers are needed. However, by using machine harvesters, farmers can save labour, cost as well as the time required for harvesting. Sprayers are one of the widely used farm implements for applying plant-protecting chemicals in the field.

For measuring the extent of usage of various farm implements by the farmer respondents, usage index was constructed. For the construction of this index, farmers were asked to rate the extent of usage of each farm implement on a three point scale i.e. Always, Occasional and No usage. The opinions of farmers were assigned the scores of 2, 1 and 0. The score of all the farmer respondents for each farm implement were summed up to arrive at the total score. The total score obtained by each farm implement was then divided by the maximum possible score for that farm implement to obtain the index of usage of that farm implement. The index was separately calculated for individual users, group users and non -

users. Usage index for farm implements such as tractor, transplanter, sprayers and harvester using three point scale are depicted in Table 4.18.

Table 4.18 Usage index of farm implements by farmers

Sl. No	Users of AMSCs	Farm implements				Overall index
		Tractor	Transplanter	Harvester	Sprayers	
1.	Green Army	100	100	100	100	100
2.	Sivasakthi	100	100	100	100	100
3.	Parijatham	100	100	100	93.33	98.33
	Overall index	100	100	100	97.77	98.52
4.	Non-users	100	0	100	85.56	71.38
	Composite index	100	66.67	100	90.74	89.35

Source: Compiled from primary data

The major use of tractors is for preparing land before sowing. All the farmers, both in the users and non-users of AMSCs category are using tractors for land preparation and hence the composite index is 100. Power tiller is another implement used for land preparation instead of tractors. It is economical than tractor and can be easily used in wet areas. But no farmer in the study area is using tillers.

It also inferred that 100 per cent of users of AMSCs applying mechanised transplanting in their fields. As result of this the use of labour in the field gradually reduced. They are also enjoying the benefits of mechanised transplanting i.e. uniformity in spacing and more number of seedlings per row. In the case of non-users they are not adopting mechanised transplanting because of the water logged nature of the field. So the non-users have to engage more labour at a high wage rate.

The farmers, both users and non-users of AMSCs adopt cent per cent mechanised harvesters in their field. They find economies of scale in the use of harvesters compared to manual labour. Further, harvesting operations are to be

done in a timely manner to avoid wastage and losses of grain. Mechanised harvesters offer solution to labour scarcity for timely harvesting of paddy.

The usage index of sprayers is more among users of AMSCs (97.77 per cent) than the non-users (85.56 per cent). Recently, farmers are trying to adopt organic methods of cultivation by reducing chemicals. It reduces the use of sprayers by the farmers to some extent. It is already seen that sprayers are the most commonly purchased farm implement by farmers (Table 4.17). Hence the usage of sprayers for paddy cultivation without depending on AMSCs is prevalent among farmers. In general, the use of farm machinery and implements is more among the users rather than non – users of AMSCs, even though the users depend on AMSCs only for transplanting operations of paddy (Table 4.12).

4.3.9 Measurement of mechanisation of farmers

The sustainable development of an area is possible through development in agriculture. But over the years people were demotivated to undertake agricultural activities due to severe labour shortage. The adoption of mechanisation became a revolutionary model in agriculture sector. Mechanisation of agriculture is an important factor promoting higher output of the agricultural farm and thereby increasing profitability of the farming practices (Ghosh, 2012). In this context, measurement of the extent of adoption of mechanisation by farmers gains more importance, which is measured in the study using mechanisation index.

4.3.9.1 Mechanisation index

Mechanisation planning requires the quantitative assessment of a mechanisation index, and its impact on agricultural production or yield, and economic factors like, cost of cultivation, deployment of animate and mechanical power, and economic advantage. The index should incorporate the relevance and economic utility of using equipments with animate and electro-mechanical power for different farm operations in different crops. A mechanisation index based on

the ratio of cost of use of machinery to the total cost of use of human labour, draught animals and machinery has been suggested for estimation (Singh, 2006).

Mechanisation index (IE) expressed by the percentage of machine work (EM) to the sum of manual (EH), animal (EA) and machine work (EM) expressed in energy units, as suggested by Nowacki (1978), has been accepted as a model for measuring mechanisation. The Equation would be:

$$IE = EM/ (EH + EA + EM) \quad \text{Equation (1)}$$

A mechanisation index based on the matrix of use of animate and mechanical energy inputs is given by incorporating cost factors into Equation (1).

$$MI = CM/ (CH + CA + CM) \times 100 \quad \text{Equation (2)}$$

Where, MI is the mechanisation index; CM is the cost of use of machinery; CH is the cost of use of human labour; and CA is the cost of use of animal labour. In the study area, none of the farmers are using animal labour for cultivation. So there is no animal labour cost for calculating the mechanisation index. Based on the above discussion, two types of indices are developed for the purpose of the study, viz.,

(i) Overall mechanisation index
(ii) Mechanisation index for usage of AMSC service

(i) Overall mechanisation index

Overall mechanisation index follows the aforesaid criteria for estimating the index based on overall mechanisation costs in relation to the sum of costs for labour as well as machine usage.

Table 4.19 Overall mechanisation index for paddy farming

Sl. No	Farmer groups	Mechanisation index				Average index
		0 to 20	20 to 40	40 to 60	60 to 80	
1.	Green Army	0	0	22	8	57.79
2.	Sivasakthi	0	0	18	12	56.99
3.	Parijatham	0	0	2	28	61.62
	Total users	**0**	**0**	**42**	**48**	**57.34**
4.	Non users	5	33	7	0	30.72

Source: Compiled from primary data

As revealed by Table 4.19, the mechanisation index is 57.34 per cent for users and 30.72 per cent for non-users. i.e. users of AMSCs are adopting more mechanisation in their farm operations than the non-users of AMSCs. The difference in the degree of mechanisation is due to the present status of mechanisation adopted by the farmers as revealed by Table 4.12. Hence, more the mechanisation index less would be the labour cost incurred for users of AMSCs. The higher mechanisation cost of users of AMSCs is nullified by the higher labour cost of non-users of AMSCs.

To test the hypothesis that users have higher mechanisation index than non-users, t- test was performed. The results are depicted in Table 4.20

Table 4.20 Results of Independent sample t-test for mechanisation index

Sl. No	Variables	Mean	F	t statistic	p- value
1.	Users of AMSCs	60.2377	90.099**	24.189**	0.000
2.	Non- users of AMSCs	30.6271			

The t- statistic is significant at one per cent level. This indicates that there is significant difference in the mechanisation index of users and non-users of AMSCs. i.e. mechanisation index is high among users than non-users. Users of AMSCs adopt more mechanisation in their farm operations than non - users. Hence it is implied that extent of usage of mechanisation is higher in users of AMSC when compared to non-users.

(ii) Mechanisation index of usage of AMSC service

AMSCs are mainly providing the transplanting service to the farmers. In order to compute the mechanisation index for usage of services of Agro Machinery Service Centres, their transplanting services alone is taken into account. The index helps to understand the effect of using such services in replacing the overall labour costs incurred in farm operations. This index is the ratio of mechanised transplanting cost to total labour cost and machine cost. The index is also useful to understand the contribution of such services to overall mechanisation of paddy farming. It is done only for users of AMSCs since non – users do not avail such services from AMSCs. The mechanisation index of usage of transplantation costs and its proportion to total mechanisation costs of users are depicted in Table 4.21.

Table 4.21 Mechanisation index of usage of services of AMSCs

Sl. No.	Farmer group	Mechanisation index			Average index	Proportion of AMSC charges to total mechanisation cost
		0 to 15	15 to 30	30 to 45		
1.	Green Army	0	28	2	26.39	45.68
2.	Sivasakthi	0	24	6	30.05	52.73
3.	Parijatham	0	7	23	30.93	50.19
	Total	0	59 (66)	31 (44)	29.48	51.40

Source: Compiled from primary data
Note: Figures in parenthesis denote proportion of respondents in the category to total users

For 66 per cent of the users, the mechanisation index of usage of services of AMSCs lies between 15 to 30 per cent. The average mechanisation index of usage of AMSC is estimated at 29.48 per cent. It means that out of the total labour and machine cost of users, the cost incurred for using AMSC services of transplantation is almost 30 per cent. i.e., the cost incurred by non - users over and above this 30 per cent for transplantation can be saved, if they shift to mechanisation of transplantation. It is also found that the share of transplantation costs to total mechanisation costs of land preparation, transplantation and harvesting of users is nearly 51 per cent. This implies that, out of the total

mechanisation costs, 51 per cent is contributed by AMSCs by the way of transplanting cost.

It can be concluded that paddy is the main crop which has been mechanised and major portion of paddy land holdings in the study area are mechanised. Traditionally cultivation of paddy was highly labour oriented. But, at present scarcity of labour and high wage rate has demotivated people to continue with paddy cultivation. The introduction of machines displaces labour at certain stages of cultivation especially preparation of land, transplanting and harvesting. The major farm implements used are tractors, transplanters, pumpsets and sprayers. However purchase of major implements by farmers is not feasible. Introduction of AMSCs is a boon to the farmers at this level where they can avail mechanised farm operations by a skilled crew using specialised implements, which will ensure timely operations and offer first hand solutions to the problems of labour scarcity for farm operations. Since the users of AMSCs are adopting mechanised transplanting other than land preparation and harvesting, the extent of mechanisation is higher for them compared to non-users.

4.4 Determinants of paddy mechanisation through AMSCs

The second objective of the study is to identify the determinants of paddy mechanisation through AMSCs. AMSCs are the promoters of farm mechanisation among the farming community. The Centres act as technology and information disseminating centres and provide modern machinery services to farmers. Many authors have made an attempt to study the various determinants of farm mechanisation among the farmers. According to Rasouli *et al.* (2009) and Amadi *et al*. (2010) the concept of farm mechanisation is determined by a set of inter - related factors including size of farm, irrigation, access to institutional credit, and experience of farmers. In the present study the researcher has tried to identify the determinants of paddy mechanisation through Agro Machinery Service Centres by taking into account the relationship between overall mechanisation index of farmers and variables such as level of education, farm experience, cost of

cultivation, production and income from paddy. The same variables are considered for group farmers except education and farming experience. To identify the determinants, Chi-square test was used and the values are presented in a 2x2 contingency table. If any of the values in a 2x2 contingency table is less than five, Yates's correction factor for continuity is performed to find out the determinant. If any variable is found to be a determinant of mechanisation, it is considered as a determinant of adoption of mechanisation by users through AMSCs. The variables considered for determinants along with their Table values and level of significance is presented in Table 4.22.

Table 4.22 Determinants of mechanisation by users of AMSCs

Sl. No.	**Variables**	**Mechanisation index**		**X^2 value**	**p- value**
		40 to 60	**60 to80**		
1.	**Education**				
	Up to SSLC	8	20	0.004	0.952
	Above SSLC	5	12		
2.	**Experience in farming**				
	0 to 30	5	7	1.301	0.254
	30 to 60	8	25		
3.	**Cost of cultivation**				
	34000 to 43000	37	9	43.108**	0.000
	43000 to 52000	5	39		
4.	**Production**				
	3000 to 6000	17	27	2.230	0.135
	6000 to 8000	25	21		
5.	**Income from paddy**				
	50000 to 100000	17	28	2.857	0.091
	100000 to 150000	25	20		

Source: Compiled from primary data

From Table 4.22 it is inferred that the Chi-square value is significant at one per cent level, only in the case of cost of cultivation, which means that cost of cultivation is a determinant of adoption of mechanisation by the users of AMSCs.

Through mechanisation farmers can save labourers, thus resulting in reduction of labour cost. This ultimately leads to lower cultivation cost.

The Chi-square value fails to show any relationship between mechanisation index and education, experience, production and income from paddy of user farmers. Hence it is inferred that these variables has no role in the adoption of mechanisation by the farmers through AMSCs.

The determinants of adoption of mechanisation by non-users of AMSCs are also found out with the help of Chi-square test by using the same variables as in the case of users of AMSCs. Here, for variables like education, experience in farming, production and income from paddy, Chi-square is calculated using Yates's correction factor since one of the values in a 2x2 contingency table is less than 5. The values are depicted in Table 4.23.

Table 4.23 Determinants of mechanisation by non-users of AMSCs

Sl. No.	**Variables**	**Mechanisation index**		**X^2 value**	**p- value**
		0 to 20	**25 to 50**		
1.	**Education**				
	Up to SSLC	7	23	0.015	1.000
	Above SSLC	4	11		
2.	**Experience in farming**				
	0 to 26	3	18	1.290	0.256
	26 to 52	8	16		
3.	**Cost of cultivation**				
	35000 to 55000	6	13	0.906	0.341
	55000 to 75000	5	21		
4.	**Production**				
	2500 to 5000	8	19	0.406	0.524
	5000 to 7500	3	15		
5.	**Income from paddy**				
	35000 to 71000	4	9	0.061	0.805
	71000 to 107000	7	25		

Source: Compiled from primary data

In the case of non- users of AMSCs, Chi-square fails to show any relationship between adoption of mechanisation and education, experience in farming, cost of cultivation, production and income from paddy. The water logged nature of land hinders them from adopting mechanisation especially for transplanting. So they depend on manual labourers for transplantation. The farmers cannot adopt mechanisation for transplanting even though they are aware that mechanisation will lead to reduced cost of cultivation. This leads to high cost of cultivation and less income from paddy. If they were in a position to adopt mechanised transplanting, they would also have become users of AMSCs by adopting mechanised transplanting and enjoying economies of scale in their cultivation.

4.4.1 Evaluation of service quality of AMSCs

The quality of services provided by AMSCs may be considered as one of the factors determining the selection of AMSCs and hence inquired into as a determinant of mechanisation through AMSCs. The variables identified with respect to quality of services are accessibility, approachability, punctuality, skillfulness of workers, specialised services, usefulness in farm operations, time saving and cost saving.

The qualities are analysed using a service quality index. For calculating the index, farmers are asked to rate the qualities through a five - point scale ranging from 1 to 5. The response of farmers was rated as Very Good, Good, Moderate, Poor and Very Poor. ‘Very good’ is assigned a score of ‘5’ and rest of them in descending order with ‘Very Poor’ rated as ‘1’. The index is calculated separately for individual users and group users. An overall index of AMSCs is also worked out from the response of farmers and is given in Table 4.24. The specialised services as one of the indicators of service quality include any other mechanisation service over and above transplantation service. Punctuality and timeliness are defined differently. By punctuality is meant whether the Centre undertakes the work at the time already agreed upon, while timeliness denotes

whether the Centre has availability of skilled labourers and machines at its disposal to meet the demands of the farmers whenever they approach the Centre.

Table 4.24 Index of service quality of AMSCs

Indicators of service quality	**Green Army**		**Sivasakthi**		**Parijatham**		**AMSC index**
	Individual	**Group**	**Individual**	**Group**	**Individual**	**Group**	
Accessibility	86.67	92	88	84	84	80	86.89
Approachability	89.33	93.33	90.67	89.33	85.33	90.67	89.78
Punctuality	81.33	94.67	84	89.33	80	93.33	87.11
Skillfulness of workers	100	100	100	100	100	100	100
Specialised services	20	20	20	20	20	20	20
Timeliness	90.67	92	88	88	94.67	85.33	89.78
Time saving	100	100	100	100	100	100	100
Cost saving	100	100	100	100	100	100	100
Overall service quality	85		83.83		83.33		

Source: Compiled from primary data

It could be observed from Table 4.24 that skilled labour force provided by AMSCs and saving in time and costs of farm operations are the major indicators of service quality of AMSCs which encourage all the user farmers to depend on AMSCs for the mechanisation of their paddy farming operations. Farmers are experiencing acute labour shortage at peak seasons due to the availability of employment to those people below poverty line under the Mahatma Gandhi National Rural Employment Guarantee (MGNREG) Act, 2005 and huge demand from the construction sector in cities. The availability of labour at exhorbitant rates leading to higher cultivation cost per Ha dissuades the farmer to depend on manual labour and encourages to go for mechanisation. AMSCs are tailor - made solution to this problem wherein labourers are organised to carry out bulk operations using specialised mechanical implements especially paddy transplanting with minimum time requirement. This will directly reduce the cost of cultivation. The charges for the services provided by AMSCs other than transplanting which is categorised as ‘specialised services’, are very high which is not affordable to the farmers. Hence farmers rate such services as ‘very poor’,

providing the least score i.e. one. The services of AMSCs are getting extended to other districts, especially in the case of Green Army and Sivasakthi. Due to the seasonality in agricultural operations, the farmers, whether individual or group might be demanding the services of AMSCs at the same time. As the demand is getting increased day by day, the Centres may not be able to allocate skilled labourers and machines and attend mechanisation work at a time in all the fields. Hence there might be some delay in certain cases. As a result the farmers have given lower scores for punctuality and timeliness.

The overall evaluation of AMSCs shows that Green Army takes the lead position (85%) followed by Sivasakthi (83.83%) and Parijatham (83.33%). Due to the better service quality of Green Army its operations are spread to more districts of Kerala compared to the other two AMSCs. The farmers as a whole are satisfied with the performance of their respective AMSC as evident from the index of 100 for the indicators of skilled labour force provided by AMSCs and saving in time and costs of farm operations. It has already been proved statistically that cost of cultivation is a determinant of mechanization (Table 4.22), which is reinforced here. In addition to cost of cultivation, saving in time and availability of skilled force are factors that encourage the farmers to opt for mechanisation, in the opinion of farmers. It can be concluded that reduced cost of cultivation, availability of skilled labour force, and saving in time are the factors that encourage the adoption of mechanisation by farmers through AMSCs.

4.5 Impact of AMSCs on mechanisation of paddy cultivation

The third and important objective of the study is to examine the impact of AMSCs on mechanisation of paddy cultivation. The impact is measured by attempting a disaggregated analysis of different aspects of cost and production of rice. To examine whether there is any significant difference in the cost incurred and production of rice between users and non-users of AMSCs, t- test has been performed. The analysis of impact of AMSCs on mechanisation is structured under four sections, considering the various aspects of paddy farming.

4.5.1 Impact of AMSCs on cost of cultivation of paddy

4.5.2 Impact of AMSCs on labour cost

4.5.3 Impact of AMSCs on production of rice

4.5.4 Evaluation of benefits of AMSCs

4.5.1 Impact of AMSCs on cost of cultivation of paddy

The cost of cultivation of rice is the total of material costs, cost of labour, machine cost and miscellaneous expenses. Material cost includes cost of seed, plant protection and fertilizers. Machine rental charges for land preparation, mechanised transplanting and harvesting are covered under machine cost. Labour cost is the sum total of cost incurred for bunding, inter cultural operations and manual transplanting. Transportation cost and other expenses which are not included in the above constitute the miscellaneous expenses of paddy cultivation. In order to compute the cost of cultivation of paddy, the cost per Ha is calculated for each farmer respondent and put under class intervals ranging from Rs. 34,000 to above Rs 46000. The percentage of farmers comprising of individual users, group users and non – users in each class is found out. An independent sample t-test is applied to check whether there is any significant difference in the cost of cultivation of paddy among the users and non-users of AMSCs.

Table 4.25 Cost of cultivation of farmer respondents

Sl. No.	**Cost of production/Ha (in Rs.)**	**Users of AMSC**		**Total users**	**Non-users of AMSCs**	**Grand Total**
		Individual	**Group**			
1	34000 to 37000	1	1	2 (2)	1 (2)	3 (2)
2	37000 to 40000	3	2	5 (6)	1 (2)	6 (5)
3	40000 to 43000	17	22	39 (43)	2 (5)	41 (30)
4	43000 to 46000	16	19	35 (39)	0	35 (26)
5.	Above 46000	8	1	9 (10)	41 (91)	50 (37)
	Total	45	45	90	45	135
	Average cost	42980	41625	41590	48360	41750

Source: Compiled from primary data

Note: Figures in parenthesis represents percentage share of each to category total

Table 4.25 reveals that the average cost of cultivation per Ha is lower for users of AMSCs (Rs. 41590) compared to non – users (Rs 48360). Within the users, group users have lesser cost due to economies of large scale production. The cost of cultivation of 37 per cent of farmers is more than Rs. 46000 per Ha. Ninety one per cent of non – users fall in this category, while it is only 10 per cent for the users. It is because non -users belonging mainly to Pazhayznnur, Avanoor and Kuzhoor Panchayats are mainly dependent on manual labourers, especially for transplanting due to the water logged nature of the land and adopt mechanisation only for land preparation and harvesting which constitutes adoption of only 30 per cent of mechanisation in their field (Tables 4.12 and 4.19). Apart from this, the non-users of Pazhayannur Panchayat are adversely affected by weed problems and pest attacks, as a result of which they have to incur more labour charges for inter - cultural operations. In the case of Avanoor and Kuzhoor panchayats, farmers are facing severe labour shortage because of the migration of agricultural labourers into MGNREG programme. Farmers have to pay high wages to the available labourers. As a result, cost of cultivation of non-users has increased considerably. In Avanoor Panchayat, in order to tackle the labour problems, farmers are availing the services of migrant labourers from the State of Bengal. In the case of users, they are adopting 57 per cent mechanisation in paddy farming (Table 4.19), and using mechanised transplanting services, the cost of which are less than that of human labour. So users have the benefit of less cultivation cost than non-users. Table 4.21 has revealed that out of the total labour and machine cost of users, the cost incurred for using AMSC services of transplantation is almost 30 per cent. This implies that the cost incurred by non - users over and above this 30 per cent for transplantation can be saved, if they shift to mechanisation of transplantation, leading to reduced cost of cultivation of paddy.

Sidhu and Vatta (2012) in their study titled “Improving economic viability of farming- A study of Co-operative Agro Machinery Service Centres in Punjab” found that the operations of the AMSCs are economically viable as the

service centres have been generating profits to the extent of two to thirty per cent of the annualised costs. It has also helped in reducing the debt burden of the farmers by bringing down the costs of operations. This is reiterated by the finding of the present study that An independent sample t-test is performed to check whether there is any significant difference in the cost of cultivation between users of AMSCs and non-users of AMSCs. The result is depicted in Table 4.26.

Table 4. 26 Independent sample t-test of cost of cultivation: Category wise

Sl. No	Variables	Mean	F	t statistic	p- value
1.	Users of AMSCs	43015.25	67.738**	-6.096**	0.000
2.	Non- users of AMSCs	55441.9768			

The t- statistic is significant at one per cent level. It indicates that there is significant difference in the cost of cultivation between users and non- users of AMSCS. i.e., non-users have to spend more by way of cultivation cost than the users of AMSCs. By adopting mechanised transplanting service of AMSCs users are saving labour cost and hence less cultivation cost than non-users**.**

4.5.2 Impact of AMSCs on labour cost

Labour is an important element of agricultural operation. Labour cost covers the actual wages paid to the workers and the imputed value of family labour (Thomas, 2002). Labourers are required for rice farming, mainly for bunding, sowing and transplantation, inter - cultural operations and transportation. Wages per man-day differ from area to area. Normally a male labourer is paid a minimum of Rs. 650 and female labourer Rs. 400 for a maximum of seven hours per day. Farmers are adopting mechanisation as a solution to severe labour shortage. The saving of labourers and labour cost is possible in land preparation, transplanting and harvesting operations. As already stated, the difference between users and non – users is in the usage of machines for transplantation.

Table 4.27 exhibits the average of the various costs involved in paddy farming and the proportion of each to the total cost of cultivation. These include

either AMSC cost or manual transplantation cost, other machine costs, other labour costs, and other costs, consisting of material and miscellaneous expenses. The mechanisation cost of paddy cultivation includes cost of land preparation, transplanting and harvesting. Mechanised transplanting cost is the AMSC cost. Other machine costs include cost of land preparation and harvesting. Other labour costs comprise of cost of bunding, inter- cultural operations and transportation. The cost is given separately for users and non-users of AMSCs.

Table 4.27 Types of costs in paddy cultivation

Sl. No	Types of cost/ Ha(in Rs)	Users of AMSC	Non-users of AMSC
1.	AMSC cost	8630 (21)	0
2.	Other machine costs	8155 (20)	11085 (23)
	Total machine cost	**16785 (41)**	**11085 (23)**
3.	Manual transplanting cost	0	10970 (22)
4.	Other labour cost	12490 (30)	15130 (31)
	Total labour cost	**12490**	**26100 (54)**
	Total machine and labour cost	**29275 (71)**	**37185 (77)**
5.	Other costs	12315 (29)	11175 (23)
	Total cost of cultivation	41590 (100)	48360 (100)

Source: Compiled from primary data
Note: Figures in parenthesis represents percentage share of each to total cost

Table 4.27 reveals that the share of machine cost to total cost is higher for users (41 per cent) than non- users of AMSCs (23 per cent). This difference in mechanisation cost is due to the difference in status of mechanisation in paddy cultivation adopted by the farmer respondents (Table 4.12). In the case of transplanting, only users are following mechanised transplanting which constitute 21 per cent of their total cost of cultivation, as seen in Table 4.27, and 51 per cent of total mechanisation cost (Table 4.21). For the same purpose of transplanting, non – users are using manual labourers and 22 per cent of their total cost is devoted for this operation. It is to be noted here that even though there is difference between users and non – users in the total cost of cultivation, there is not much difference in the proportion of transplantation cost – mechanised or

manual to total cost of cultivation of both categories. In the study area non-users of AMSCs are using migrant labourers from the State of West Bengal for manual transplanting, who are available at cheaper rates and for more man-hours per day than the native labourers. Hence there is not much variation in the transplanting cost of users and non – users. If the migrant labour had not been available, the transplantation cost of non – users would have been much higher, leading to a higher proportion of total cost of cultivation.

The materials cost including cost of seeds, fertilizers, herbicides, fungicides and miscellaneous expenses is lower for non – users, compared to users. The frequency of fertilizer and herbicide / fungicide application, type of fertilizers – chemical or organic, and distance to the markets reflecting in transportation costs are some of the factors that will cause variation in the 'other costs'.

Manual labour is being displaced by machines when mechanisation is adopted. Hence considering the total of manual labour and machine costs, it is seen that there is a difference of nearly Rs 8000/- between users and non – users, to the advantage of users of AMSCs. To get a better understanding of the machine/ labour costs involved, the activity – wise costs for which manual labour or machines are employed in rice farming, are analysed in Table 4.28.

Table 4.28 Labour/ Machine cost involved in paddy cultivation

Sl. No	**Activity**	**Average cost/Ha (in Rs)**	
		Users of AMSCs	**Non-users of AMSCs**
1.	Bunding	3750	6225
2.	Transplanting	8630	10970
3.	Weeding	2990	3775
4.	Manuring	1250	1675
5.	Plant protection	750	1310
6.	Miscellaneous labourers	3750	2145
7.	Land preparation	4100	4265
8.	Harvesting	4050	6820
	Total	29270	37185

Source: Compiled from primary data

As evident from Table 4.28, the labour costs of non – users are higher than that of users with respect to all activities, except miscellaneous labour charges. This is due to the difference in the wage rates of labourers in the area to which the farmers belong. The highest difference in costs is found in the case of transplanting, where non – users have to spend Rs 2340/- per Ha more than the users of AMSCs. This supports the statement given in the website of Food Security Army of Kerala Agricultural University that by using the mechanised transplanting services of AMSCs, farmers can save a minimum of Rs. 2500/- per Ha than doing the same with manual labourers (www.foodsecurityarmy.org).

Among the non-users, farmers of Pazhayannur panchayat are facing severe weed problems. So they have to spend more amount of money for inter- cultural operations (Table 4.25). Regarding harvesting, non-users have to pay more amount than users. The shape of landholdings by non-users creates difficulties in driving the harvesting machine and takes more time for completing the harvesting operation. Apart from these the water logged nature of land also leads to high cost for harvesting. Normally two types of harvesters are available for harvesting viz., belt type and wheel type. Belt type harvesters charges Rs. 2200 per hour and chain type charges a minimum of Rs. 1600 per hour. Belt type harvesters are used by non-users due to water logged nature of their land. So they need to pay more amounts for harvesting than users.

An independent sample t-test was employed to check whether there is any significant difference in the labour cost between users and non-users of AMSCs. The result is presented in Table 4.29.

Table 4.29 Independent sample t-test of labour cost: Farmer category - wise

Sl. No	Variables	Mean	F	t statistic	p- value
1.	Users of AMSCs	30886.7588	49.065**	-5.586**	0.000
2.	Non- users of AMSCs	37736.7209			

The t-statistic is significant at one per cent level. This indicates that, there is significant difference in the labour cost between users and non-users of AMSCs. As already seen, labour cost is more for non-users of AMSCs due to manual transplanting.

4.5.3 Impact of AMSCs on production of rice

The production of paddy is based on various inputs such as seeds, fertilisers, water management, weather conditions etc. If any of these fails to perform well, the production of paddy may be adversely affected. The yield is also dependent on the type of soil. The details of paddy production of the respondents, category – wise are given in Table 4.30.

Table 4.30 Rice production of farmer respondents: Category - wise

Sl. No.	Production (Kg/Ha)	Users of AMSC		Total users	Non-users of AMSCs	Grand Total
		Individual	Group			
1	2000 to 3000	0	0	0	1 (2)	1 (1)
2	3000 to 4000	3	1	4 (4)	15 (33)	19 (14)
3	4000 to 5000	6	5	11 (12)	11 (24)	22 (16)
4	5000 to 6000	16	13	29 (32)	17 (39)	46 (34)
5	6000 to 7000	12	14	26 (30)	1 (2)	27 (20)
6	7000 to 8000	8	12	20 (22)	0	20 (15)
	Average production	5775	6115	6090	5025	5905

Source: Compiled from primary data
Note: Figures in parenthesis represents percentage of each to total

Table 4.30 makes it clear that production of rice is higher for users of AMSCs than that of non – users. Group users have still better production than individual users, due to economies of large scale production. When the production of rice decreases, naturally the income from the same will also be less. It is already seen that non – users have less annual income from paddy with 96 per cent of them falling in the category of less than Rupees one lakh, while only 62 per cent of the farmers are in the category from users (Table 4.8). The reason for the high production is the adoption of mechanisation in the field. Mechanised transplanting ensures more growth per seedlings, more seed density and less distance between seedlings resulting in more production than manual

transplanting. The result of this study also supports the findings of Tan (1981), Verma (2001), and Reid (2011) which state that mechanisation leads to more production by the way of timeliness in farm operations and efficient management of inputs. Hence through mechanised transplanting services of AMSCs, users get more production than non-users.

Independent sample t-test is performed to check whether there is any significant difference in the production of paddy between users and non-users. The result is depicted in Table 4.31.

Table 4.31 Independent sample t-test of paddy production: Farmer category - wise

Sl. No	Variables	Mean	F	t statistic	p- value
1.	Users of AMSCs	5823.6111	3.972*	8.170*	0.000
2.	Non- users of AMSCs	4374.7222			

The t-statistic is significant at five per cent level. It reveals that there is significant difference in the production of users of AMSCs and non-users of AMSCs i.e. users have more production than non-users. By adopting mechanised transplanting, in addition to other mechanized operations, users of AMSCs get more production with less grain loss than non-users.

Apart from the impact of AMSCs discussed above, farmers are enjoying a lot of benefits from AMSCs. Farm mechanisation by using the services of AMSCs help the farmers to overcome several constraints felt by them at ground level. Hence an evaluation of the respondents' opinions regarding beneficial effects of services of AMSCs in carrying out rice farming operations is discussed in the next section.

4.5.4 Evaluation of benefits of AMSCs

The direct benefits derived by the farmers from using the services of AMSCs are listed first using an indicator approach. These benefits have been grouped into two, viz, operational benefits and economic benefits. Operational benefits include those benefits that the farmers derive from the usage of AMSCs

for operational purposes. The evaluation covers aspects such as timeliness in farm operations, overcoming paucity of labour and increase in usage of farm lands for cultivation purposes.

Usage of services of AMSCs provides the effect of what mechanisation brings about in agriculture. In fact, this can lead to economically quantifiable benefits in terms of increased production and consequent rise in income, increase in productivity due to increase in efficiency in operations of mechanisation, saving in machine buying costs and labour costs, and timeliness in farm management practices leading to increase in production.

A benefit index has been designed to examine the benefits provided by the AMSCs using a five point scale and allotted scores ranging from five to one. The response of farmers includes Very Good, Good, Moderate, Poor and Very Poor. The opinion Very good' is assigned a score of '5' and rest of them in descending order with 'Very Poor' rated as '1'. The evaluation of the benefits derived by the farmers based on the index is exhibited in Table 4.32.

Table 4.32 Evaluation of benefits of AMSCs

Benefits	**Agro Machinery Service Centres**						**Total index**
	Green Army		**Sivasakthi**		**Parijatham**		
Operational benefits	**Individual users**	**Group users**	**Individual users**	**Group users**	**Individual users**	**Group users**	
Timeliness in farm operations	88	89.33	88	88	85.33	88	87.78
Labour scarcity	100	100	100	100	100	100	100
Increased acreage of cultivation	73.33	80	76	77.33	76	74.67	76.22
Overall operational benefits	**88.44**		**88.22**		**87.33**		**88**
Economic benefits							
Capital investment in machinery	88	85.33	90.66	88	85.33	88	87.56
Improvement in farm income	86.67	93.33	92	84	89.33	84	88.22
Motivation to continue farming	100	100	100	100	100	100	100
Overall economic benefits	**92.22**		**92.44**		**91.11**		**91.93**
Over all benefits	**90.29**		**90.09**		**89.14**		**89.96**

Source: Compiled from primary data

It is clear from Table 4.32 that other than the mechanisation services, there are remarkable operational and economic benefits derived by the farmers from being users of AMSCs. There is not much difference between the three AMSCs with respect to the benefits as evaluated by the beneficiary farmers. The benefit of overcoming labour scarcity has actually given a motivation for the farmers to continue in rice farming, both of which are scoring cent per cent in the case of all three AMSCs. The farmers can get their operations done timely without any capital expenditure. The need to pay only the hiring charges for the machines without having the problems of maintenance and repairing. Improvement in farm income is possible due to advantages of mechanised transplantation like, high seed density, less grain loss and timely operations. The economic benefits have

surpassed the operational benefits since the indicator 'increased acreage under cultivation' has scored less. Mechanisation through AMSCs has motivated all the user farmers to remain and continue in rice farming, but still has to go a long way to induce them to bring additional land under rice farming.

4.6 Role of institutional credit in the mechanisation of paddy farms

The last objective of the study is to examine the role of institutional credit in the mechanisation of paddy farms. Institutional credit has a pivotal role in the agricultural development of the country, as one of the critical inputs for agriculture. It capitalises farmers to undertake new investments and adopt new technologies. A large number of institutional agencies like Co-operatives, Regional Rural Banks (RRBs), Scheduled Commercial Banks (SCBs), Non–Banking Financial Institutions (NBFIs), and Self Help Groups (SHGs) are involved in meeting the short and long term mechanisation needs of farmers. Many schemes are sponsored by the Central Government and state governments for agricultural mechanisation. This section examines the role of various institutional agencies in farm mechanisation including paddy farming, the constraints faced by farmers and AMSCs in obtaining institutional credit and suggestions for improving the delivery of institutional credit for mechanisation of paddy farming. Since there are no separate schemes for mechanisation of paddy farming alone, but only general schemes for farm mechanisation as a whole, encompassing all crops, details of such schemes are discussed in this section.

4.6.1 Schemes for agricultural mechanisation: Central and State

Government of India has introduced a number of schemes for agricultural mechanisation. Under the Schemes, machines are made available to individual farmers, SHG groups and farmer co-operatives who can hire the machines suitable for their crops. One of the ongoing schemes for agricultural mechanisation is the Sub-Mission on Agricultural Mechanisation (SMAM) under National Mission on Agricultural Extension and Technology (NMAET**),** Ministry

of Agriculture, started during the Twelfth Five Year Plan, 2012 to 2017. The Scheme is implemented in all the States, in order to promote the usage of farm mechanisation and increase the ratio of farm power to cultivable unit area upto 2 KW/ha. The Scheme is implemented through the combined contributions of the Central and State Governments in the proportion of 75: 25 respectively. Farm mechanisation programmes of Central Government are also being implemented through schemes such as Rashtriya Krishi Vikas Yojana (RKVY), Mission for Integrated Development of Horticulture (MIDH), National Mission on Oilseeds and Oil Palm (NMOOP) and National Food Security Mission (NFSM). The Central Sector schemes such as 'Promotion and Strengthening of Agricultural Mechanisation through Training, Testing and Demonstration' and 'Post Harvest Technology and Management' are also merged with this Sub-Mission.

4.6.1.1 Sub-Mission on Agricultural Mechanisation

The Scheme is implemented with the joint funding of Central and State Governments in the year 2014-15. The Mission aims at the inclusive growth of agricultural mechanisation in India by providing custom-hiring facilities for agricultural machinery. The focus of the Mission is on increasing the reach of farm mechanisation to small and marginal farmers, and to the regions where availability of farm power is low. The custom hiring of farm machinery envisages promoting establishment of farm machinery banks for custom hiring by way of providing financial assistance to individuals, Self-Help Groups or Farmers' Co-operatives in order to avoid the burden of huge capital investment on hi-tech and high productive equipments.

The Scheme helps to increase the reach of farm mechanisation to small and marginal farmers and to the regions where availability of farm power is low, by creating awareness through demonstration and capacity building activities. For the smooth implementation of the Scheme, committees are constituted at National, State and District level. Institutions identified by the States, Indian Council of Agricultural Research (ICAR) institutions, Agricultural Technology Management

Agency (ATMA), and Central Farm Machinery Training and Testing Institute (FMTTI) are the implementing agencies of the Scheme. The expected output of the Mission is the inclusive growth of farm machinery in the next five years in terms of farm power availability, human resource development, productivity and quality assurance of agricultural machinery in India.

The components of the Sub-Mission on Agricultural Mechanisation are:

a) *Promotion and Strengthening of Agricultural Mechanisation through Training, Testing and Demonstration:* The Scheme aims to ensure performance testing of agricultural machinery and equipment, capacity building of farmers and promoting farm mechanisation through demonstrations. For this, trainings are organised for trainers, officials from State Governments and farmers, in the selection, operation, maintenance and repairs of equipments, energy conservation, scheduling and management of various agricultural implements and machinery. The assessment of suitability of machines to Indian conditions, and comparison of the performance of various machineries helps the financial institutions to effectively finance their schemes of assistance for procurement of machinery. They also demonstrate new and technologically advanced equipments at farmers' field for induction of new technology in agricultural production system.

b) Demonstration, Training and Distribution of Post Harvest Technology and Management (PHTM): The Scheme is focusing on popularising technology for primary processing, value addition, low - cost scientific storage and transportation and crop by-product management through demonstrations, and capacity building of farmers and end users. The Scheme also provides financial assistance for establishing Post Harvesting Technology units.

c) Financial assistance for procurement of agriculture machinery and equipment promotes the ownership of various agricultural machinery and equipments by the farmers in their farm operations. The Scheme also provides financial assistance on per Ha basis to the beneficiaries hiring machinery/equipments from custom hiring centres in low mechanised areas.

d) The Mission provides financial assistance for the establishment of Farm Machinery Banks and hi-tech, high productive equipment hub for custom hiring by the farmers. This will avoid the difficulty in the ownership of machineries with huge capital investment. The Farm Machinery Banks are also set up in identified villages of low mechanised States. The Scheme extends financial assistance to beneficiaries in high-potential but low mechanised States of north-east region. This ensures reach of farm mechanisation in every region of the country.

4.6.2 Role of Local Self Governments in agricultural mechanisation

The Local Self Governments (LSG) provide subsidy to the farmers for the purpose of mechanisation in agriculture. The farmers get power sprayers, tillers, pumpsets, harvesters and weeders from Panchayats on subsidy basis. The individual farmers get 50 per cent subsidy and group farmers get 100 per cent subsidy for the purchase of these implements. The SC/ST farmers get 75 per cent as subsidy with a maximum limit of Rs. 75000/- per family for purchasing farm implements.

The subsidy and implements are available to farmers on certain conditions. Only small and marginal farmers can enjoy the subsidy of 50 per cent and 75 per cent respectively in the purchase of agricultural implements. The unit cost of each implement is decided by the District Level Officer of Agriculture Department. The farmers get subsidy through their bank account if they directly purchase machinery from company. The farmers whose primary occupation is agriculture and having paddy land of minimum 50 cents and one acre are eligible for power sprayer and harvester respectively. Group farmers, farmers clubs, AMSCs, co-operative societies where members are only farmers and women farmers clubs are eligible for 100 per cent subsidy for agricultural implements. The ownership of implements made available on subsidy will be with Panchayats and no one has the right to sell or transfer these implements to others. The farmers who get the implements on subsidy have to enter into an agreement with the institutions from which they are purchasing the machinery with respect to the safe custody of

implements by the farmers. The agreement should also state that implements should be provided to farmers on hire at a concession rate of 25 per cent less than that of private agents.

4.6.3 Role of commercial banks in farm mechanisation

The banks are providing loans for farm mechanisation with the objective of improving efficiency in farm operations and assisting the farmers for adopting improved or scientific cultivation practices by providing need based credit support for acquiring farm machineries and equipments or implements. The scale of finance for paddy cultivation as per the norms of District Level Technical Committee of Thrissur District for the year 2015-16 is Rs. 24000/- for Virrippu, Mundakan and Puncha, and Rs 40,000/- for Kole lands. The specific purposes for which commercial banks grant loans for farm mechanisation are:

(i) Purchase of new and second hand tractors, accessories and machinery implements

(ii) Purchase of new power tiller, accessories and matching implements

(iii) Purchase of power threshers, power sprayers, power dusters and chaff cutters

(iv) Purchase of jeeps, pick- up vans, mini trucks, two wheelers, bullock carts etc. to be used for transporting agricultural inputs and farm products.

(v) Finance for major repairs/renovations of new/ second hand tractors/ trailer, tractor drawn implements, power tiller, jeep, pick up van, truck etc.

In order to avail the loan, the farmer should have owned or registered leased land. For a tractor loan, the farmer should have a minimum of five acres perennially irrigated land. Productive use of tractor and power tiller for a minimum of 1000 hours and 600 hours per annum respectively to be ensured. Agro Service Centres run by technically qualified entrepreneurs may be financed for acquiring farm machinery.

The viability of the scheme should be assessed keeping in view the capital cost and working expenses vis-a-vis expected incremental income from the farm and custom hiring. The assessment should clearly indicate that the net incremental income will be enough to repay the loan with interest within a reasonable period and the farmer will also get a fair return on the investment. The bank will charge margin of 15 to 25 per cent for loan amounts more than Rs. 50000 for purchasing new tractor unit or transport vehicle and 33 per cent margin for purchase of second hand tractor. The loan amount is directly disbursed to supplier with instructions to supply the goods as per quotations/ offer letter. The repayment period may vary according to loan purposes. The normal repayment period of mechanisation loans of different banks is summed up in Table 4.33.

Table 4.33 Repayment schedule of loans for farm mechanisation

Sl. No	Item	Repayment period (in years)
1.	New tractor	Maximum 9 years
2.	New power tiller	Maximum 7 years
3.	Second hand tractor	Maximum 4 years
4.	Other machinery	Maximum 3 to 5 years
5.	Repairs/ renovation	Maximum 3 to 5 years

Source: Websites of various commercial banks

Loans for agricultural mechanisation are usually investment loans involving capital expenditure. Hence most of the loans are given as long term loans for a period exceeding three years or five years. Expenses of current nature like repairs and renovation may be given for a period less than three years as evident from Table 4.33.

4.6.5 Role of institutional credit in mechanisation of paddy farming in study area

As seen in the previous section, credit for farm mechanisation is given to farmers as well as to institutions. But it is noteworthy that neither the respondent farmers nor the selected Agro Machinery Service Centres have taken any loans for paddy mechanisation. All the AMSCs are provided with agricultural implements by the respective Grama Panchayat and Block Panchayat free of cost. Only one

farmer owns machinery, viz., tractor for agricultural operations. The farmers seek the help of Agro Machinery Service Centres and private agencies for their mechanisation needs. It is not economical for the farmers to invest in agricultural implements for their seasonal agricultural operations. Hence institutional credit is found to have very limited role in the mechanisation of paddy farming in the study area.

4.6.5.1 Constraints of farmers and AMSCs in availing institutional credit

In Kerala majority of the farmers belong to the categories of marginal and small farmers. Large farmers are very limited in number. The small and marginal farmers have no option other than to depend on AMSCs for mechanisation of their paddy farming operations. The major institutional constraints identified during the survey with respect to availability of credit for mechanisation of paddy farming are:

(i) A minimum of five acres of land is a precondition for eligibility for farm mechanisation loans from banks. Hence marginal and small farmers naturally do not satisfy the eligibility criteria of farm mechanisation loans. These loans are available only to group/large farmers.

(ii) AMSCs are not identified as an institutional set up by Government and other formal financial institutions for the purpose of giving loans for farm mechanisation. AMSCs are not in a position to offer collateral security for loans since they do not have ownership of the machines available with them. These machines are being donated by either the Grama or Block Panchayats. Hence AMSCs are also outside the purview of financing by banks for farm mechanisation.

(iii) In the case of automobiles and heavy machinery, the manufacturing companies themselves provide loan facility to the purchasers, by way of hire purchase or installment system. In the case of agro machinery, the manufacturing companies do not provide such facility or Equated Monthly Instalments (EMI)

system for purchase by AMSCs. Hence it becomes difficult for the AMSCs to mobilize funds for purchase of new machines. Even if their business is getting expanded they have to work with the limited number of machines donated by the Panchayats.

4.6.5.2 Suggestions for improving flow of institutional credit for mechanisation of paddy farming

At present the AMSCs are providing only transplantation services to the farmers as part of mechanised paddy farming. Land preparation and harvesting is yet to be touched upon by most of them. Provision of institutional credit will enable the AMSCs to acquire machines for mechanisation of activities other than trasplantation, which can be easily repaid out of the income of service charges or rentals from farmers. This will lead to increase in the extent of mechanisation of rice farming through AMSCs.

As per the latest RBI norms of priority sector lending for commercial banks, the difference between direct and indirect agriculture is dispensed with (Priority sector Lending – Targets and Classification, Reserve Bank of India, 2015). Instead, the lending to agriculture sector has been redefined to include three categories, viz, farm credit consisting of short term crop loans and medium / long term credit to farmers, agriculture infrastructure and ancillary activities. One of the items eligible for financing under the ancillary activities is loans for setting up of agri clinics and agri business centres. As per the latest priority sector norms of RBI for the Urban Co-operative Banks, under the category of ‘other indirect agriculture loans’, loans to Custom Service Units managed by individuals, institutions or organizations who maintain a fleet of tractors, bulldozers, well – boring equipment, threshers, combines etc. and undertake farm work for farmers on contract basis are included in addition to loans for setting up of agri clinics and agri business centres. It is suggested that this facility may be extended through commercial banks also for financing Agro Machinery Service Centres. Under the category of ‘ancillary activities’ of lending to agriculture, ‘loans to Agro

Machinery Service Centres managed by individuals, institutions or organizations for maintaining transplanters, tractors, harvesters, cono-weeder, sprayers etc. and undertake farm work for farmers on contract basis' may be included. This will make the AMSCs eligible for obtaining loans from commercial banks enabling them to acquire machines for land preparation, harvesting and other purposes as required by farmers. This will finally lead to enhancement of the extent of mechanisation in rice farming through AMSCs.

For the purchase of small machinery for farm mechanisation, like sprayers, subsidy is available to farmers, which is disbursed through the LSGs. But there is a lot of procedural delay in the disbursement of this subsidy to the farmers, which demotivate them to approach the LSGs. Even after the introduction of the DBT system, this delay exists. Hence steps may be taken to eliminate such delays, which will motivate farmers to approach LSGs to purchase such machines which will also increase the extent of mechanisation.

As a solution to the problem of ineligibility of small and marginal farmers for obtaining mechanisation loans, it is suggested that under priority sector lending, short and medium term loans to marginal and small farmers for purchase of small agricultural implements and machinery may be added along with the present category of 'medium and long term loans to farmers for agriculture and allied activities'.

Manufacturing companies may also be motivated to provide loan facility to the well – functioning AMSCs by way of hire – purchase or instalment system.

For conducting the timely operations of paddy farming, mechanisation is a must. But it is not necessary that the farmers should own the machines; it should be available as and when they need them at rentals. Moreover, majority of the farmers in Kerala, since belonging to the category of small and marginal, it is uneconomic for them to purchase them. Hence institutional credit from commercial banks and LSGs may be made available for small machines for small and marginal farmers. Agro Machinery Service Centres may be declared as an

eligible institutional set up for provision of medium and long term loans for purchase of machinery involving huge capital investment, so that all categories of farmers can avail the services as and when they need it.

4.7 Role of KAU in mechanisation of paddy farms

The study on mechanisation of paddy farming in Kerala and particularly Thrissur District would be incomplete without a discussion on the role of Kerala Agricultural University (KAU) in farm mechanisation. Mechanisation in paddy farming in Kerala started with the formation of Green Army, the so called labour bank which later developed into an Agro Machinery Service Centre. The training imparted to the farmers and labourers of Wadakkanchery Block Panchayat by the Agricultural Research Station (ARS), Mannuthy of KAU has led to the formation of Green Army. Hence the last part of this chapter is devoted for the role of KAU in mechanisation of paddy farms and the benefits derived from the mechanisation activities of Green Army.

4.7.1 Initiatives of KAU for farm mechanisation

Farmers of Kerala face a lot of challenges, including lack of farm labourers and high wage rates, in taking up paddy cultivation. This leads to high cost of cultivation and less return from agriculture which tempts farmers to move away from agriculture. Apart from these due to the problems of drudgery, health and life insecurity and lack of social respect involved in farming operations, the younger generation is not motivated to get involved in farming operations. (Table 4.8) A solution to this problem is mechanisation and making available required machineries to farmers at reasonable rates at the right time. Lack of technically trained and skilled workers and inappropriate service and maintenance of farm machinery resulted in less usage of whatever little machinery introduced. It was in this context that, KAU with its primary goal of providing human resources, skills and technology required for the sustainable development of agriculture and other allied disciplines in the State, through its ARS at Mannuthy took up the ‘Agricultural Human Resources Development Programme’ and introduced an

innovative concept of Agro Machinery Operation Service Centre (AMOSC) for creating a “Service Provider Sector” in the agricultural machinery operation service and to transform the agricultural sector into a service sector. While introducing this concept, it was expected that the farmers in Kerala would have easier access to support services such as labour, mechanised farm equipment, technical advice, planting material, and agromet information through specially-equipped block-level units.

Through its research station at Mannuthy, KAU is facilitating the task of establishing a network of Agro Machinery Service Centres at Panchayat level, to provide farmers with a range of agricultural inputs. KAU was the implementing agency for the Department of Agriculture for the pilot phase of a programme to revive the flagging agriculture sector. The thrust of the Programme was on promoting mechanisation and group farming to make agriculture more productive and remunerative. A Farm Machinery Facilitation Centre (FMFC) functional at the station, cater to the needs of farmers who are in need of farm machinery by providing apt machinery on time on custom-hire-basis with trained operators. The University provides equipment and expert training to a core group of 15 persons for 18 to 24 days for using all types of agricultural machines. The schedule of training programme consists of 20 hours of class room lecture and 155 hours of machine operation. Raising of mat nursery in dry and wet condition is the starting class so that the trainees can use their own raised mat nursery for transplanting. The running of the machine both on road and field and operation of the machine in field are thoroughly experienced. The repair of machine, including complete dissembling and assembling of the machine is taught. By the time a trainee completes 22 days training, he/she becomes an authority of the machine. The trainee can then become a trainer. The trainees receive a certificate from KAU for participating in the work experiencing vocational training programme. After the training, the trainees become the referral persons of the Station for machine transplanting and they contract for mechanical transplanting. Their services are rendered on contract basis by charging a fixed rate from farmers. KAU also

provide necessary support services to the trainees who have successfully completed their training, for promoting agricultural mechanisation. An intervention model of Kerala Agricultural University in farm mechanisation is Food Security Army.

The FSA concept provides social accreditation to farm workers and farmers by upgrading their capability and skill as a committed unit. The introduction of FSA encourages the younger generation to undertake agriculture activities and provides employment opportunities to many youngsters. FSA is based on the premise that agricultural mechanisation would help to remove the drudgery of farm labour and ensure life security and health security. Agro Machinery Operation Service Centres (AMOSCs) and Mobile Agro Machinery Training Units (MAMTU) have also been set up under the FSA programme. The FSA central unit at ARS, Mannuthy has a Mobile Agro Machinery Repair Service Unit specifically for paddy mechanical transplanter. The unit moves to the work spot with spares and undertake repairs on service call. The Farm Machinery Facilitation Centre at Mannuthy also provides information about the machinery and its operations and availability.

The introduction of paddy straw baling service in Kerala is another critical innovation made by KAU. The use of baling machines encouraged the collection of straw from Kole land, resulting in a chain of benefits for paddy farmers, baling machine operators and dairy farmers. Several other States, including Karnataka, Tamil Nadu and Andhra Pradesh, later, adopted the FSA concept to encourage farming. The ARS has also launched a novel programme to attract students to agriculture called Green Cadet Corps (GCC), which is an offshoot of FSA. FSA provides lectures and practicals on rice cultivation, different types of nurseries, advantages and disadvantages of paddy transplanters, dry and wet mat nursery raising, running of transplanter in puddle soil, assembling of transplanter, repairs, and servicing of machines. Thus FSA facilitate agriculture development by offering an efficient labour force for agricultural operation. Farmers need just prepare the main field and rest of the work viz; mat nursery raising, machine

planting and gap filling are done by this group. Now the FSA is getting training for total rice mechanisation work from the Station.

4.7.1.1 Genesis and growth of Green Army Labour Bank

On seeing the success of paddy mechanisation rolling on, the Thrissur District Panchayat decided to sponsor their farmers and farm workers for the training programme of ARS, and to supply machines to Grama Panchayats free of cost so as to enable the farmers to get the services. Later, Wadakkanchery Block Panchayat got trained 18 farmers/farm workers from their nine Grama Panchayats at the ARS of KAU from 28th January to 22nd February 2008. After the training, the Block Panchayat supplied nine machines to this group of 18 farmers, encompassing all the nine Grama Panchayats of the Block. The Group thus started functioning in 2008 at the initiative of the Wadakkanchery Block Panchayat. This Group of trained and skilled farmers in the mechanisation operations came to be called as 'Green Army' under Wadakkanchery Block Panchayat and it turned to be the most successful labour bank in Kerala. It was formally registered under the Charitable societies Act, 1955 in the year 2010. Green Army Labour Bank (GALB) is an institutional intervention originated with the aim to rejuvenate paddy sector in the Wadakkanchery block of Thrissur district, Kerala through mechanisation in paddy farming and contribute to food security in the State. Green Army helps the farmers to familarise with new technological innovation in paddy farming. It also provides skilled farm labourers to the needed farmers at reasonable cost. The labourers are fully trained and are experts in using machines for paddy cultivation. All the transactions of Green Army came to be routed through Peringandoor Service Co-operative Bank and finally got linked with the Bank. Now the entire activities of Green Army are co-ordinated by the Bank and have developed to a co-operative model of Agro Machinery Service Centre. Some of the facets of growth of GALB in terms of membership, labour days provided, machines held, area covered, productivity of paddy and trainings given are illustrated in the ensuing paragraphs of this section.

The membership of Green Army is open to people who own the labour card of MGNREGS. The members are categorised into three groups i.e., a labour bank at the Grama Panchayat level, a labour team at the ward level and a special team based on the padasekharams. Each team has a leader and deputy leader. The details of membership are depicted in Table 4.34.

Table 4.34 Details of membership of Green Army, 2010-11 to 2014-15

Year	Number of members		Total
	Male	Female	
2010-11	58	145	203
2011-12	58	145	203
2012-13	58	145	203
2013-14	103	150	253
2014-15	110	170	280

Source: Compiled from primary data

Table 4.34 reveals that the membership of labour bank which has been stable for the first three years have tremendously increased in the last two years. This is due to the steep increase in the number of men who joined the Bank in the last two years. Women were more interested to join the Bank compared to men in the initial years. This is because membership of GALB is open only to those who have labour card of MGNREGS. Still women outnumber men in the membership of GALB.

For getting the work done through Green Army, the padasekhara samithies and farmers have to give a list of needed agricultural works, unit, and time of work to the Labour Bank and remit 25 per cent of amount in advance. The land owner has to make payment to the Labour Bank as the work progresses. The farmers can entrust the entire work or even a single work to the Green Army labour force, mechanised and non – mechanised. As already stated, the entire work of labour bank is linked with the Employment Guarantee Scheme. This ensures maximum labour days to the workers and availability of labourers on time to the farmers. The members are graded into different levels based on their

abilities and interest. The grades will change every six months. The wages are given to the workers based on this grade and value of work. The extent of labour days provided by Green Army is depicted in Table 4.35

Table 4.35 Details of labour days provided by Green Army, 2010-11 to 2014-15

Year	Labour days		Total
	Male	Female	
2010-11	3020	7800	10820
2011-12	5257	10810	16067
2012-13	2065	7170	9235
2013-14	1860	6148	8008
2014-15	2463	7405	9868

Source: Compiled from primary data

The labour days depicted in Table 4.35 include labour for mechanised and non – mechanised operations encompassing land preparation, transplanting and harvesting. The labour days of females are more than the males, since the number of female members is more than males (Table 4.34). In the initial year of 2010 - 11, out of 10820 labour days, 6200 are for transplanting alone (www.greenarmywky.org). Later members entered the field of harvesting using machines. The labour days generated by harvesting is less than transplanting, because transplanting is the major service provided by the Army. There is a steep decrease in the labour days in the year 2013 -14 compared to the previous year, which is due to limiting paddy cultivation to one season, namely Mundakan, by some farmers and formation of other AMSCs in the area.

The services of Green Army are at present spread over the nine Panchayats of Wadakkanchery Block, kole lands of Thrissur district, and also the districts of Palakkad, Malappuram and Pathanamthitta. It offers a package of services to the farmers from preparation of seedlings to harvesting. For this purpose Green Army formulates an “agricultural calendar” with the effective participation of farmers. The calendar deals with the timing of each and every activity in paddy cultivation and this calendar becomes a model for the entire

agricultural sector. Based on this calendar the office of the Army schedule the work and determines the number of machineries required. Table 4.36 deals with the number and type of machinery held by Green Army.

Table 4.36 Details of machinery held by Green Army, 2014-15

Sl. No	Implements	Number
1.	Transplanters	67
2.	Combine harvesters	3
3.	Bailer	3
	Total	73

Source: Compiled from primary data

The Green Army Labour Bank holds 73 agricultural machineries out of which 52 transplanters are provided by Wadakkanchery Block Panchayat and rest 15 are provided by Peringandoor Service Cooperative Bank. The combine harvesters and bailers have been provided by the Block Panchayat. The ownership of machineries is vested in the hands of the Block Panchayat and Service Cooperative Bank. The fact that AMSCs do not have ownership of the machinery held by them appears to be one of the constraints faced by AMSCs in obtaining institutional finance, as already seen (Para 4.6.5.1).

At the time of inception, the area covered by Green Army included nine Panchayats of Wadakkanchery Block Panchayat viz, Mullurkkara, Wadakkanchery, Velur, Erumappetty, Kadangode, Varavoor, Desamangalam, Thekkumkara and Mundathikkode. Later it was extended to other panchayats and districts. The details number of padasekharams and area covered by the Army are depicted in Table 4.37. The area covered is based on the area under cultivation of each padasekharam.

Table 4.37 Padasekharams and area covered by Green Army, 2010-11 to 2014-15

Year	No. of padasekharams covered	Area covered (in Ha)
2010-11	116	1480
2011-12	112	1726
2012-13	118	1560
2013-14	127	1159
2014-15	108	991

Source: Compiled from primary data

Even though Green Army was formally registered only in the year 2010, its activities were started in 2008. In the year of its inception, the Green Army covered only 12 padasekharams covering paddy cultivation in 232 Ha of land. In the second stage it was increased to 50 padasekharams and 840 Ha of land. After its tremendous growth, both in terms of number of padasekharams and area covered, as seen in Table 4.37 the coverage of Green Army is seen to decrease from both angles. As already pointed out in Table 4.35, some of the farmers have limited their cultivation to one season. Moreover, with the entry of new AMSCs the number of padasekharams has got reduced for Green Army, resulting in lesser area under coverage.

The rice farmers of Wadakkanchery Block Panchayat were facing the problem of labour scarcity and as such the area under paddy farming decreased considerably leading to decreased production and even productivity due to the absence of timely availability of labour. A solution to this was brought about with the formation of Green Army and adoption of mechanisation. The details of productivity of rice per Ha after the adoption of Green Army Labour Bank in the Panchayat are shown in Table 4. 38. The productivity of the Panchayat is compared with that of Thrissur District and Kerala as a whole.

Table 4.38 Productivity of paddy in Wadakkanchery Block, 2010-11 to 2014-15

Sl. No	Year	Production (in Kg / Ha)
1.	2010-11	5920
2.	2011-12	6904
3.	2012-13	6867
4.	2013-14	5794
5.	2014-15	5950

Source: Compiled from primary data

Table 4.38 shows that the paddy production per Ha of land is ranging between 5000 to 7000 kg. The reason behind the increased productivity is the adoption of mechanised services of Green Army. Before the formation of Green Army, the productivity in the Panchayat was below 3000 kg per Ha (www. greenarmywky.org). The average productivity of paddy is 2925 Kg/Ha and 2827 Kg /Ha in Thrissur District and Kerala during 2012-13 and 2013-14 respectively. (Directorate of Economics and Statistics, 2013-14). It implies that there was not much difference between productivity of paddy in the Panchayat before introduction of Green Army and the current productivity at District and State level. It is already found that productivity of paddy is higher in the case of users of AMSCs compared to non-users due to mechanised transplantation. (Table 4.30). Hence this finding is reinstated here, the credit of which is due to Green Army.

Training constitutes a basic concept in human resource development. As already seen, the training in farm mechanisation imparted by Kerala Agricultural University to 18 farmers and farm workers of Wadakkanchery Block Panchayat culminated in the formation of Green Army under the leadership of the Panchayat. The members of Green Army who got training from KAU become the resource persons or major trainers for the other members. At present Green Army is designated as the training agency of Government for Mahila Kisan Sasthaktikaran Pariyojana (MKSP) and coconut climbing training of Coconut Development Board (CDB). Spreading of the benefits of mechanisation to the neighbouring

places and the entire State is possible only through training of new members who can turn out to be trainers and master trainers. Recognising this, Green Army is undertaking this responsibility, the details of which are shown in Table 4.39.

Table 4.39 Training programmes of Green Army, 2013 -15

Sl. No	Name of training	Year	Duration	No. of trainees	No. of batches	Sponsor
1.	Coconut Climbing	2013-15	6 days	1020	51	CDB
2.	MKSP	2013-14	18 days	4500	120	MKSP
3.	Skill development training on organic product making	2014-15	20 days `	40	2	Green Army

Source: Compiled from primary data

From the Table 4.39 it could be observed that mainly three types of trainings are offered by Green Army to its members and non- members consisting of coconut growers and those interested in coconut farming. The training on coconut climbing is provided under the label of “Friends of coconut trees”. The training is sponsored by CDB in order to tackle the problem of labour scarcity for coconut climbing. All the aspects of coconut i.e. from seed to marketing of coconut, is covered under the training. It also develops technical skills, entrepreneurship capacity, leadership qualities and communication skills to address the needs of the coconut growers.

Mahila Kisan Sashaktikaran Pariyojana (MKSP) is a scheme introduced by the Central Government to support the women engaged in agricultural sector. The primary objective of the Scheme is to increase participation of women in the agricultural sector. A woman who has worked for 40-50 days in Employment Guarantee Scheme can become a member of MKSP Labour Bank for Women. Green Army Labour Bank is identified as the trainer of this Scheme by the Government. Both Central and State Government contributes equally to this Scheme. The Scheme is started in Thrissur, Malappuram and Pathanamthitta districts of Kerala State through the labour banks formed under each Block. The

Scheme aims to provide 200 days of labour to the women and attain a rice production of 230444 ton per year. The training of MKSP is provided in the concerned district by the Green Army members. During the training members are trained to use transplanters, driving of transplanters in field, repairing of its parts, cleaning etc. During the year 2013-14, 4500 women were trained in 120 batches by the Green Army under MKSP.

The training on organic product making includes preparation of garlic - neem oil, coconut leaf - jaggery, chrysanthemum, amritham, panchagavyum, fish amino acid etc for pest and disease control during the summer season organic vegetable cultivation. It is prepared by Green Army members in their residence and sold through the outlets of Peringandoor Service Co-operative Bank, the co-co-ordinating agency of Green Army. These products are used instead of chemicals and fertilizers. The main aim of this venture is to supply fresh organic vegetables free from hazardous chemicals to the society as well as to provide work for Green Army members during off season. This training has just been started in the year 2014-15 and hence the number of trainings is only two during the year.

Even though KAU is not directly involved in the activities of Green Army, the Agricultural Research Station of the University can feel proud that its earnest efforts to find a solution to the agricultural labour shortage in the State, by way of training to a group of 18 farmers and farm workers of Wadakkanchery Block Panchayat has culminated in the formation of Green Army, which by its sincere efforts and the patronage of the Panchayat and PSCB has achieved State level acceptance and has become a model for other Agro Machinery Service Centres in the State.

Paddy is the main crop which has been mechanised in Kerala. Scarcity of labour and high rate of available labour has demotivated farmers to continue with paddy cultivation. The use of machines in paddy farming, displaces labour at certain stages of cultivation especially preparation of land, transplanting and

harvesting. Introduction of AMSCs is an apt solution to the farmers where they can avail mechanised farm operations by a skilled crew using specialised implements, which will ensure timely operations and offer first hand solutions to the problems of labour scarcity for farm operations. Mechanised transplanting is the main service provided by AMSCs to the farmers. The farmers who have paddy fields with puddle soil are unable to adopt mechanised transplanting in paddy, leading to higher cost of cultivation. The use of transplanting service of AMSCs are providing benefits such as timeliness in farm operation, reduced cost of cultivation, increased income and improved farm income to the users. These factors also encourage farmers to adopt mechanisation in paddy farming. Mechanisation through AMSCs has motivated all the user farmers to remain and continue in rice farming, but still has to go a long way to induce them to bring additional land under rice farming.

The study clearly indicates that mechanisation is the only solution to the current problems of non - availability and high cost of manual labour for rice farming. Mechanisation can also attract younger generation to the agricultural sector in general and to paddy farming. Majority of paddy farmers in Kerala are small and marginal farmers. Hence ownership of machines for transplanting, land preparation and harvesting will be not be a viable proposition for them. Institutional credit from commercial banks, co-operative banks and LSGs may be made available for small machines like sprayers, cono weeders for small and marginal farmers, as part of their priority sector lending. Agro Machinery Service Centres may be declared by policy makers as an eligible institutional set up for provision of medium and long term loans for purchase of machinery involving huge capital investment, under priority sector lending, so that all categories of farmers can avail the services as and when they need it from the AMSCs.

As mentioned already, farmers having landholdings with water logged nature or kole lands are unable to use the presently available transplanters for transplanting of paddy seedlings. The scientists of full Kelappaji College of Engineering and Technology (KACET), Tavanur of Kerala Agricultural

University may undertake research in this area, and design transplanters which can be used in these types of soil also. This will be a boon to the paddy farmers, especially to those of Thrissur District, where kole lands are found.

Lastly, but not the least, the farmers should be made aware of all the institutional arrangements and facilities of credit for mechanisation of their paddy farms, for which financial literacy is a must. This task can be entrusted to the Co-operation and Banking students of Kerala Agricultural University as part of their course work, especially through their Experiential Learning (EL) and Rural Agricultural Work Experience (RAWE) Programmes, with the active support of the LSGs, lead bank and financial institutions.

The present study concentrates on the impact of AMSCs on mechanisation of paddy cultivation in Kerala. The users of AMSCs and non - users are compared. The impact of mechanisation before and after using the mechanisation services of AMSCs, measurement of the empowerment of agricultural labourers through AMSCs and effect of mechanisation on farm income through AMSCs are some of the areas that need further enquiry.

SUMMARY OF FINDINGS & CONCLUSION

CHAPTER 5

SUMMARY OF FINDINGS AND CONCLUSION

Agricultural mechanisation plays a key role in improving agricultural production and hence considered as an essential input to agriculture. Proper use of mechanised inputs in agriculture has a direct and significant effect on labour productivity, profitability of farms and improvement in the quality of life of the people engaged in agriculture. Rice, the staple food of the people of Kerala is facing problems in production and productivity mainly due to the shortage and untimely availability of labour. The fall in the area under cultivation as well the production of paddy has negative implications in the economic, ecological and social development of Kerala. Selective mechanisation is accepted as the only panacea to tide over labour shortage and increasing labour cost. In Kerala among the various crops cultivated, mechanisation is mostly adopted in paddy, which is provided mainly through Agro Machinery Service Centres. These Centres play a critical role in mechanising the activities involved in paddy cultivation, by providing machineries on hire at an economical rate.

The study entitled “Impact of Agro Machinery Service Centres on mechanisation of paddy cultivation in Kerala” was conducted with the objectives of assessing the extent of farm mechanisation among farmers, identifying the determinants of paddy mechanisation through Agro Machinery Service Centres (AMSCs), studying the impact of AMSCs on mechanisation paddy cultivation and examining the role of institutional credit in the mechanisation of paddy farms.

The study was based on data drawn from a sample of 135 paddy farmers through multi stage sampling technique. The sample farmers were categorised into two viz., users of AMSCs and non-users of AMSCs. Out of the total sample, 90 farmers, using the services of AMSCs and 45, not using the services of AMSCs were

selected. The users were again grouped into 45 individual users and 45 group users /Padasekharams.

Major sources of data were websites of various institutions, such as commercial banks, LSGs, Directorate of Economics and Statistics, Government of India, Directorate of Economics and Statistics, Government of Kerala, and www.inputsurvey.dacnet.nic.in.

Compound Annual Growth Rate (CAGR), independent sample t- test, one way ANOVA, Post- hoc test for multiple comparisons, Chi-square test, Yates's correction for continuity, and indices such as mechanisation index, benefit index of AMSCs, service quality index of AMSCs and usage index of farm implements by farmers were used to analyse the data.

5.1 Major findings

The major findings of the study are summarised and presented under the following subheadings.

5.1.1 Status of farm mechanisation: An overview
5.1.2 Area, production and productivity of rice
5.1.3 Extent of farm mechanisation among paddy farmers in Kerala
5.1.4 Determinants of farm mechanisation through AMSCs
5.1.5 Impact of AMSCs on mechanisation of paddy cultivation
5.1.6 Role of institutional credit in the mechanisation of paddy farms.
5.1.7 Role of KAU in mechanisation of paddy farms

5.1.1 Status of farm mechanisation: An overview

Farm mechanisation is an important element of agricultural development. Even though mechanisation is widely accepted, the small size and scattered holdings

of the farmers stand in its way of mechanisation. Majority of small cultivators are poor and not in a position to purchase costly machinery like tractors, combine harvesters etc. Lack of proper knowledge of farmer to purchase farm machinery, lack of repair and replacement facilities especially in the remote rural areas are act as hindrances in efficient small farm mechanisation.

As per the land holdings, farmers are grouped into marginal farmers, small farmers, and large farmers. The agricultural implements used by farmers are classified into three categories - hand operated implements, animal operated implements and power operated implements. Among these hand operated and animal operated implements are also called traditional farm implements. Power operated implements are replacing traditional farm implements, leading to increased mechanisation in agriculture.

In India, 67 per cent of farmers are marginal and 15 per cent are large farmers. The marginal farmers are showing the highest growth rate in the use of power operated implements. The number of marginal farmers who shifted to power operated implements increased more than three times during the period 1996-97 to 2006-07, while there is only a marginal increase in the case of large farmers, implying that marginal farmers are also switching to mechanised farming on an increasing scale in spite of their limitation of small holdings.

As far as Kerala is concerned, 96 per cent of the farmers are marginal. There is a reduction in the number of large and small farmers and hike in the number of marginal farmers during the period 1996-97 to 2006-07. There is negative growth in the use of traditional agricultural implements by marginal, small and large farmers. But this reduction has not resulted in a corresponding increase in the use of power – operated implements by the farmers .Only in the case of marginal farmers, there is a positive growth with respect to the usage of power operated implements.

Paddy is the main crop which is getting mechanised in Thrissur District. But there is a reduction in the usage of all types of implements, traditional and mechanised, by the farmers. Due to lack of adequate and timely availability of labour, farming operations cannot be conducted in time. Moreover, the high cost of labour has made rice farming non-remunerative. So the farmers are leaving their land unutilised engaging in non – farm activities, as a result of which area under actual cultivation of rice has come down.

5.1.2 Area, production and productivity of rice

Rice is produced in a wide range of locations under a variety of climatic conditions, using thousands of rice varieties in the world. But the farmers are facing many agro ecological, technical and socio - economic constraints in rice cultivation. As a result the average size of farm holdings gradually reduced over the years. India is one of the world's largest producers of white rice and brown rice, accounting for 20 per cent of world rice production. From 2000-01 to 2012-13 there is a negative growth in the area under cultivation of rice, but positive growth for production and productivity in India. But still India’s productivity (2469kg/Ha) is much below the world productivity of rice.

In Kerala, area under cultivation of rice is showing a negative growth over the period 2002-03 to 2013-14, while productivity is on positive growth. Conversion of paddy lands for housing purposes and for cultivation of commercial plantation crops along with the practice of leaving them fallow due to high labour cost, shortage of labour, and very low market price of rice are the major reasons for the drastic decline in the area under cultivation of rice in Kerala. Even with the steep and continuous decline in the area under cultivation of rice, production of rice over the years has shown a lesser intensity of decline, due to the increased yield per hectare and productivity of rice in Kerala (2827 kg/Ha).

The share of paddy area to State total is the highest for Palakkad followed by Alappuzha, while the proportion of paddy area to Gross Cropped Area is the highest for Alappuzha followed by Palakkad. More than 40 per cent of the paddy area in Kerala belongs to Palakkad. Thrissur is having the fourth position with respect to area under paddy, with a marginal difference from Kottayam, which occupies the third position.

More than half of the income of the people of Thrissur District is generated from agriculture and allied activities. The area and production of rice in Thrissur district is showing a negative trend during the periods, 2000-01 to 2009-10. But from 2010-11 to 2012-13, there is an increase in the area and production of rice which can be attributed to the use of power drawn implements in cultivation. The productivity of rice is the highest for Thrissur District (2925kg/Ha) compared to the National and State average.

Scarcity of labourers, high wage rate, conversion of paddy lands for other purposes and low procurement price of paddy have played an important role in the reduction of paddy cultivation in Kerala. As a result there always exist a gap between the demand and supply of rice which leads to food insecurity in the State.

5.1.3 Extent of farm mechanisation among paddy farmers in Kerala

The use of improved farm implements / machines constitutes the level of mechanisation adopted by farmers. In Kerala among the various crops cultivated, mechanisation is mostly adopted in paddy, which is provided mainly through AMSCs.

Paddy cultivation needs appropriate mechanisation to cope up with the increased cost of cultivation due to high wages and scarcity of labourers. The farm workers are largely migrating to works offered under the Mahatma Gandhi National Rural Employment Guarantee Act, 2005 thereby causing a shortage of labour for

labour-intensive crops such as paddy. In such a situation Agro Machinery Service Centres (AMSCs) assist the farmers for obtaining machineries on hire and also provide mechanised transplanting at an economical rate.

AMSCs are registered under Charitable Societies Act, 1955. The initial members of the AMSCs established in Thrissur District were trained by the Agricultural Research Station (ARS), Mannuthy of Kerala Agricultural University, under the Food Security Army Training Programme. There are three models of AMSCs, viz, co-operative model - Green Army, individual model - Sivasakthi and Self Help Group (SHG) model – Parijatham, which are considered for the study.

In Thrissur district, both male and female are engaged in paddy cultivation and majority (86 per cent) are male. Forty six per cent of the respondents are aged and fall in the category of 50 to 65 years. Only less than one- fourth of the respondents fall under the age group of 35 to 50 years. This clearly shows that the younger generation is not attracted towards paddy farming and to agriculture as a profession. With regard to education level, majority of the respondents (64 per cent), both in users (62 per cent) and non-users (67 per cent) have completed their matriculation. The primary occupation of 59 per cent of respondents are agriculture and rest of them (41 per cent) undertake paddy farming as a subsidiary activity. In the study area 42 per cent of the respondents have an experience of more than 40 years in farming. A few of the educated, retired and government employees find time to undertake paddy cultivation and are having an experience of 10 to 30 years. Income from paddy of 79 per cent are less than Rupees one lakh since majority of the respondents are marginal farmers considering their land holding under paddy cultivation. The agriculture income of majority of the respondents (71 per cent) is less than Rupees one lakh per annum. Nuclear families (73 per cent) are common in the study area than joint families. Annual family income of the respondents consists of income from agriculture plus income earned from other sources by the family

members of respondents. Majority of the respondents (64 per cent) have annual income within Rupees two lakh.

In Kerala, group farming is more popular in paddy cultivation. Farmers create Padasekhara Samithies for this purpose. Among the surveyed padasekharams, 44 per cent are having paddy landholdings of upto eight hectares. Regarding the member strength, 51 per cent of padasekharams are found to have less than 30 farmers and only 27 per cent are having farmer members more than 60 and having an annual income from paddy upto Rs. 5 lakhs. These 12 Padasekharams come in the category of having annual income exceeding Rs 25 lakh.

Based on the paddy farm size, respondents are categorised in to tenant farmers, marginal farmers, small farmers and large farmers. There is no tenant farmer among the farmer respondents selected for the study. Eighty two per cent of the respondents belong to the category of marginal farmers and 11 per cent are small farmers. Only seven per cent are large farmers.

Cropping pattern is an important element of farming system. It is the proportion of area under various crops at a point of time. Cropping pattern also depends on terrain, topography, slope, soils, and availability of water for irrigation, pesticides, fertilisers and mechanisation. The cropping system of farmers consists of paddy, coconut, banana and arecanut. Other crops include vegetables, nutmeg, pepper, cashew, cocoa, tapioca and rubber.

Farm productivity is positively correlated with the availability of farm power together with efficient farm implements and their careful utilisation. In the study area, farm operations by the farmers are not fully mechanised. Mechanisation is adopted only for land preparation, transplanting and harvesting. In the case of all the users, they depend on AMSCs only for transplanting; the mechanisation needs for land preparation and harvesting are met through private agencies. But non-users of AMSCs are still following manual transplanting instead of mechanised transplanting

and adopting mechanisation only for land preparation and harvesting. The water-logged nature of the land held by non-users hinders them from adopting mechanised transplanting in their land.

Mechanisation is available at present only for paddy. So the mechanised area of farmers covers only the area under paddy cultivation. The land under paddy cultivation is considered as mechanised if any one of the agricultural operations is mechanised by the farmer. Eighty one per cent of the total land holdings of the farmers are mechanised. The mechanised land holding is more for users of AMSCs (90.74 per cent) than for non-users (62.80 per cent). It means that as the size of paddy land holding increases, the mechanised area also increases.

In all the panchayats, majority of the farmers do not own farm implements. The reasons for lack of ownership of farm implements are small land holdings and high investment. Farmers are not in a position to buy huge farm machines and if mechanisation has to take place, the machines should be available on rent. This calls for the need for Agro Machinery Service Centres or similar institutional set up for the provision of machines and implements on hiring basis to the farmers. Among the total sample respondents only one farmer owns tractor which is used for own purpose and also rented out. Sprayers are the most commonly purchased farm implement followed by pumpsets by both users and non-users of AMSCs.

The extent of usage of various farm implements such as tractors, transplanters, harvesters and sprayers by the farmer respondents was analysed with the help of usage index. All the farmers, both users and non-users are always using tractors and harvesters for land preparation and harvesting and the composite index of these implements is 100. They find economies of scale in the use of tractors and harvesters compared to manual labour. The users of AMSCs are always using mechanised transplanting in their field. As result of this the use of labour in the field got gradually reduced. Regarding the usage of sprayers, the index is more among

users of AMSCs (97.77 per cent) than the non-users (85.56 per cent). In general, the use of farm machinery and implements is more among the users rather than non – users of AMSCs, even though the users depend on AMSCs only for transplanting operations of paddy.

Mechanisation planning requires the quantitative assessment of a mechanisation index, and its impact on agricultural production or yield, and economic factors like, cost of cultivation, deployment of animate and mechanical power, and economic advantage. A mechanisation index based on the ratio of cost of use of machinery to the total cost of use of human labour, draught animals and machinery was constructed to measure the adoption of mechanisation by the farmers. Two types of indices were developed for the purpose of the study, namely, overall mechanisation index and mechanisation index for usage of AMSC services.

Regarding the overall mechanisation index, it is 57.34 per cent for users and 30.72 per cent for non-users. More the mechanisation index less would be the labour cost incurred for users of AMSCs. The higher mechanisation cost of users of AMSCs is nullified by the higher labour cost of non-users of AMSCs. Hence the extent of usage of mechanisation is higher in users of AMSC when compared to non-users.

The average mechanisation index of usage of AMSC is estimated at 29.48 per cent. It means that out of the total labour and machine cost of users, the cost incurred for using AMSC services of transplantation is almost 30 per cent. i.e., the cost incurred by non - users over and above this 30 per cent for transplantation can be saved, if they shift to mechanisation of transplantation. Out of the total mechanisation costs, 51 per cent is contributed by AMSCs by the way of transplanting cost.

The introduction of machines displaces labour at certain stages of cultivation especially preparation of land, transplanting and harvesting. Since the users of AMSCs are adopting mechanised transplanting other than land preparation and harvesting, the extent of mechanisation is higher for them compared to non-users.

5.1. 4 Determinants of paddy mechanisation through AMSCs

Determinants of paddy mechanisation through Agro Machinery Service Centres are identified, taking into account the relationship between overall mechanisation index of farmers and variables such as level of education, farm experience, cost of cultivation, production and income from paddy. The same variables are considered for group farmers except education and farming experience.

The Chi-square value is significant at one per cent level, only in the case of cost of cultivation, which means that cost of cultivation is a determinant of adoption of mechanisation by the users of AMSCs. Other variables have no role in the adoption of mechanisation by the farmers through AMSCs. Through mechanisation farmers can save labourers, thus resulting in reduction of labour cost. This ultimately leads to lower cultivation cost. But in the case of non-users no variable is a determinant of adoption of mechanisation by farmers. The water logged nature of land hinders them from adopting mechanisation especially for transplanting. If they were in a position to adopt mechanised transplanting, they would also have become users of AMSCs by adopting mechanised transplanting and enjoying economies of scale in their cultivation.

The quality of services provided by AMSCs may be considered as one of the factors determining the selection of AMSCs and hence inquired into as a determinant of mechanisation through AMSCs. The variables identified with respect to quality of services are accessibility, approachability, punctuality, skillfulness of workers, specialised services, usefulness in farm operations, time saving and cost saving. The qualities are analysed using a service quality index. The farmers as a whole are satisfied with the performance of their respective AMSC as evident from the index of 100 for the indicators of skilled labour force provided by AMSCs and saving in time and costs of farm operations. Hence, reduced cost of cultivation,

availability of skilled labour force, and saving in time are the factors that encourage the adoption of mechanisation by farmers through AMSCs.

5.1.5 Impact of AMSCs on mechanisation of paddy cultivation

The average cost of cultivation per hectare is lower for users of AMSCs (Rs. 41590) compared to non – users (Rs 48360). Within the users, group users have lesser cost due to economies of large scale production. The usage of labourers for manual transplanting, adoption of less mechanisation in the farm operations and problems of weeds and pests are the major reasons of increased cost of cultivation in the case of non-users. Out of the total labour and machine cost of users, the cost incurred for using AMSC services of transplantation is almost 30 per cent. This implies that the cost incurred by non - users over and above this 30 per cent for transplantation can be saved, if they shift to mechanisation of transplantation, leading to reduced cost of cultivation of paddy.

Regarding different types of costs in paddy cultivation, the share of machine cost to total cost is higher for users (41 per cent) than non- users of AMSCs (23 per cent). In the case of transplanting, only users are following mechanised transplanting which constitute 21 per cent of their total cost of cultivation. For the same purpose of transplanting, non – users are using manual labourers and 22 per cent of their total cost is devoted for this operation. In the study area non-users of AMSCs are using migrant labourers from the State of West Bengal for manual transplanting, who are available at cheaper rates and for more man-hours per day than the native labourers. Hence there is not much variation in the transplanting cost of users and non-users. If the migrant labour had not been available, the transplantation cost of non – users would have been much higher, leading to a higher proportion of total cost of cultivation.

Regarding labour costs, it is higher for non – users than that of users. The highest difference in costs is found in the case of transplanting, where non – users

have to spend Rs 2340/- per hectare more than the users of AMSCs. Among the non-users, farmers of Pazhayannur panchayat are facing severe weed problems. So they have to spend more amount of money for inter- cultural operations. In the case of harvesting, non-users have to pay more amount than users. The shape of landholdings by non-users creates difficulties in driving the harvesting machine and takes more time for completing the harvesting operation. Apart from these the water logged nature of land also leads to high cost for harvesting. Hence, non-users have higher labour cost than users of AMSCs. .

The production from paddy varies according to area and variety of seed used. Production of rice is higher for users of AMSCs (5775 Kg/Ha) than that of non – users (5025Kg/Ha). Group users have still better production than individual users, due to economies of large scale production. The reason for the high production is the adoption of mechanisation in the field. Mechanised transplanting ensures more growth per seedlings, more seed density and less distance between seedlings resulting in more production than manual transplanting. Hence, by adopting mechanised transplanting, in addition to other mechanized operations, users of AMSCs get more production with less grain loss than non-users.

The economic benefits have surpassed the operational benefits since the indicator ‘increased acreage under cultivation’ has scored less. The benefit of overcoming labour scarcity has actually given a motivation for the farmers to continue in rice farming, both of which are scoring cent per cent in the case of all three AMSCs. The farmers can get their operations done timely without any capital expenditure. Improvement in farm income is possible due to advantages of mechanised transplantation like, high seed density, less grain loss and timely operations.

Mechanisation through AMSCs has motivated all the user farmers to remain and continue in rice farming, but still has to go a long way to induce them to bring additional land under rice farming.

5.1.6 Role of institutional credit in the mechanisation of paddy farms

Government of India has introduced a number of schemes for agricultural mechanisation. Under the Schemes, machines are made available to individual farmers, SHG groups and farmer co-operatives who can hire the machines suitable for their crops. One of the ongoing schemes for agricultural mechanisation is the Sub-Mission on Agricultural Mechanisation (SMAM) under National Mission on Agricultural Extension and Technology (NMAET**),** Ministry of Agriculture, started during the Twelfth Five Year Plan, 2012 to 2017. The Scheme is implemented in all the States, in order to promote the usage of farm mechanisation and increase the ratio of farm power to cultivable unit area upto 2 KW/ha. The Scheme is implemented through the combined contributions of the Central and State Governments in the proportion of 75: 25 respectively.

The Sub-Mission on Agricultural Mechanisation aims at the inclusive growth of agricultural mechanisation in India by providing custom-hiring facilities for agricultural machinery. The focus of the Mission is on increasing the reach of farm mechanisation to small and marginal farmers, and to the regions where availability of farm power is low, by creating awareness through demonstration and capacity building activities. Institutions identified by the States, Indian Council of Agricultural Research (ICAR) institutions, Agricultural Technology Management Agency (ATMA), and Central Farm Machinery Training and Testing Institute (FMTTI) are the implementing agencies of the Scheme.

The Local Self Governments (LSG) provide subsidy to the farmers for the purpose of mechanisation in agriculture. The farmers get power sprayers, tillers, pumpsets, harvesters and weeders from Panchayats on subsidy basis. The individual

farmers get 50 per cent subsidy and group farmers get 100 per cent subsidy for the purchase of these implements. The SC/ST farmers get 75 per cent as subsidy with a maximum limit of Rs. 75000/- per family for purchasing farm implements.

The banks are providing need -based credit support for acquiring farm machineries and equipments or implements. The scale of finance for paddy cultivation as per the norms of District Level Technical Committee of Thrissur District for the year 2015-16 is Rs. 24000/- for Virrippu, Mundakan and Puncha, and Rs 40,000/- for Kole lands.

Credit for farm mechanisation is given to farmers as well as to institutions. Neither the respondent farmers nor the selected Agro Machinery Service Centres have taken any loans for paddy mechanisation. All the AMSCs are provided with agricultural implements by the respective Grama Panchayat and Block Panchayat free of cost. Only one farmer owns machinery, viz., tractor for agricultural operations. The farmers seek the help of Agro Machinery Service Centres and private agencies for their mechanisation needs. It is not economical for the farmers to invest in agricultural implements for their seasonal agricultural operations. Hence institutional credit is found to have very limited role in the mechanisation of paddy farming in the study area.

The farmers in Kerala are facing many institutional constraints with respect to availability of credit for mechanisation of paddy farming. The major constraint faced by the farmers is that, marginal and small farmers naturally do not satisfy the eligibility criteria of minimum of five acres of land for farm mechanisation loans. AMSCs are not identified as an institutional set up by Government and other formal financial institutions for the purpose of giving loans for farm mechanisation. In the case of agro machinery, the manufacturing companies do not provide the facility of Equated Monthly Installments (EMI) system for purchase by AMSCs. Hence it becomes difficult for the AMSCs to mobilize funds for purchase of new machines.

5.1.7 Role of KAU in mechanisation of paddy farms

Mechanisation in paddy farming in Kerala started with the formation of Green Army, the so called labour bank which later developed into an Agro Machinery Service Centre. The training on various aspects of mechanisation under the Food Security Army, imparted to the farmers and farm workers of Wadakkanchery Block Panchayat by the Agricultural Research Station, Mannuthy of KAU has led to the formation of Green Army.

Green Army Labour Bank (GALB) is an institutional intervention originated with the aim to rejuvenate paddy sector in the Wadakkanchery block of Thrissur district, Kerala through mechanisation in paddy farming and contribute to food security in the State. Green Army helps the farmers to familarise with new technological innovation in paddy farming. It also provides skilled farm labourers to the needed farmers at reasonable cost. The labourers are fully trained and are experts in using machines for paddy cultivation. All the transactions of Green Army came to be routed through Peringandoor Service Co-operative Bank and finally got linked with the Bank. Now the entire activities of Green Army are co-ordinated by the Bank and have developed to a co-operative model of Agro Machinery Service Centre. The GALB provides mechanisation services to the paddy farmers from the preparation of seedlings to harvesting.

The membership of Green Army is open to people who own the labour card of MGNREGS. The membership, which has been stable for the first three years, have tremendously increased during 2013-14 to 2014-15. Women were more interested to join the Bank compared to men and still they outnumber men in the membership of GALB

The labour days provided by Green Army include labour for mechanised and non – mechanised operations encompassing land preparation, transplanting and harvesting. The labour days of females are more than the males, since the number of female members is more than males. There is a steep decrease in the labour days in the year 2013 -14 compared to the previous year, which is due to limiting paddy cultivation to one season, namely Mundakan, by some farmers and formation of other AMSCs in the area.

The Green Army Labour Bank holds 73 agricultural machineries out of which 52 transplanters are provided by Wadakkanchery Block Panchayat and rest 15 are provided by Peringandoor Service Cooperative Bank. The combine harvesters and bailers have been provided by the Block Panchayat. The ownership of machineries is vested in the hands of the Block Panchayat and Service Cooperative Bank.

The coverage of Green Army is seen to decrease during the periods 2010-11 to 2014-15. Some of the farmers have limited their cultivation to one season. Moreover, with the entry of new AMSCs the number of padasekharams has got reduced for Green Army, resulting in lesser area under coverage. Regarding production, it is ranging between 5000 to 7000 kg/ha. The reason behind the increased productivity is the adoption of mechanised services of Green Army. Before the formation of Green Army, the productivity in the Panchayat was below 3000 kg /ha. Now the productivity of rice in Wadakkanchery Block Panchayat is higher than the State and District average rice productivity.

Three types of trainings are offered by Green Army to its members and non-members. The training on coconut climbing is provided under the label of “Friends of coconut trees”. The training is sponsored by Coconut Development Board in order to tackle the problem of labour scarcity for coconut climbing. Green Army Labour Bank

is identified as the trainer of MKSP, a scheme introduced by the Central Government to support the women engaged in agricultural sector. The training on organic product making with the aim of supplying fresh organic vegetables free from hazardous chemicals to the society provide work for Green Army members during off season.

Even though KAU is not directly involved in the activities of Green Army, it is to the credit of the Agricultural Research Station, Mannuthy, of the University that its earnest efforts to find a solution to the agricultural labour shortage in the State, by way of training to a group of 18 farmers and farm workers of Wadakkanchery Block Panchayat has culminated in the formation of Green Army, which by its sincere efforts and the patronage of the Panchayat and PSCB has achieved State level acceptance and has become a model for other Agro Machinery Service Centres in the State.

5.2 Conclusion

The study clearly indicates that mechanisation is the only solution to the current problems of non - availability and high cost of manual labour for rice farming. Mechanisation can also attract younger generation to the agricultural sector in general and to paddy farming. Majority of paddy farmers in Kerala are small and marginal farmers. Hence ownership of machines for transplanting, land preparation and harvesting will be not be a viable proposition for them. Institutional credit from commercial banks, co-operative banks and LSGs may be made available for small machines like sprayers, cono weeders for small and marginal farmers, as part of their priority sector lending. Agro Machinery Service Centres may be declared by policy makers as an eligible institutional set up for provision of medium and long term loans for purchase of machinery involving huge capital investment, under priority sector lending, so that all categories of farmers can avail the services as and when they need it from the AMSCs.

Farmers having landholdings with water logged nature or kole lands are unable to use the presently available transplanters for transplanting of paddy seedlings. The scientists of Kelappaji College of Engineering and Technology (KACET) , Tavanur of Kerala Agricultural University may undertake research in this area, and design transplanters which can be used in these types of soil also. This will be a boon to the paddy farmers, especially to those of Thrissur District, where kole lands are found.

Lastly, but not the least, the farmers should be made aware of all the institutional arrangements and facilities of credit for mechanisation of their paddy farms, for which financial literacy is a must. This task can be entrusted to the under graduate students of Co-operation and Banking, of Kerala Agricultural University as part of their course work, especially through their Experiential Learning (EL) and Rural Agricultural Work Experience (RAWE) Programmes, with the active support of the LSGs, lead bank and financial institutions. Through these efforts KAU would be adding to the accomplishment of its primary goal of providing human resources, skills and technology required for the sustainable development of agriculture and other allied disciplines, by integrating education, research and extension.

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IMPACT OF AGRO MACHINERY SERVICE CENTRES ON MECHANISATION OF PADDY CULTIVATION IN KERALA

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ABSTRACT OF THE THESIS

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ABSTRACT

Agricultural operations essentially require labour as an inevitable input. But the availability and cost of agricultural labour is a major problem faced by the farmers of Kerala. The role of Agro Machinery Service Centres (AMSCs) in the mechanisation of farming operations is assuming importance in this scenario. Agro Machinery Service Centres are service providers where all agro machinery operation services with respect to crop production are rendered on contract basis. An Agro Machinery Service Centre should have all facilities to meet the critical need of the farmers and at the same time become a self-reliant and viable proposition.

The study entitled "Impact of Agro Machinery Service Centres on mechanisation of paddy cultivation in Kerala" was conducted with the main objectives of assessing the extent of mechanisation among farmers, identifying the determinants of paddy mechanisation through Agro Machinery Service Centres (AMSCs), studying the impact of AMSCs on mechanisation paddy cultivation and examining the role of institutional credit in the mechanisation of paddy farms.

One hundred and thirty five respondents from three Panchayats of Thrissur district viz., Avanoor, Kuzhoor and Pazhayannur and three AMSCs viz, Green Army, Sivasakthi and Parijatham were selected as samples through multistage sampling method. The sample farmers were categorised into two viz., users of AMSCs and non-users of AMSCs. Out of the total sample, 90 farmers are using the services of AMSCs and 45 are not using the services of AMSCs. The users are again grouped into 45 individual users and 45 group users /Padasekharams. Data were collected through pre-tested structured interview schedule.

The major statistical tools used for the study were independent sample t-test, one way ANOVA, Post-hoc test, Chi-square test, Yates' correction for continuity and indices such as mechanisation index, benefit index of AMSCs, service quality index of AMSCs and usage index of farm implements by farmers.

The extent of mechanisation adopted by farmers is analysed based on the farm size of farmers, different crops cultivated by them, purposes of mechanisation, area of mechanised land holdings of the farmers, farm implements used and owned by the farmers and measurement of adoption of mechanisation by the farmers. Mechanisation of farm lands is confined to paddy cropped areas. It is found that 81.43 per cent of total land holdings of farmers are mechanised. The mechanised land holding is more for users of AMSCs (90.74 percent) than the non-users (62.80 percent). The major farm implements used by farmers consist of tractors, transplanters, harvesters and sprayers. Users of AMSCs mainly adopt mechanisation for the purposes of land preparation, transplanting and harvesting whereas non-users adopt mechanisation for the purpose of land preparation and harvesting. The major farm implement owned by both categories of farmers are sprayers .The usage index of mechanised implements worked out to be 89 per cent by the farmers.

Mechanisation index is constructed as ratio of cost of use of machines and total cost of use of human labour, draught animals and machines to measure the extent of mechanisation among the farmers. The mechanisation index shows that the extent of mechanisation is more in the case of users than the non-users of AMSCs. The adoption rate of mechanisation is found to be 57.34 per cent for users and 30.72 per cent for non-users of AMSCs.

The mechanisation index for usage of services of Agro Machinery Service Centres is done separately in order to understand the effect of using such services in replacing the overall labour costs incurred in farm operations and also to understand the contribution of services of AMSCs in overall mechanisation of paddy farming. The mechanisation index of farmers who use AMSC services is

estimated at 30 per cent. . i.e., the cost incurred by non - users over and above this 30 per cent for transplantation can be saved, if they shift to mechanisation of transplantation. It is also found that the share of transplantation costs to total mechanisation costs of land preparation, transplantation and harvesting of users is nearly 51 per cent. This implies that, out of the total mechanisation costs, 51 per cent is contributed by AMSCs by the way of transplanting cost.

The determinants of farm mechanisation through Agro Machinery Service Centres is analysed by examining the relationship between mechanisation index of farmers with variables such as education level, farm experience, cost of cultivation, production and income from paddy of farmers. Chi-square test and Yates' correction factor for continuity was employed to study the relationship between these variables with mechanisation index. Among the above said variables, only cost of cultivation has significant relationship with the adoption of mechanisation by the user farmers and is a determinant of adoption of mechanisation through AMSCs by the user farmers. But in the case of non-users, none of the variables is a determinant of the adoption of mechanisation by the farmers.

The evaluation of service quality of AMSCs shows that reduced cost of cultivation, availability of skilled labour force, and saving in time are the factors that encourage the adoption of mechanisation by farmers through AMSCs.

The impact of AMSCs in paddy farming is measured by attempting a disaggregated analysis of different aspects of cost and production of rice. Mechanisation in paddy cultivation has resulted in labour displacement; AMSCs have served the purpose of labour saving in farm operations of transplanting. Average labour costs per acre of non-users are estimated as Rs. 37185 whereas that of users is estimated to be Rs. 29270. The highest difference in costs is found in the case of transplanting, where non – users have to spend Rs 2340/- per hectare more than the users of AMSCs. The usage of migrant labourers from the State of West Bengal for manual transplanting by the non-user panchayats

reduced the difference between transplantation using machine and manual labour to Rs. 2340. Estimating the net effect of labour saving and machine hiring costs reveals that average cost of cultivation of users of AMSCs (Rs 41590/Ha) is less than that of non-users (Rs.48360/Ha). Increased usage of mechanisation (by way of usage of AMSC services) also show impact on production, wherein the average production of user farmers (6090 kg/Ha) was found to be higher than non-users (5025 kg/Ha).

The users of AMSCs are enjoying two types of benefits from their service centres. One is economic benefits and the other one is operational benefits. Operational benefits include timeliness in farm operations, solution to labour scarcity and increased acreage of cultivation. The economic benefits deal with capital investment, farm income and sustainability of farming and motivation to continue farming in future. The economic benefits (92 per cent) have surpassed the operational benefits (88 per cent) since the indicator 'increased acreage under cultivation' has scored less. Hence, mechanisation through AMSCs has motivated all the user farmers to remain and continue in rice farming, but still has to go a long way to induce them to bring additional land under rice farming

Institutional credit has a pivotal role in the agricultural development of the country, as one of the critical inputs for agriculture. It capitalises farmers to undertake new investments and adopt new technologies. A large number of institutional agencies like Co-operatives, Regional Rural Banks (RRBs), Scheduled Commercial Banks (SCBs), Non– Banking Financial Institutions (NBFIs), and Self Help Groups (SHGs) are involved in meeting the short and long term mechanisation needs of farmers. In the case of farmers and Agro Machinery Service Centres studied, loan for mechanisation is found to be availed by none. All the service centres are provided with agricultural implements by Grama Panchayats and Block Panchayat at free of cost. Only one farmer owned machinery (tractor) for agricultural operations. The farmers seek the help of Agro Machinery Service Centres and private agencies for their mechanisation needs. It is not economical for the farmers to own agricultural implements. Hence the role

of institutional credit in mechanisation of paddy farming in the study area was found to be very limited.

Even though KAU is not directly involved in the activities of Green Army, it is to the credit of the Agricultural Research Station, Mannuthy, of the University that its earnest efforts to find a solution to the agricultural labour shortage in the State, by way of training to a group of 18 farmers and farm workers of Wadakkanchery Block Panchayat has culminated in the formation of Green Army, which by its sincere efforts and the patronage of the Panchayat and PSCB has achieved State level acceptance and has become a model for other Agro Machinery Service Centres in the State.

The introduction of AMSCs is an apt solution for severe labour shortage faced by farmers in paddy farming. They facilitate timely availability of machine labour and timeliness in farm operations. Hence, transplanting service of AMSCs, resulted in reduced cost of cultivation, increased production and farm income of farmers. Mechanisation through AMSCs has motivated all the user farmers to remain and continue in rice farming, but still has to go a long way to induce them to bring additional land under rice farming.

ANNEXURE

INTERVIEW SCHEDULE

1. Name of the Taluk :
2. Name of Panchayat :
3. Name of AMSC :
4. Name of the respondent :
5. Age :
6. Gender : Male / Female
7. Educational Qualification : Below SSLC ☐ SSLC ☐ Plus two ☐

   UG ☐ PG ☐ others (specify)
8. Marital status : Single/Married/ Widowed
9. Type of House :
10. Family size:
11. Family details of the respondent :

Sl. No	Name	Sex	Relation	Age	Education	Main occupation	Monthly income	Subsidiary occupation	Monthly income
1.									
2.									
3.									
4.									
5.									

12. Type of family : Joint/Nuclear

13. Asset position

Sl.No.	Asset	Unit	Volume	Annual Income
1.	Homestead land			
2.	Paddy Land			
3.	Total land holding			
4.	Poultry			
5.	Milch animals			
6.	Fish			
7.	Building			
8.	Others			

14. Nature of farming : Individual/ Group/ Padasekhara samithy

(Specify the no. of farmers in group and Padasekhara samithy)

15. Experience in farming :(Specify number of years)

16. Details of ownership of farm implements:

a) Tractor Yes/ No

b) Power tiller Yes/ No

c) Pump sets Yes/ No

d) Sprayer Yes/ No

e) Others (specify) Yes/ No

17. Did you face the following constraints before availing the services of AMSCs

a. Labour shortage during agricultural operations (Y/N)

b. Lack of ability to purchase machinery(Y/N)

c. Non availability of machinery on hire (Y/N)

d. High cost of cultivation(Y/N)

18. Are you using the service of AMSCs frequently? Yes/ No (If No, reason)

19. What are the services that you are availing from AMSC

a.

b.

c.

20. How long you are receiving the services of AMSCs?
21. How do you evaluate the services of AMSCs?

Quality of services (Very Good-5, Good-4, moderate-3, Poor-2, Very Poor-1)

- Accessibility of AMSC
- Approachability of AMSC
- Punctuality of workers
- Skilled workers
- Availability of specialised services
- Timeliness (usefulness) in farm operation
- Time saving when compared to manual labour
- Cost saving

22. What are the benefits that you perceive by using AMSC services for farm operations: rate your opinion (Very Good-5, Good-4, moderate-3, Poor-2, Very Poor-1)

a. Farm operations can be completed on time
b. No need for additional investment on farm machinery
c. Farm land need not be put idle for want of support services
d. No need to worry about labour shortage for farm operations
e. Farm operations can be completed within no time
f. Income from farm has improved over the years
g. Motivation to continue farming in future
h. Any other specify

23. What are the major crops cultivated?

a)
b)
c)

24. Details of cultivable land holding by the farmer

Land	Area	
	Mechanized	**Non mechanized**
Owned Cultivated Not cultivated		
Leased Cultivated		

25. Which are the crops in which you are adopting mechanization?

Sl.No	**Crop**	**Farm operations for which mechanization is used**	**Type of mechanisation/service used**	**Area of cultivation**
1				
2				
3				

26. Details of cost of cultivation

Cost components	**Users of AMSC**			**Non users of AMSC**		
	Cost/ unit (in ₹)	**Total consumption (in units)**	**Total cost (in ₹)**	**Cost/ unit (in ₹)**	**Total consumption (in units)**	**Total cost (in ₹)**
1. Material costs						
Seeds						
Fertilizer						
Herbicides -Weedicides -Insecticides						

-Fungicides						
2. Labour Costs						
a)Land preparation						
Raising of nursery						
Transplanting						
Weeding						
Manuring						
Plant protection						
Harvesting , threshing and processing						
Miscellaneous						
3. Machine charges						
Tractor						
Threshing						
Pumping						
4. Water management						
5. Post harvest charges						
Storage						
Transportation						
Marketing						
6. Other expenses						

27. Whether you have received any facility for irrigation and water management from AMSCs? Yes / No

28. Details of cropping pattern

Owned

Crop	**Users of AMSC**				**Non users of AMSC**			
	Area	**Production**	**Productivity**	**Income**	**Area**	**Production**	**Productivity**	**Income**

Leased

Crop	**Users of AMSC**				**Non users of AMSC**			
	Area	**Production**	**Productivity**	**Income**	**Area**	**Production**	**Productivity**	**Income**

29. Details of income generated from paddy :

Crop	Income generated	
	Users of AMSCs	Non users AMSCs
Sale of food grains		
Others (specify)		

30. Are you satisfied with the services of AMSCs? Yes / No

If No specified the reason

31. Suggestions for improving services from AMSCs?

32. What are the other services you are expecting from AMSCs?

33. In your opinion what are the advantages and disadvantages of mechanization?

Role of institutional credit in the mechanisation of paddy farms

1. Name of AMSC:
2. Are you availing any loans for farm mechanisation? Yes/ No

   If yes give details...

Sl. No	Source	Purpose	Loan amount	Interest rate	Term of loan	Amount outstanding
1.	Bank	Purchase of • Tractors • Combine harvester • Power tillers with matching implements • Threshers • Sprayers • Other farm implements				
2.	Panchayats / Krishi Bhavan					
3.	NGOs					
4.	Money lenders					
5.	Chits/ nidhies					
6.	Others (specify)					

3. Whether you are enjoying any insurance facility for the farm implements? Yes/ No

   If yes give details……
4. Whether the loan amount sanctioned is adequate to meet your mechanisation needs? Yes/ No
5. What are the problems you are facing in obtaining credit?

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