

# **FARM MECHANIZATION IN TAMILNADU: ISSUES AND PROSPECTS**

Theses submitted in part fulfillment of the requirement for the **Degree of MASTER OF SCIENCE (Agriculture) in AGRICULTURAL EXTENSION** to the Tamil Nadu Agricultural University Coimbatore

By

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COIMBATORE – 641 003.**

1999

**CERTIFICATE**

This is to certify that the thesis entitled, **FARM MECHANISATION IN TAMIL NADU : ISSUES AND PROSPECTS** submitted in part fulfilment of the requirements for the award of the degree of **MASTER OF SCIENCE (AGRICULTURE)** in **AGRICULTURAL EXTENSION** to the Tamil Nadu Agricultural University, Coimbatore, is a record of bonafide research work carried out by **Mr.N.ANANDARAJA** under my supervision and guidance and that no part of this thesis has been submitted for the award of any other degree, diploma, fellowship or other similar titles or prizes and that the work has not been published in part or full in any scientific or popular journal or magazine.

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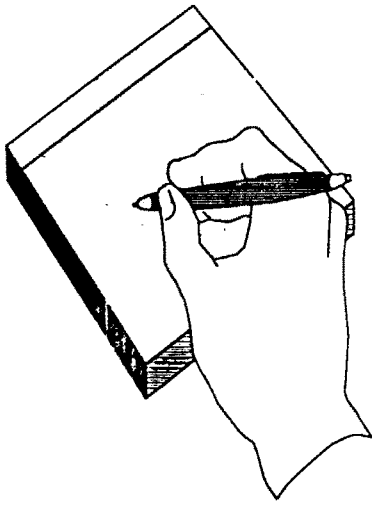
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## ABSTRACT

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### FARM MECHANISATION IN TAMIL NADU : ISSUES AND PROSPECTS

BY

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This study aimed at identifying the indigenous/traditional farm implements and tools used by farmers under different farming situations. Farmers' awareness and use of improved farm equipments and the impact of farm mechanisation on operational efficiency and farm productivity were studied. This study also aimed at studying the socio-economic profile of respondents and their relationship with awareness of farm implements and use, constraints in use and availability of farm equipments. The study also aimed to suggest suitable strategies to promote selective mechanisation of agriculture in the State.

Keeping in view of the above objectives the study was conducted in two blocks of High Irrigation Intensity District (HIID) and another two blocks of Low Irrigation Intensity District (LIID) of Tamilnadu. A sample size of 160 respondents was fixed from the selected 16 villages.

A total of 62 indigenous/traditional farm implements and tools was identified in both the farming situations for 17 different farming operations. Most of the respondents in HIID and LIID have been using the indigenous/traditional farm implements viz., mammati, vethaipotti, kaddaparai (crow bar), thattu koodai, kalaikothi (hand hoe), aruval (sickle), koduval, chakku, salladai, sallai chadu, muram and earthen pot.

Majority of the respondents in both the farming situations had a medium level of awareness and low use of improved farm equipments - machinery, implements and tools.

Tractor drawn cultivator, puddler, electric motor pump, power sprayer, knapsack sprayer, power duster, power thresher, dehusker and tractor-trailer were the farm equipments which had more awareness among all the categories of farmers in both HIID and LIID.

In both the farming situations, all the categories of farmers were reported to use the tractor drawn cultivator, puddler, electric motor pump, power sprayer, power duster and tractor-trailer.

In the two farming situations, majority of the respondents were old aged with secondary level of education

with agriculture alone as a major occupation having a nuclear type family and less than five members in a family. It was also found that the respondents had medium level farm size, land fragmentation, cropping intensity, farming experience, material possession, extension agency contact, exposure to media, hiring agency utilisation, attributes of efficiency, feasibility, availability and profitability, low level of training undergone, farm power asset and social participation. They had high level of irrigation intensity, labour availability, attributes of cost and trialability. The respondents in the two farming situations differed significantly with regard to the variables, family type, family size, land fragmentation, cropping intensity, irrigation intensity, labour availability, extension agency contact, and attributes of efficiency, trialability and profitability.

The six variables viz., occupational status, family size, land fragmentation, labour availability, training undergone and hiring agency had no significant relationship with awareness, while the others were positively significant in both the farming situations.

In both the farming situations extension agency contact had contributed positively towards the awareness level. The land fragmentation, labour availability and attributes of

trialability had negative contribution towards awareness of improved farm equipments - machinery, implements and tools. The extension agency contact, social participation, labour availability, farm power asset and exposure to media acted as a crucial variables to awareness.

The variables, viz., occupational status, family size, land fragmentation, labour availability, hiring agency and attributes of cost had no significant relationship with use while others were positively related.

Farming experience, irrigation intensity, farm power asset and attributes of availability contributed positively towards the use of improved farm equipments - machinery, implements and tools. The farm power asset, material possession, farm size and attributes of availability acted as crucial variables among them.

The impact of farm mechanisation on operational efficiency revealed that there was a decrease in number of labourers, work time and cost and an increase in satisfaction about quality of work.

The impact of farm mechanisation on farm productivity was, by and large, encouraging which was observed by considerable increase in yields of five out of six major crops studied. The increase was maximum in the case of sugarcane to

the tune of 180 quintals/ha and it was maximum in the case of cotton which was 0.250 quintals/ha. There observed negative trend but negligible degree in the case of ragi which was grown under rainfed conditions.

The constraints encountered by the respondents while using the improved farm equipments were inadequacy of hiring agency, non-availability of improved farm equipments, higher rates hiring charges, frequent power cut and small and fragmented land holdings. The important problems in the availability of farm implements and tools were high initial and maintenance cost, frequent repairs, lack of skilled labour to operate farm equipments, lack of credit facilities, non-availability of service centre and low resale value of farm equipments.

Setting up of private or co-operative custom/service/hiring agency, providing continuous power supply, increasing the rate of subsidy, encouraging the local artisans and developing location-specific, cost effective and efficient farm equipments were the suggestions offered by respondents to overcome the constraints.

Based on the findings of the study and the secondary data collected pertaining to all the districts in Tamil Nadu, viz., District-wise total farm power, net area sown, gross

cropped area and agricultural labourers a selective farm mechanisation strategy has been proposed which can be utilised by the farming community for better farm mechanisation and modernisation of agriculture in the State. The farm mechanisation has to be brought in a phased manner by providing alternative employment to the existing agricultural labourers as well as introducing efficient and cost effective farm equipments - machinery, implements and tools.

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## ABBREVIATIONS USED IN THIS STUDY

- HIID : High Irrigation Intensity District  
(Kancheepuram)
- LIID : Low Irrigation Intensity District  
(Dharmapuri)
- TNAU : Tamil Nadu Agricultural University
- VAO : Village Administrative Officer

## CHAPTER I

### INTRODUCTION

The economic progress of a nation is directly expressed by the overall energy availability and its consumption. Increased input in agriculture directly or indirectly increase the production and productivity. In the age old system of agriculture, the draught animal was the predominant power source for various operations such as tillage, post harvest and haulage etc. It is an established fact that inadequacy of the power and machinery resulted in very poor yields. Therefore, in order to bring more land under cultivation and to improve productivity, it is imperative to introduce other sources of power on the farm. The tractor, power tiller, oil engines and electric motors are the common sources of power being used on Indian farms. More and more application of these devices call for more and more machinery to carry out the required agricultural operations in a shorter period of time.

Traditional bullock power, indigenous implements and tools have severe limitation on coverage of land preparation and their efficiency. The use of hybrid varieties, multiple cropping system, perennial irrigation methods need more farm mechanisation on a truly gigantic scale in India.

Mechanisation is predominantly taking place mainly for operations for those the traditional practices have failed to achieve the timeliness of operation. This is due to the fact that agricultural labourers available in Indian farms are becoming scarce day by day. Quantity as well as quality of daily work output of agricultural labourers are also decreasing. Agricultural machines have now been recognised as one of the major inputs to agriculture due to the reduction of operational costs, minimising human drudgery, generation of more employment in the farm sector in addition to the increased production. Farm machines also confer definite benefits to the farms in terms of greater efficiency, economy and higher productivity particularly by speeding up agricultural operation during crucial periods. Hence the level of awareness and adoption of our farmers towards farm machineries is steadily increasing.

Mechanisation of agriculture implies the application of modern technology to agriculture. Until the ushering of the 'Green Revolution', agriculture remained backward and stagnant. Stagnancy was mainly due to the use of out moded, obsolete and primitive technology such as ploughing of land with hand operated or bullock driven plough and manual operation of the other tasks such as sowing, reaping, threshing, irrigating and harvesting.

The burgeoning human population will lead to an increase in demand for food and raw materials. All these help in understanding the need for increased mechanisation of agriculture to raise productivity levels and by achieving timeliness in farm operation, bringing precision in metering and placement of inputs, reducing avoidance and input losses, increasing utilisation and efficiency of costly inputs (seed, chemical, fertilizer, irrigation water, etc.). Efficient use of animal and commercial energy for increased productivity at the same time reduces unit cost of produce and enhances profit and competitiveness in the cost of operation. It also helps in the conservation of produce and by-products. From qualitative and quantitative damage, enables value addition and establishment of agro processing enterprise for additional income and employment from farm produce and achieve economy in meeting rural needs. By reducing drudgery in production and post harvest operations and providing quality energy to household activities, mechanisation helps in improving the quality of rural life.

In Tamil Nadu farm mechanisation had taken its pace since 1945. Traditionally all the farm implements used for cultivation practices were produced by the local artisans. They had a well structured system for hiring as well as

servicing and repairing. As the research system in the agricultural universities and their research stations concentrated mainly on agricultural engineering it took a major break-through in farm mechanisation in Tamil Nadu. The Tamil Nadu Agricultural University started its separate department crested "Agricultural Engineering" has contributed a lot in producing various type of farm machinery, implements and tools. The other phase of the development of farm mechanisation was due to the attempt of agro-industries in popularising their machinery and implements. However, only stray attempts have taken by social scientists to document agricultural engineering with extension aspects viz., traits of users and non-users farm machinery (Rao, 1972), factors influencing the farm machinery available at agro-engineering service co-operative centres (Muthuraj, 1979), utilization of processing equipments (Thiruthuvadas, 1981), use of farm implement and machinery in farming system (Philip, 1983) and diffusion of introduced farm equipments (Muneer ahamed, 1987).

Keeping all these points in a converging thought, the present study on "Farm mechanisation in Tamil Nadu : Issues and Prospects" was attempted with the following objectives.

### Specific objectives

1. To identify the indigenous/traditional farm implements and tools used by farmers in different farming situations.
2. To study the level of awareness and use (both own and hired) of improved equipments - machineries, implements and tools in different farm size categories under different farming situations.
3. To analyse the socio-economic profile of respondents and to find out their relationship with awareness and use of farm equipments.
4. To study the impact of farm mechanisation on operational efficiency and farm productivity.
5. To find out the constraints in availability and use of improved farm equipments - machinery, implements and tools.
6. To assess the extent of farm mechanisation in different districts of Tamil Nadu and its relationship with the net area sown, gross cropped area and area irrigated at macro-level with secondary data and to suggest an appropriate strategy for promotion of selective farm mechanisation in Tamil Nadu.

### Scope and importance of the study

The study will provide a list of indigenous/traditional farm implements and tools used by farmers in different farming situations viz., High Irrigation Intensity District (HIID) and Low Irrigation Intensity District (LIID). Further, it will give a thorough understanding of the awareness and use of improved farm equipments - machineries, implements and tools by the farmers and the profile of farmers influencing the awareness and adoption. It would bring out the impact of farm mechanisation on operational efficiency and farm productivity. Besides it would throw light on the bottlenecks in availability and use of improved farm equipments - machineries, implements and tools. The findings of this study will serve the policy makers, decision-makers, administrators, scientists, extension workers of government and non-government organisations to realise and know the present status of farm mechanisation. This study will be a bench mark to plan for 2020 AD where we have to mechanise the agricultural sector to feed the burgeoning human population. In addition, it will help the researcher by providing a list of indigenous/traditional farm implements and tools for test verification and to select viable and efficient technologies for popularisation.

### **Limitations of the study**

The limitation such as time, limited resource availability and finance were met during the course of investigation. Yet, sincere and thoughtful attention was put forth to make this study an objective, definite and systematic one. Despite the limitations, best efforts were extended to make the study, a quality one.

### **Organisation of the thesis**

The study is presented in five chapters. The importance, objectives, scope and limitations of the study are dealt under Chapter I.

The relevant previous works are reviewed under Chapter II.

The research methodology followed in the study is dealt under Chapter III.

The findings and discussion with reference to the study is presented in Chapter IV.

Summary and conclusion with implications of the study are presented in Chapter V.

## Concepts used for the study

**Farm equipment:** A general nomenclature which refers to all tools with hand tool technology, implements with animal draft technology and machineries with mechanical power technology, used in the farming unit.

**Farm machinery:** They are equipments being operated with mechanical power.

**Farm implement:** This will refer to the equipments being operated with animal power.

**Farm tools:** They are special type of implements held in hand for performing or facilitating the farm operation.

**Farm mechanisation:** It refers to the supplementation and or replacement of animal and human labour power in farming by mechanical power. Its role is conspicuous for increasing production, saving time, reducing costs, maximising efficiency of other inputs and reducing drudgery.

**Hired:** Farmers who do not own it by purchase but get the farm machinery, implements and tools for hire.

**Improved:** Those which having modification over the existing farm equipments - machinery, implements and tools to have greater field efficiency within a shorter period and which requires less manpower.

**Impact of farm mechanisation:** It refers to the actual change in the operational efficiency and farm productivity which may be a positive change (or) negative change due to the influence of mechanisation of the farm over a period of time.

**Operational efficiency:** It refers to the increased efficiency in terms of execution of all farm operations for a crop per season. It can be measured in terms of time, cost and quality of work.

**Farm productivity:** It refers to the increased productivity of the farm observed as a result of farm mechanisation which is measured in terms of the yield obtained from the farm.

**Constraints:** It refers to the problems/obstacles experienced by the respondents in use and availability of farm equipments.

**Suggestions:** It refers to the solution given by the respondents to overcome the problem/constraints occurred in the use and availability of farm equipments.

**Selective farm mechanisation:** It refers to find out the most suitable farm equipments for any particular farm operation for a specific crop.

With this idea in mind, the literature directly and indirectly related to the present study was collected and presented in the next chapter.

## CHAPTER II

### REVIEW OF LITERATURE

Past studies pave way for future research endeavour. An acquaintance with earlier pertinent studies has been felt necessary to develop good understanding of the present study to formulate appropriate research methodology. Review of literature helps to acquire broad and general background in the given field of discipline with regard to indigenous, improved farm machineries, equipments, implements and tools related studies, in which a few literature is available. However, an attempt was made to review the available literature in this area of research which had a meaningful relation to the study and are presented in the following sub-heads.

- 2.1. Indigenous/traditional farm implements and tools used for various farm operations
- 2.2. Awareness of respondents about the farm equipments - machinery, implements and tools
- 2.3. Use of the farm equipments - machinery, implements and tools
- 2.4. Impact of farm mechanisation on farm productivity and operational efficiency
- 2.5. Socio-economic profile of respondents
- 2.6. Relationship of characteristics of respondents with their level of awareness and extent of use

2.7. Constraints in use and availability of farm machineries, equipments, implements and tools

2.8. Suggestions

2.1. Indigenous/traditional farm implements and tools used for various farm operations

2.1.1. Importance

Srivatsava (1980) reported that since traditional technologies have undergone a selective process over centuries of empirical testing they are likely to represent optimal solutions. He also opined that the traditional tools and techniques should be studied systematically and an organised effort be made for improving their efficiency and productivity.

Thurstone (1990) indicated that traditional agricultural practices must be understood and conserved before they are lost due to rapid advance of modern agriculture in developing countries.

Joseph (1993) argued that indigenous technology can sometimes play a key role in technology development. He opined that what is now required is a methodology that will facilitate the use of indigenous technology as a basis for appropriate technology.

Pereira and Gupta (1993) pointed out that one reason for the persistence of traditional technologies and their revival now is that the westernized system cannot solve the problem that individual farmers and artisans face either because of the need for urgent action or because westernized solutions are too expensive or because they cause serious damage to the environment.

Titilola (1994) pointed out that a knowledge of local techniques can help to identify practices suitable for adoption or adaptation, with a view to improve or reinforce accepted methods and procedure without destroying local environment.

#### 2.1.2. Indigenous/traditional farm implements and tools

Sl. No.	Indigenous/traditional farm implements, tools	Farm operation/crop	Practising place	Author
1.	Clay pot, Tins Gunny bags	Used for storing of grains	Andhra Pradesh	Pushpamma and Rao (1981)
2.	Balchar blade bullock drawn implement	Primary and secondary tillage	Farmers in Andhra Pradesh	Gupta (1989)
3.	Stone slab bin	Used for wheat seed storage	-	Agarwal (1990)
4.	Earthen vessel, mud bins, tins, gunny bag and pucca godown	Storing the grains	Bangladesh	Amirazzaman (1990)

Sl. No.	Indigenous/traditional farm implements, tools	Farm operation/crop	Practising place	Author
5.	Dig drums made of clay	For storing grains	Farmers in Rajasthan	Chittirai chelvan (1990)
6.	Narulco	To scar away Birds	Farmers in Japan	Hidaka (1991)
7.	Wooden plate	To level the paddy fields	Farmers in Madhya Pradesh	Horikoshi (1991)
8.	Net is made from heavy string with bamboo/rattan	Mango harvest	Farmers in Thailand	Ito (1991)
9.	Use of broom or brush	To prevent spindly growth of seedlings	Farmers in Japan	Katsuta and Ohta (1991)
10.	Rotary cultivator	Seed bed preparation	Reunion Islands (Faranch)	Perret (1991)
11.	Manual using of Bamboo ladle	Lift irrigation	Farmers in Thailand	Shinohara (1991a)
12.	Spout made of Bamboo tube	To sprinkle the water	Farmers in Myanmar	Shinohara (1991b)
13.	Palm leaf basket	Bagging the Fruits	Farmers in Malaysia and China	Shimada (1991c)
14.	Pete and Pila	To store the grains	Farmers in Gujarat	Gupta and Patel (1992a)
15.	Santi	Cutting groundnut	Farmers in Gujarat	Gupta and Patel (1992c)

Sl. No.	Indigenous/traditional farm implements, tools	Farm operation/crop	Practising place	Author
16.	Dahaliyu	Sowing garlic	Farmers in Gujarat	Gupta and Patel (1992c)
17.	Chud balls	To preserve tomato seeds	Rural women in Bangladesh	Gupta (1993)
18.	Multi purpose tool Santi	For sowing, harrowing, digging, ploughing, inter-culturing etc.	Farmers in Gujarat	Gupta and Patel (1993)
19.	Wire loop	To pull out mango beetle larvae	Farmers in Gujarat	Gupta and Patel (1993a)
20.	Pumbu	For storing grains	Farmers in Nigeria	Odesh and Lijh (1993)✓
21.	Kiro	To store sorghum grains	Farmers in Sudan	Sharland (1993)
22.	Piece of iron	Intercultural operation	Farmers in Bhutan	Sharma (1993)
23.	Gibs, Granaries, Silos, Jars and Gourds	To store the grains	Farmers in Mali	Siaka (1993)
24.	Heavy sticks and poles	Separation of sunflower seeds from the earhead	-	Viswanathan (1993)
25.	Cycle type discarded	To save paddy crop from mealy bug	Farmers in Eastern India	Yadav (1993)
26.	Metal/clay traps	To control rodents	Farmers in Egypt	Parrish (1994)

Sl. No.	Indigenous/traditional farm implements, tools	Farm operation/crop	Practising place	Author
27.	Mud silos (Souma)	To store grains	Farmers in Egypt	Parrish (1994)
28.	Granary rooms	To store grains	Farmers in Egypt	Parrish (1994)
29.	Bullocks and rollers	Threshing	Tamil Nadu	Parvathi (1995)
30.	Solavu	Winnowing	Tamil Nadu	Parvathi (1995)
31.	Sieve	Cleaning of pulses	Tamil Nadu	Parvathi (1995)
32.	Gunny bags, Mud pots, drums, Kulumai, pattarai	For storing the grains	Tamil Nadu	Parvathi (1995)
33.	Kavathukkavvai, Pallukkavai	Used for lifting the earheads	Tamil Nadu	Parvathi (1995)
34.	Valippumar	To clean the produce	Tamil Nadu	Parvathi (1995)
35.	Owl stands	For controlling rats	Tamil Nadu	Somasundaram (1995)
36.	Thazhi	To store the grains	Tamil Nadu	Somasundaram (1995)
37.	Mud Kudhir	To preserve seeds	Tamil Nadu	Somasundaram (1995)
38.	Wooden plough	To control koari weeds	Tamil Nadu	Somasundaram (1995)
39.	Mammaty	To top the sugarcane ridges	Tamil Nadu	Somasundaram (1995)

Sl. No.	Indigenous/traditional farm implements, tools	Farm operation/crop	Practising place	Author
40.	Earthen pots with water + castor oil	To control rhinoceros beetle in coconut	Tamil Nadu	Somasundaram (1995)
41.	Mud pots	To store Gingelly seeds	Tamil Nadu	Somasundaram (1995)
42.	Hand hoe	For carrying out thinning operation in gingelly field	Tamil Nadu	Somasundaram (1995)
43.	Country plough	To sow the groundnut seeds	Tamil Nadu	Somasundaram (1995)
44.	Earthern pot	To store the groundnut oils	Tamil Nadu	Somasundaram (1995)
45.	Earthern grinders	To remove husks from Varagu	Tamil Nadu	Somasundaram (1995)
46.	Crow bar	To plant ragi seedling in pit	Tamil Nadu	Somasundaram (1995)
47.	Country plough	For weeding operation in sorghum	Tamil Nadu	Somasundaram (1995)
48.	Country plough	Ragi seedling plant behind the plough	Tamil Nadu	Somasundaram (1995)
49.	Bullock drawn wooden plant	Parampadi-thal in rice field	Tamil Nadu	Somasundaram (1995)

Sl. No.	Indigenous/traditional farm implements, tools	Farm operation/crop	Practising place	Author
50.	Kudhir Thombai	To store the grains	Tamil Nadu	Somasundaram (1995)
51.	Wooden pegged harrow	For thinning and weeding operation in paddy	Tamil Nadu	Somasundaram (1995)
52.	Wooden level board	To level the main fields	Tamil Nadu	Somasundaram (1995)

## 2.2. Awareness of respondents about the farm equipments - machinery, implements and tools

Nandakumar (1980) reported that the majority of the participants (68.33%) and non-participants (75%) belonged to the medium category of awareness.

Sripal (1983) reported that 10.00 per cent of rainfed cotton cultivators were aware of high yielding varieties, 63.00 per cent on seed treatment and 24.00 per cent on fertilizer application and 33.00 per cent on plant protection.

Theodore (1988) reported that 45.00 per cent of contact farmers and 45.00 per cent of non-contact farmers were aware of contingency farming practices.

Venugopalan (1989) reported that the awareness about summer ploughing was cent per cent among small and big farmers while it was 96.00 per cent among medium farmers.

Chandrakandan (1990) stated that 40.00 per cent of villagers were found to be aware of the existence and about one-third know the details of social and agro forestry schemes in Salem district of Tamil Nadu.

Snehalatha (1991) reported that summer ploughing and azospirillum seed treatment had the maximum level of awareness (62.50%) and the author further revealed that using of light traps for leaf hopper were known to 75.00 per cent of respondents. Further, she concluded that 35.00 per cent of the irrigated farmers had low level and medium level (20.00%) of awareness about farm technologies.

Kathiravan (1994) revealed that 80.80 per cent of the respondents had either medium to high level of awareness about tree cultivation programmes.

Kirubakaran (1995) revealed that 50.00 per cent of farmers were aware of fertigation through drip irrigation system and 50.00 per cent of farmers were not aware of fertigation.

Asokan (1996) found that although many of the farmers were aware of the new implements and they were unable to use them due to unavailability of implements in some areas and lack of purchasing power and adequate technical knowledge of the farmers.

Rabezandrina (1997) reported that department officials in Africa had become aware that the mechanization of agriculture work was a significant factor in increased productivity.

### 2.3. Use of the farm equipments- machinery, implements and tools

Philip (1983) found that 96 per cent of respondents had used hand operated sprayer and 14.17 per cent had used power sprayer for plant protection.

Sharan (1984) reported that the use of tractor had confined only to three operations viz., preparatory tillage, landscaping and hullage.

Saeed (1987) found that common hand tools, power tractors and animal drawn equipments were used in Pakistan for weed control.

Tandon (1987) observed that manual and animal operated drills are mostly used for cotton, groundnut and soybean, while tractor drawn machines have only been used for drilling cotton and groundnut.

Awadhwal (1988) revealed that low cost bullock implements of broadbed former and fertilizer application attachment, inter row weeder and planter are used for groundnut crops.

Devnani (1990) reported that the farmers used different implements for different farm operations, for seedbed preparation (tractor-operated rotavator and basin lister, sugarcane stubble shaver, manually operated multipurpose tool carrier), for sowing and for fertilizer application (seed metering device for sowing mustard, tractor mounted and three row bullock drawn groundnut planter, tractor drawn maize ridge planter), for plant protection (tractor mounted ultra low volume sprayer, self propelled power sprayer), for harvesting (reaper-windrower for rape seed, mustard, animal drawn groundnut digger) and for threshing (castor, sunflower, plot and single ear thresher, multicrop thresher for oilseeds and pulses).

Mahias (1990) identified that different types of khurpai are used for weeding, gardening, replanting and cutting short grass.

Awadhwai (1991) reported that use of simple T-bar bullock drawn implements for making broadbeds, knapsack sprayer for low growing crops, a groundnut digger for hard soils and a donkey drawn cultivator cum seeder for sowing pearl millet and sorghum in hills.

Singh (1991) found that the use of combination of a disc harrow, pulverising roller and plank to be optimum from the point of view of energy expenditure and economic returns.

Suganthi (1991) identified that majority of the users and non-users of regulated market used bullock carts to transport their produce to the market yard. Tractor was a means of transport for regulated market users and non-users used bus and cycle.

Mathews (1992) observed that tall trees has required the use of thermal fog applying aerosal panicles, these application need to be repeated to achieve adequate control.

Ponnu (1992) reported that marginal farmers did not owned tractor and tractor drawn implements.

Shyam (1992) revealed that a tractor, a cultivator, a seed drill and atleast one pumpset were owned by more than 92.00 per cent of the farmers and crop thresher by 72.50 per cent of the farmers.

Surendra Singh (1992) reported that tractor use was in the range of 1.7 - 10.4 hrs/ha the minimum being for rabi fodders and maximum for wheat. Maximum use of electric motor was for rabi fodders (305.6 hrs/ha) followed by paddy (256 hrs/ha) and wheat (72.72 hrs/ha). Similarly, maximum use of diesel engine was 210.7 hrs/ha for rabi fodders followed by 116.8 hrs/ha for kharif fodders.

Anonymous (1993) opined that about half of the farmers possessed spraying equipment and slightly above two-thirds of sprayman possessed the plant protection equipments.

Singh (1994) reported that the seed cum fertilizer drill was used by 25.51 per cent of respondents, 24.48 per cent of respondents used manual fertilizer broadcaster, 15.30 per cent respondents used mechanical weeder and only 10.20 per cent respondents used disc harrows.

Singh (1994) found that the average use of tractor in Bihar per year was 1234 hours which was above the recommended annual use of tractor which was found to be on own account and the remaining two-third being rented. However, the utilisation was more heavily tilted towards field preparation in the former, while in the later, tractor was used heavily for transportation.

Shibayama (1995) revealed that majority of respondents, mainly carried out weed control practices using hand tools in upland conditions and rotary weeders in paddy fields.

#### **2.4. Impact of farm mechanisation on farm productivity and operational efficiency**

Bansal (1989) identified that introducing a package of low-cost improved animal drawn implements, energy saving of

44.3, 37.7, 56.7 and 60.3 per cent were recorded with improved technology in crops of wheat, mustard, cotton and pearl millet respectively. Average yield increases of 5.4, 17.4, 14.8 and 16.3 per cent and operating cost savings of upto 51.6, 28.8 40.5 and 59.4 per cent respectively were observed.

Goldberg (1990) concluded that the drip irrigation system distributed water uniformly and accurately, shortened the growing season of the crop, avoided levelling of fields, reduced the salinity damage and increased the yield compared with sprinkler or furrow irrigation.

Nagappa (1990) reported that the net returns from cropping per hectare was higher in tractor operated farms than that of bullock operated farms.

Varshney (1990) concluded that rotating twice with the power tiller led to better seed bed preparation than with the blade harrow, further added, there was a time saving of 45.85 per cent in seed bed preparation by rotating twice with the power tiller compared with blade harrowing three times with bullocks.

Sharma et al. (1991) reported that returns were found to be much higher on mechanized farms while yields exceeded those on non-mechanized farms by upto 55 per cent.

Wadhwa (1991) reported that the improved pruning tools were about 38 per cent more efficient than the conventional tools and effort requirements for cutting were 83.99 per cent more for conventional tools than for improved tools.

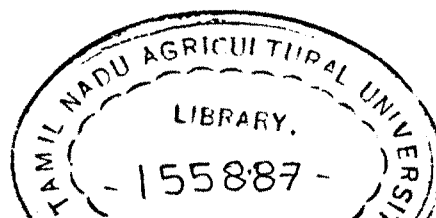
Moorthy (1992) found that the paddy wheel hoe used twice resulted in the greatest weed control (80%), rice grain yields (1.65 t/ha) and straw yields (3.54 t) when comparatively the finger weeder used twice resulted in the greatest weed control (86.7%) and yields (2.18 t).

Murthy (1992) concluded that improved bullock drawn intercultural harrow conserved soil water better, ensuring better grain and straw yields, than existing designs of harrow.

Abdul Razzag (1993) results showed that disc harrow plus chisel plough and mould board plough plus disc harrow were the most appropriate tillage packages as they increased yields by 14.24 and 19.91 per cent respectively.

Dash (1993) observed that power tiller farming systems were superior to bullock farming systems in terms of yield and cost of operations.

Murthy (1993) showed that in ragi field, weed control of 80.34 per cent was recorded when harrowing was done twice



with the improved harrow, compared with 61.47 per cent with the traditional harrow used once. Grain yield of 2766.2 to 3206.02 kg/ha were achieved.

Sharma et al. (1993) reported that drilling in soyabean and wheat resulted the yields of 1389 and 3671 kg/ha respectively compared with yields of 1274 and 3495 kg respectively with broadcast sowing.

Mayande (1995) observed that use of ploughing, sowing and harvesting implements and tools has produced an increase in field coverage, operational efficiency and crop yields compared to conventional methods.

Srivastava (1995) concluded that for sugarcane set unit, cutter, planter, the energy and cost requirements were about 40 per cent less, compared with the traditional method of planting sugarcane.

Subudhi (1996) reported that rice grain yield was highest in plots tilled by Bose plough (5.01 t/ha) followed by roller plough (4.87 t) and mould board plough (4.78 t). Tillage by wooden plough gave the lowest yield (4.28 t). The performance indices of iron ploughs were significantly higher than those of the wooden plough.

## 2.5. Socio-economic profile of respondents

### 2.5.1. Age

Babu (1990) revealed that 46.20 per cent of the respondents were young, followed by old (32.70%) and middle (21.10%) age categories.

Krishnakumar (1996) found that among the paddy growers, almost an equal per cent of respondents belonged to old age group (50.00%) and middle age (48.00%). Only 2.00 per cent of the farmers were young.

Usharani (1998) indicated that nearly three-fourth (67.52%) of the respondents were middle aged whereas one-fifth (17.10%) of them were young farmers. Only less (15.38%) portion of them were found to be old farmers.

### 2.5.2. Educational status

Athimuthu (1990) stated that more than half of respondents (61.00%) had medium level of education, 28.00 per cent had low level of education and 11.00 per cent had high level of education.

Rajkumar (1992) observed that most of the respondents had primary, middle and secondary school education ie., 29.17 per cent, 23.33 per cent and 30.84 per cent respectively. Illiterate farmers accounted for 13.33 per cent and only a meagre percentage (3.33%) had college level of education.

Sriram (1997) found that almost all the cotton growers (98.00%) were literates and illiterates were only 2.00 per cent.

Venkattakumar (1997) reported that more than one-third (38.05%) of the respondents possessed medium level of education followed by low (34.52%) and high (27.43%) level of education.

#### 2.5.3. Occupational status

Balasubramanian (1992) found that majority of the respondents were primarily agriculturists, about one-fourth of them were engaged in non-agriculture occupation.

Ponkathaperumal (1994) observed that 81.00 per cent of the respondents had agriculture as their primary occupation and for the rest (19.00%) agriculture was found to be the secondary occupation.

Krishnakumar (1996) stated that two-thirds of the respondents (64.00%) expressed agriculture as their primary and main occupation.

#### 2.5.4. Family status

Helen (1990) reported that 60.00 per cent of the respondents families lived in a joint family system and had upto four members and the remaining 40.00 per cent families

lived in the nuclear family system with more than four members.

Mansingh (1990) stated that two-third of the respondents lived in the nuclear families and had upto five members.

Sujatha (1996) revealed that majority of the farmers had nuclear type of families.

#### 2.5.5. Farming experience

Suganthi (1991) observed that majority of the users of regulated market had high level of farming experience.

Karthikeyan (1994) revealed that a majority of the farmers had more farming experience in sugarcane cultivation.

Krishnakumar (1994) found that 43.00 per cent and 42.00 per cent of the respondents had medium and low level of farm experience followed by a few respondents (15.00%) had high level of farm experience.

Usharani (1998) reported that more than 90.00 per cent of the respondents had high level of farming experience and only a meagre per cent (5.13%) had low level of farming experience.

#### 2.5.6. Farm size

Grover (1991) indicated that majority of the respondents (40%) were having no land holding followed by 37 per cent having 2.50 to 5.00 acres, 20 per cent having 5.10 to 7.50 acres and only 3.30 per cent having 7.50 to 15.00 acres.

Gopalakrishnan (1994) stated that most of the farmers possessed small sized land holdings (42.50%) followed by marginal land holdings (28.33%) and medium land holdings respectively (15.83%).

Velusamy (1996) found that 46.67 per cent of women respondents had no land, whereas one-third of women respondents were marginal farmers, followed by small farmers.

#### 2.5.7. Land fragmentation

Thiagarajan (1980) indicated that the reasons for non-coverage of entire land by tractors is due to the fragmentation and small sized holdings.

Lanjouw (1991) stated that the distribution of lands were largely accounted by household splits.

Amer (1994) found that land fragmentation increases production costs, continued land fragmentation which will lead to decreasing efficiency and is problematic when it results in small fields.

Venkatasubramanian (1996) reported that greater fragmentation of land holdings, scarcity of farm labourers and rearing of animals primarily for milk were mostly responsible for the reduction in number of working bullocks.

#### 2.5.8. Cropping intensity

Tetlay (1990) found that cropping intensity of cotton and wheat areas of Punjab in Pakistan was well below its potential and also significantly lower than in neighbouring areas of Punjab in India. Ownership of factor plays a lesser role in increasing cropping intensity.

Rahim (1995) stated that cropping intensity of the tractor owning farms was higher than that of the control group.

Pushpa (1996) observed that cropping intensity was generally high in crop alone farming system and it was found to decrease with the addition of enterprises.

Rexlin (1998) revealed that 53 per cent of the respondents had low level cropping intensity, merely equal percentage (23.24%) of respondents were in the high and medium levels.

#### 2.5.9. Irrigation intensity

Rajagopal (1986) reported that irrigation intensity was very little ranging from 1.30 per cent to 16.00 per cent in

coastal and old delta region respectively and 13.30 per cent in new delta.

Khan (1994) revealed that 48.33 per cent had high irrigation intensity and low irrigation intensity for hiring in groups.

#### 2.5.10. Labour availability

Bhople (1992) revealed that women were involved in all types of farm activities, but their maximum contribution was in pre-sowing, sowing, manuring, harvesting, grain storage and in marketing operations.

Iqbal (1992) found that majority of the respondents reported non-availability of labour as one of the problem encountered by respondents in applying integrated farming system.

Palaniswamy (1995) reported that non-availability of labour as a key factor influencing the non-adoption of satellite farms.

Pushpa (1996) expressed that inadequate supply and high cost of labour were felt by 66.67 per cent of respondents.

Inaizumi (1998) observed that high labour requirement were noted as constraints for processing of cassava, especially by female labourers.

#### 2.5.11. Training undergone

Gulothungan (1986) reported that majority (89.12%) of the Fresh Agricultural Officers had undergone only one pre-service training before entering into their job and majority (81.23%) of them underwent one to three in inservice training.

Rajagopalan (1990) noticed that within a month after the training programme, the trained tribal youth were able to repair as many as eight bore well hand pumps in Attapady.

Satyanarayana (1995) found that rural artisans were provided with houses/worksheds, improved tools, equipments and working capitals. Training was offered to enable them to make best use of new skills and techniques.

Viswanathan (1997) found that 58.10 per cent of respondents attended trainings with more than 15 days duration whereas the other 41.90 per cent respondents also attended training but less than 15 days duration.

#### 2.5.12. Hiring agency

Srinivasan (1975) observed that 45 per cent of the farmers in the village were aware of the availability of implements with gramsevaks and only 16.30 per cent had utilized them.

Muthuraj (1979) revealed that cent per cent of of the small and marginal farmers were aware of the hiring out farm machinery in Agricultural Engineering and Service Co-operative Centres.

Singh (1992) reported that small and marginal farmers may form bullock co-operatives to meet their demands for bullock power.

NABARD (1994) reported that tractorization helped to create additional employment and income through custom hiring.

#### 2.5.13. Farm power asset

Babu (1990) stated that majority of the respondents (51.00%) fell under low category of farm power possession followed by high (29.80%) and medium category (19.20%).

Muruganathan (1996) described that bullock labour power utilization on preparatory cultivation was 19 pair days in small farms, while it was only 2 pair days in medium farms and no bullock labour in large farms.

Venkattakumar (1997) found that nearly equal proportion of the respondents had low (46.02%) and medium (41.59%) levels of farm power whereas sparse respondents had high level of farm power possession.

#### 2.5.14. Material possession

Iqbal (1992) reported that of the respondents possessing plant protection equipments, 40.00 per cent of them possessed sprayers and 3.33 per cent possessed dusters.

Mallika (1995) found that nearly half of the respondents had medium level of material possession.

Ashok (1996) stated that a little more than half (53.33%) of the farmers had high material possession.

Rexlin (1998) revealed that 46.50 per cent of the respondents had low level of material possession and 28.00 and 25.50 per cent belonged to high and medium level respectively.

#### 2.5.15. Extension agency contact

Helen (1990) indicated that majority of the dryland farmers utilized input agencies followed by Assistant Agricultural Officers and Livestock Assistant.

Sophia (1991) found that a little more than half (54.50%) of the respondents had medium level of extension agency contact, while others had low (23.30%) and high (22.20%) level contact with extension agency.

Krishnakumar (1996) pointed out that nearly three-fourth of respondents had medium level of contact with extension agency.

Sriram (1997) observed that majority of the cotton growers had medium and high levels of contact with extension agency.

#### **2.5.16. Social participation**

Ratnabai (1990) pointed out that majority (68.00%) of sugarcane growers possessed medium level of social participation.

Elangovan (1994) described that majority of the respondents had medium level of social participation.

Venkattakumar (1997) revealed that an equal proportion of the respondents (40.71%) had low and medium levels of social participation whereas nearly one-fifth of them had high level of social participation.

Usharani (1998) stated that nearly an equal proportion of the respondents had high (50.43%) and low (49.57%) levels of social participation whereas none of them had medium level of social participation.

#### **2.5.17. Level of exposure to media**

Natarajan (1991) observed that majority of the farmers (67.80%) had medium level of media exposure followed by low and high levels.

Kumar (1994) pointed out that majority of the farmers (78.33%) were having medium degree of mass media exposure whereas 17.17 per cent of the farmers had low degree of media exposure and 7.50 per cent had a high degree of exposure.

Sriram (1997) found that less than three-fourths of the respondents had medium and high levels of message exposure.

#### 2.5.18. Attributes of farm machinery

##### 2.5.18.1. Cost

Chandrakandan (1973) conducted that there was some amount of difference between users and non-users in the perception of cost of burmese setturn and in the working cost of the power sprayer.

Chennakesavan (1978) stated that the cost of power sprayer was perceived as high. With respect to other machinery, the users and non-users perceived the cost of tractor as high and the cost of electric motor as low. Users of all engines perceived their cost as low whereas non-users perceived it as high.

Thiruthuvadas (1981) reported that 88.57 per cent multi crop thresher users and 77.14 per cent of sugarcane crusher users felt that the cost of the equipment was very high while none stated that the cost was low.

#### 2.5.18.2. Efficiency

Chandrakandan (1973) concluded that the efficiency of power sprayer was found to have considerable effect on its adoption.

Chennakesavan (1978) reported that farmers perceived the tractor, electric motor, oil engine and power sprayer as efficient.

Thiruthuvadas (1981) observed that users of sugarcane crusher had very high efficiency in saving time (71.42%), labour (74.28%) and medium efficiency in timely completion of work (68.57%) and users of multi crop thresher had very high efficiency in saving time, (97.14%), efficiency in coverage (97.14%) and medium in labour saving (51.43%).

#### 2.5.18.3. Feasibility

Chandrakandan (1973) revealed that amongst small farmers there was no significant relationship between feasibility and extent of adoption.

Chennakesavan (1978) found that the users perceived all the four machinery viz., tractor, electric motor, oil engine and power sprayer as highly feasible in their operation.

Thiruthuvadas (1981) reported that 54.28 per cent of sugarcane users and 74.29 per cent of multi crop thresher

users had vast feasibility in the use of this equipment with available farms and crops grown and to certain extent feasibility with the available skill of the labour.

#### 2.5.18.4. Availability

Anbalagan (1974) indicated that non-availability of fertiliser, and plant protection chemicals were found to be the major limiting factor for adoption of the recommended practices.

Arulraj (1976) concluded that the extent of adoption was independent of the availability of inputs required for adoption.

Thiruthuvadas (1981) observed that the multi crop thresher was easily available for hire (57.14%) and 42.86 per cent was subsequently difficult to get for hire and in required time. Majority of users of sugarcane crusher (57.14%) opined that this equipment was difficult to get for hire at the required time.

#### 2.5.18.5. Profitability

Chandrakandan (1973) found that a non-significant relationship exists between adoption and profitability of the power sprayer.

Arulraj (1976) concluded that the profitability of the practices influenced significantly the extent of adoption.

Thiruthuvadas (1981) indicated that 82.86 per cent of multi crop thresher users perceived much profitability and 85.71 per cent of sugarcane crusher were also perceived much profitability.

## **2.6. Relationship of characteristics of respondents with their level of awareness and extent of use**

### **2.6.1. Relationship between characteristics and awareness level**

In this section, the relationship between the characteristics and awareness level is given in Table A.

### **2.6.2. Relationship between characteristics with extent of use**

In this section, the relationship between characteristics of farmers with their extent of use is given in Table B.

## **2.7. Constraints in use and availability of farm equipments - machinery, implements and tools**

Chennakesavan (1978) concluded that the problems faced by the users of farm machinery were inadequate local service and repair facilities, non-availability of spare parts and fuel locally, lack of technical assistance, frequent current cut, high tariff rate, higher rent and non-availability of skilled labourers.

Table A. Research findings on relationship of characteristics of farmers with awareness level

Sl. No.	Author	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	X <sub>6</sub>	X <sub>7</sub>	X <sub>8</sub>	X <sub>9</sub>	X <sub>10</sub>	X <sub>11</sub>	X <sub>12</sub>	X <sub>13</sub>	X <sub>14</sub>	X <sub>15</sub>	X <sub>16</sub>	X <sub>17</sub>	X <sub>18</sub>	X <sub>19</sub>	X <sub>20</sub>	X <sub>21</sub>	X <sub>22</sub>	X <sub>23</sub>	X <sub>24</sub>
1.	Mandhakumar (1980)	Neg.S	NS	-	-	PS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.	Theodore (1988)	NS	NS	NS	-	-	-	PS	-	-	-	-	PS	-	NS	-	-	-	-	-	-	-	-	-	-
3.	Athimathu (1990)	NS	PS	NS	-	-	NS	-	NS	NS	-	-	-	-	PS	-	-	-	-	-	-	-	-	-	-
4.	Natarajan (1991)	PS	NS	NS	-	-	NS	-	NS	-	-	-	-	-	NS	-	NS	-	-	-	-	-	-	-	-
5.	Kathiravan (1994)	PS	NS	NS	-	-	NS	-	-	-	-	-	-	-	-	-	NS	PS	PS	-	-	-	-	-	-
6.	Sriram (1997)	NS	PS	Neg.S	-	-	PS	NS	-	-	-	-	-	Neg.S	PS	PS	NS	-	-	-	-	-	-	-	-
7.	Usharani (1998)	NS	NS	NS	-	-	NS	NS	NS	-	-	-	-	-	NS	NS	NS	PS	NS	-	-	-	-	-	-

PS - Positively significant    NS - Non-significant    Neg.S - Negatively significant

X<sub>1</sub> - Age, X<sub>2</sub> - Educational status, X<sub>3</sub> - Occupational status, X<sub>4</sub> - Family type, X<sub>5</sub> - Family size, X<sub>6</sub> - Farming experience, X<sub>7</sub> - Farm size, X<sub>8</sub> - Land fragmentation, X<sub>9</sub> - Cropping intensity, X<sub>10</sub> - Irrigation intensity, X<sub>11</sub> - Labour availability, X<sub>12</sub> - Trainings undergone, X<sub>13</sub> - Hiring agency, X<sub>14</sub> - Farm power asset, X<sub>15</sub> - Material possession, X<sub>16</sub> - Extension agency contact, X<sub>17</sub> - Social participation, X<sub>18</sub> - Exposure to media, X<sub>19</sub> - Attributes of farm machinery - Cost, X<sub>20</sub> - Efficiency, X<sub>21</sub> - Triability, X<sub>22</sub> - Feasibility, X<sub>23</sub> - Availability, X<sub>24</sub> - Profitability.

Table B. Research findings on relationship of characteristics of farmers with extent of use

Sl. No.	Author	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	X <sub>6</sub>	X <sub>7</sub>	X <sub>8</sub>	X <sub>9</sub>	X <sub>10</sub>	X <sub>11</sub>	X <sub>12</sub>	X <sub>13</sub>	X <sub>14</sub>	X <sub>15</sub>	X <sub>16</sub>	X <sub>17</sub>	X <sub>18</sub>	X <sub>19</sub>	X <sub>20</sub>	X <sub>21</sub>	X <sub>22</sub>	X <sub>23</sub>	X <sub>24</sub>	
1.	Manivannan (1980)	Neg.S	PS	NS	-	-	PS	-	-	-	-	-	-	-	-	-	PS	PS	PS	-	-	-	-	-	-	
2.	Radhakrishna moorthy (1984)	PS	PS	-	-	-	PS	PS	-	-	-	-	-	-	NS	-	PS	PS	PS	PS	-	-	-	-	-	-
3.	Chenniappan (1957)	Neg.S	PS	NS	-	-	PS	Neg.S	-	-	-	-	-	-	PS	-	PS	PS	PS	PS	-	-	-	-	-	-
4.	Krishnamoorthy (1986)	NS	Neg.S	S	-	-	NS	NS	-	-	-	-	-	-	-	-	NS	PS	NS	-	-	-	-	-	-	
5.	Santha (1992)	PS	NS	NS	-	-	NS	NS	-	-	-	-	-	-	NS	-	NS	NS	NS	NS	-	-	-	-	-	
6.	Karthikeyan (1994)	PS	NS	NS	-	-	PS	PS	-	-	-	-	-	-	PS	-	PS	PS	PS	PS	-	-	-	-	-	
7.	Krishnakumar (1996)	PS	PS	NS	-	-	NS	PS	-	-	-	-	-	-	-	-	PS	PS	PS	PS	-	-	-	-	-	
8.	Srinam (1997)	NS	NS	Neg.S	-	-	PS	NS	-	-	-	-	-	-	Neg.S	-	NS	PS	NS	NS	-	-	-	-	-	
9.	Usharani (1998)	NS	NS	NS	-	-	NS	NS	NS	-	-	-	-	-	NS	NS	NS	NS	NS	NS	-	-	-	-	-	

PS - Positively significant NS - Non-significant Neg.S - Negatively significant

X<sub>1</sub> - Age, X<sub>2</sub> - Educational status, X<sub>3</sub> - Occupational status, X<sub>4</sub> - Family type, X<sub>5</sub> - Family size, X<sub>6</sub> - Farming experience, X<sub>7</sub> - Farm size, X<sub>8</sub> - Land fragmentation, X<sub>9</sub> - Cropping intensity, X<sub>10</sub> - Irrigation intensity, X<sub>11</sub> - Labour availability, X<sub>12</sub> - Trainings undergone, X<sub>13</sub> - Hiring agency, X<sub>14</sub> - Farm power asset, X<sub>15</sub> - Material possession, X<sub>16</sub> - Extension agency contact, X<sub>17</sub> - Social participation, X<sub>18</sub> - Exposure to media, X<sub>19</sub> - Attributes of farm machinery - Cost, X<sub>20</sub> - Efficiency, X<sub>21</sub> - Triability, X<sub>22</sub> - Feasibility, X<sub>23</sub> - Availability, X<sub>24</sub> - Profitability.

Muthuraj (1979) reported that problems faced by small and marginal farmers in the case of oil engine and power sprayer from Agro-Engineering and Service Co-operative Centres were high cost of fuel, non-availability of fuel in time and non-availability of fuel at local stations.

Saikia (1982) concluded that long distances to be covered and expenditure on purchase and repair of implements discouraged the farmers.

Benny (1983) found that the problems of human energy users were non-availability of labour during peak season, higher wage rates and insincere labourers, mechanical hire charges, frequent power cut, fragmented and small holdings and lack of technical guidance.

Philip (1983) revealed that all the users of hand operated sprayers expressed that the frequent repair as a major problem and a few of the users mentioned that less area coverage as a problem in using it. While the users of power sprayer expressed frequent repair and starting trouble as their major problems in using it.

Dash (1988) studied and reported that the lack of spare parts, repair and service facilities is a major drawback, and initial implement cost were often prohibitive.

Harbans (1988) identified the list of constraints for low wheat production (i) non-usage of improved tillage implements, (ii) shortage in the availability of wheat threshers in hilly areas, (iii) illiteracy, (iv) low purchasing power, (v) poor communication in the hilly areas and (vi) the weak extension approach.

Hulst (1989) found that arguments against mechanization include unemployment; the use of expensive, often imported, fossile energy, machine damage to the environment and that mechanization makes the rich richer and the poor poorer.

Kamble (1990) observed that there is a non-availability of improved implements and skilled labour, the cost of factor of production are excessive and there is a lack of capital as well as timely available.

Iqbal et al. (1992) found that fragmentation of land into small pieces is a major constraint in the adoption of agricultural mechanization.

Anonymous (1993) revealed that main problems associated due to spraying were health problems, weight of equipment, poor remuneration and high cost of petrol. The most common health problem expressed by farmers and spraymen were body ache, giddiness, head ache, fever and nausea.

Ray (1993) reported that constraints in the non-adoption of agricultural implements and machinery in most of the states were small farm size, low adoption of HYV seed, low percentage of area under irrigation, poor cropping intensity, higher wage rates and poor holding size. In addition, there was limited use and shortage of spare parts of the new machinery was a major constraint.

Pariyar (1995) reported that the lack of factual information on the availability of farm implements was the major constraint in Nepal.

Rahim (1995) identified various constraints such as small holding size, lack of capital and high cost of farm machinery played a significant role in non-adoption of mechanization.

Sunziduo (1996) found that the extension system had not provided suitable support for mechanization and national support had not been strong.

Makanga (1997) reported constraints in agricultural mechanization technologies include land, capital, technological adaptability, product pricing structure, marketing, extension and adult education, problems related to transition to animal power, soil and water erosion, machinery operation and maintenance and lack of required infrastructure.

## 2.8. Suggestions

Radhakrishnamurthy (1984) concluded that majority (above 70%) of marginal and small farmers had suggested for financial assistance on credit basis and providing subsidy facility, about 50 to 60 per cent of big farmers sought for adequate technical guidance in the post harvest technology.

Dass (1988) suggested some recommendations for sugarcane cultivation to be mechanized using improved implements and machinery for covering cultivation, planting, inter-row cultivation, plant protection, harvesting, cleaning and in ratoon management.

Nag (1988) suggested modifications of sickles to be in weight: 200 gram, total length of sickle 33 cm, handle length 11 cm, handle diam 3 cm, radius of blade curvature 15 cm, blade concavity 5 cm, serrated sickle tooth pitch 0.20 cm and tooth angle 60'.

Ahamed (1990) recommends for local manufacturing of small tractors with available spare parts. The government should assist in training skilled mechanics, easy credit should be provided by the government to attract local manufacturers and enable farmers to purchase or rent locally produced low-cost tractors.

Kamble (1990) believed that credit facilities can help to overcome the drawbacks, especially if extended with farm inputs through co-operatives.

Bhople (1992) reported that since women play an important role in agriculture, a need to train women in skilled jobs in the areas of plant protection, threshing and grain storage and marketing, in order to increase their efficiency as well as their income. There is also a need to introduce appropriate tools and techniques to minimize the physical exertion involved in the farm operations carried out by women farm labourers.

Solanki (1993) observed rural artisans can become agents of change for improvement in the socio-economic conditions of rural society, so the rent institutions and central and state agencies first establish linkages with artisan groups in villages.

Khatiwada (1995) reported that problems encountered by local TIM (tools, implements and machinery) producers and users were identified and training and credit requirements were assessed. Furthermore, emphasis was placed on the identification of farmers needs for different farm tools and implements and the promotion of local products.

Pariyar (1995) concluded that comprehensive research is needed to determine the appropriate levels of mechanization for different farm conditions.

Makanga (1997) reported that more support should be given to the farmers by the government in terms of financial and technical assistance and establishment of spare parts depot(s) and adaptive small scale machinery manufacturing facilities.

After reviewing the above pertinent literature to have an understanding about the concepts involved in this study, the appropriate methodology was formulated and given in the next chapter.

## CHAPTER III

### RESEARCH METHODOLOGY

This chapter elucidates the research methods and techniques followed in this study. The methodological details are dealt under the following sub heads.

3.1. Locale of research

3.2. Sample and sampling procedure

3.3. Research design

3.4. Operationalisation of variables and their measurement

3.5. Techniques of data collection

3.6. Statistical tools used

3.1. Locale of research

3.1.1. Selection of districts

In Tamil Nadu, there are 22 districts (1995). Of them Kancheepuram and Dharmapuri districts were selected purposively as the study area due to the following reasons.

According to the Statistical Hand book of Tamil Nadu (1995), Kancheepuram had the highest percentage of irrigated area (81.7) and Dharmapuri had the least percentage of irrigated area (25.8%) in the plain regions.

Table 1. Percentage of area irrigated by all sources

Sl.No.	Districts	Percentage of area irrigated
1.	Kancheepuram	81.7
2.	Thanjavur	77.7
3.	Nagapattinam	73.6
4.	Tirunelveli	72.6
5.	Sivaganga	66.0
6.	Madurai	59.5
7.	Erode	57.2
8.	Pudukottai	56.3
9.	Tiruvannamalai	55.7
10.	Villupuram	54.6
11.	Cuddalore	53.6
12.	Vellore	49.7
13.	Coimbatore	45.6
14.	Kanyakumari	44.7
15.	Trichy	43.1
16.	Dindigul	40.9
17.	Salem	39.3
18.	Virudhunagar	37.0
19.	Ramanathapuram	34.3
20.	Tuticorin	26.8
21.	Dharmapuri	25.8
22.	Nilgiris (Hilly area)	0.6

Source: Statistical Hand book of Tamil Nadu, 1995,  
Commissioner of Statistics, Department of Statistics,  
Chennai-6, Tamil Nadu.

### 3.1.2. Description of the districts

#### Kancheepuram

Kancheepuram is situated on the East coast of Tamil Nadu and lies between 12°10' and 13°15' North latitude and 79°15' and 80°21' East longitude.

It is bounded on the East by Bay of Bengal, on the North by Tiruvallur and Chennai districts, on West by Vellore

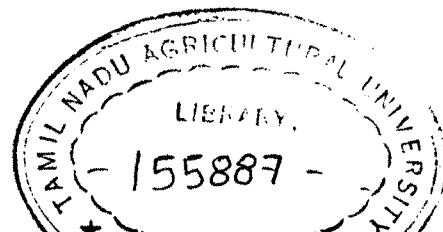
and Thiruvannamalai districts and on the South by Villupuram and Pondicherry State.

This district lies in the tropical climate region. It is benefited by both the North-East and South-West monsoon. The average annual rainfall of this district is 1165.3 mm. The average maximum and minimum temperatures are 39°C and 18°C respectively.

There is no perennial river in this district. Palar is the principal river and other seasonal rivers are Adyar and Cheyyar. The ayacut area is 12,512 ha. There are seven major types of soil in this area. Among this red non-calcareous soils accounts for 64 per cent.

The total population of the district as per 1991 Census is 24,15,000, of which 12,31,000 are males and 11,84,000 are females and 14,30,000 persons constitute rural population. Out of the total population and 9,85,000 are living in urban areas. About 70 percentage of the population is engaged with agricultural pursuits.

District head quarters	:	Kancheepuram
No. of revenue divisions	:	3
No. of taluks	:	8
No. of blocks	:	13
No. of town panchayats	:	78
No. of village panchayats	:	649
No. of municipal centres	:	6
No. of revenue villages	:	1137



### Land use pattern

The district has a strong agriculture base. The total net sown area constitutes about 37.57 per cent of the total geographical area of the district.

The land utilisation pattern of the district is presented in Table 2.

Table 2. Land use pattern of Kancheepuram district

Sl. No.	Particulars	Area in ha	Percentage of geographical area
1.	Forest	23856	5.34
2.	Barren and uncultivable land	11054	2.50
3.	Land put to non-agri. use	134708	30.50
4.	Culturable waste	10602	2.40
5.	Permanent pastures and other grazing lands	19908	4.50
6.	Miscellaneous tree crops and groves	10649	2.41
7.	Current fallows	9861	2.22
8.	Other fallow lands	56073	12.65
9.	Net area sown	166499	37.57
	Total	443210	100.00

Source: Annual Credit Plan, 1997-98, Kancheepuram.

### Dharmapuri

Dharmapuri is situated in the North West part of Tamil Nadu and at the foot of the mighty western ghats. It lies between Salem district of Tamil Nadu and Karnataka State. The district lies between 11°47' and 13°01' North latitudes and 77°13' and 78°45' East longitude and has a geographical area



of 9630 sq.km. which contribute 7.4 per cent of the state's total geographical area.

The total rainfall in this area amounts to 857 mm/annum. The average maximum and minimum temperatures are 38°C and 18°C respectively. River Cauvery flows throughout the year covering a distance of 67 km without directly irrigating even an inch of land. Major source of irrigation are tanks and wells. The rainfall is unevenly distributed. The land gets dry during summer. Thus it is a drought prone area. There are 14 types of soil prevailing in this district of which brownish red sandy soil is a predominant one.

The total population of the district as per 1991 Census was 2,428,596 of which 1,250,676 were males and 1,177,925 were females and 2,197,921 persons constituted rural population of the total population and 2,230,675 were living in urban area. About 81 per cent of the population is engaged with agricultural pursuits.

District head quarters	:	Dharmapuri
Total geographical area	:	9,64,103 ha
No. of revenue division	:	3
No. of taluks	:	10
No. of blocks	:	18
No. of municipal towns	:	3
No. of revenue village	:	1106

### Land use pattern

This district also has a strong agriculture base. The total net sown area constitutes 43.55 per cent of the total geographical area of the district.

Table 3. Land use pattern in Dharmapuri district

Sl. No.	Particulars	Area in ha	Percentage of geographical area
1.	Forest	366226	37.99
2.	Barren and uncultivable land	43846	4.55
3.	Land put to non-agri uses	49380	5.12
4.	Culturable waste	14424	1.50
5.	Permanent pasture and other grazing lands	12931	1.34
6.	Miscellaneous tree crops and groves	8608	0.89
7.	Current fallows	38329	3.98
8.	Other fallow lands	10535	1.09
9.	Net area sown	419824	43.55
Total		964103	100.00

Source: Annual Credit Plan, 1997-98, Dharmapuri district.

### 3.1.3. Selection of taluks

#### Kancheepuram

There are eight taluks in Kancheepuram district viz., Kancheepuram, Uthiramerur, Sriperumpudur, Chengalpattu, Thirukalukundram, Parangimalai, Maduranthakam and Cheyyar. Out of these eight taluks, Kancheepuram taluk was selected

based on simple random sampling, using single digit random number.

### **Dharmapuri**

There are ten taluks in Dharmapuri district viz., Dharmapuri, Harur, Pappireddipatti, Palacode, Uthangarai, Pochapalli, Krishnagiri, Denkanikottai, Hosur and Pennagaram. Out of these ten taluks, Pappireddipatti taluk was selected based on simple random sampling, using appropriate random number table.

#### **3.1.4. Selection of blocks**

##### **Kancheepuram**

Kancheepuram taluk has two blocks, namely Kancheepuram and Walajabad. Both these two blocks were selected for the study. Kancheepuram block had an irrigated area by all sources of irrigation was 9185 ha (least) and it was 15800 ha (highest) in Walajabad. To get an unbiased representative sample, both blocks were selected from Kancheepuram district.

##### **Pappireddipatti**

This taluk has two blocks, namely, Pappireddipatti and Morappur. These two blocks were selected for the study. The area under irrigation by all source in Pappireddipatti block was 14,767 ha (highest) and it was 12738 ha (least) in Morappur block. To get an unbiased representative sample, both the above blocks were selected from Dharmapuri district.

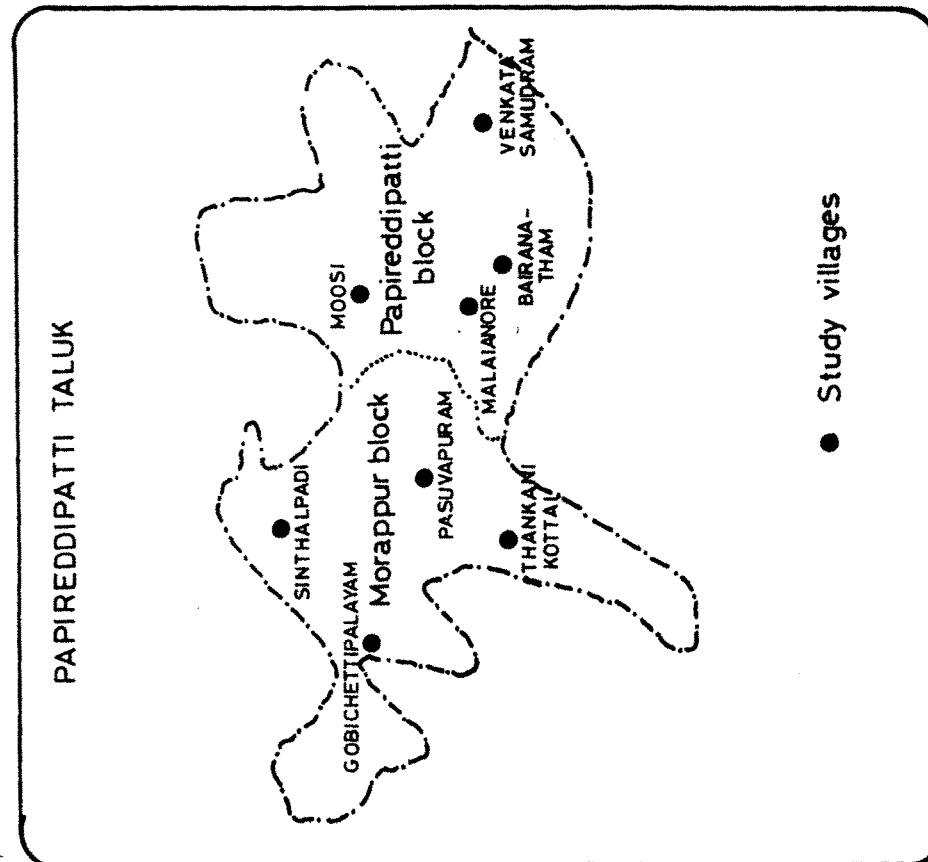
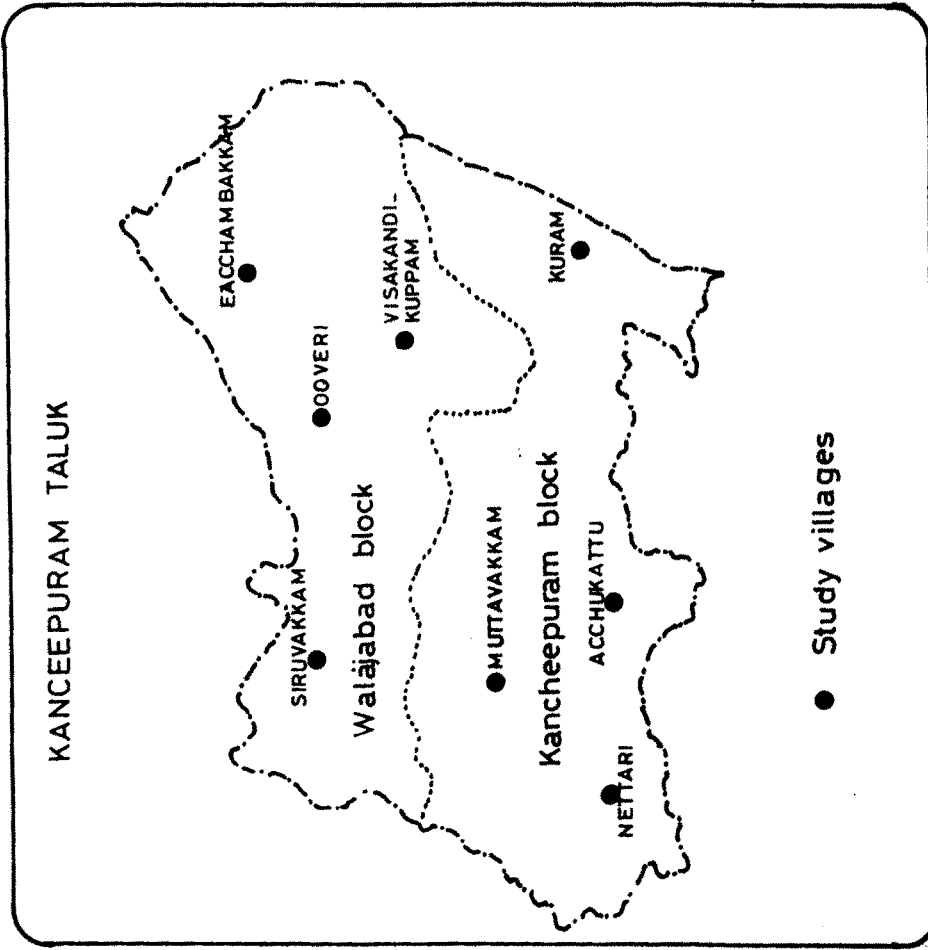


Table 4. Land use pattern of selected blocks

Sl. No.	Particulars	Block name (area in ha)			
		Walaja- bad	Kanchee- puram	Pappi- reddi- patti	Morap- pur
1.	Forest	-	-	2025	17761
2.	Barren and uncultivable land	396	157	1401	1714
3.	Land put to non-agri use	11787	10207	1096	3662
4.	Culturable waste	1434	959	218	697
5.	Permanent pastures and other grazing land	948	723	90	186
6.	Miscellaneous tree crops and groves	431	200	20	41
7.	Current fallows	657	456	6770	6732
8.	Other fallow	4078	3238	278	1488
9.	Net area sown	15819	11038	28853	21917
	Total	35550	26978	40751	56198

### 3.1.5. Selection of villages

The list of villages was obtained from the taluk office of the concerned districts. Four villages were selected from each block using simple random sampling procedure. As a total sixteen villages were selected. The following table 5 shows the selected villages from blocks.

Table 5. Number of villages selected from each block

Sl. No.	Name of the Block	Total No. of villages	Selected village
<b>A. Kancheepuram</b>			
1.	Walajabad	58	1. Eacchambakkam 2. Siruvakkam 3. Visakandikuppam 4. Ooveri
2.	Kancheepuram	51	5. Muttavakkam 6. Kuram 7. Nettari 8. Acchukattu
<b>B. Dharmapuri</b>			
3.	Pappireddipatti	46	9. Venkatasamudram 10. Bairanatham 11. Malaianore 12. Moosi
4.	Morappur	35	13. Gobichettipalayam 14. Pasuvapuram 15. Thankanikottai 16. Sinthalpadi

### 3.2. Sample and sampling procedure

#### Selection of respondents

The list of farmers of the selected villages was obtained from the Village Administrative Officer (VAO). It was decided to have a sample size of 160 for the study. These 160 respondents were selected at the rate of 10 from each village using simple random sampling as the population in all these 16 villages was more or less equal. The details are given in Table 6.

Table 6. Distribution of respondents

Sl.No.	Village name	Sampling population	Sample size
1.	Eacchambakkam	873	10
2.	Siruvakkam	962	10
3.	Visakandikuppam	912	10
4.	Ooveri	867	10
5.	Muttavakkam	886	10
6.	Kuram	798	10
7.	Nettari	817	10
8.	Acchukattu	918	10
9.	Venkatasamudram	767	10
10.	Bairanatham	860	10
11.	Molaiyanore	896	10
12.	Mousi	758	10
13.	Gobichettipalayam	740	10
14.	Pasuvapuram	787	10
15.	Thenkanikottai	698	10
16.	Sinthalpadi	716	10
Total sample size			160

### 3.3. Research design

The research design is the most important and crucial one in research methodology. In a broad sense, research design is the entire process of planning and carrying out the research. To put it in Kerlinger's (1978) words,

"Research design is the plan, structure and strategy of investigation so as to obtain answers to research questions and to control variance".

The plan is the overall scheme (or) programme of research.

For this study, expost-facto design was used. In this design, the researcher instead of creating a treatment, evaluates the effects of satisfactorily occurring phenomenon

after the occurrence. The use of farm equipments - machinery, implements and tools being an already occurred phenomenon in the study area, the above mentioned design was employed.

#### 3.4. Operationalisation of variables and their measurements

Independent variables included in the study were selected in consultation with the experts in the field of Extension Education, Agricultural Engineering and through perusal of literature. Only those variables which were found to have relevancy with the present investigation were included. A list of variables along with the instruments for their measurement are elucidated in Table 7.

Table 7. Variables studied and their measurement

Sl.No.	Variables	Technique of measurement
<b>A. Independent variables</b>		
1.	Age	Procedure followed by Karthikeyan (1994)
2.	Educational status	Scoring procedure developed by Mansingh (1993)
3.	Occupational status	Scoring procedure followed by Kathiravan (1994)
4.	Family status	Scoring procedure developed by Trivedi (1963)
5.	Farming experience	Scoring procedure followed by Sujatha (1996)
6.	Farm size	Government of Tamil Nadu classification (1974) adopted by Venkatapirabu (1988)

Table 7 (Contd.)

Sl.No.	Variables	Technique of measurement
7.	Land fragmentation index	Procedure followed by Philip (1983)
8.	Cropping intensity	Formula suggested by Indian Society of Agronomy (1987)
9.	Irrigation facilities	Scoring procedure followed by Muneerkhan (1994)
10.	Labour availability	Scoring procedure developed for the study
11.	Training undergone	Scoring procedure developed for the study
12.	Hiring agency utilisation	Scoring procedure developed for the study
13.	Farm power asset	Scoring procedure followed by Venkattakumar (1997)
14.	Material possession	Scoring procedure followed by Kavitha (1988)
15.	Contact with extension agency	Scoring procedure followed by Sriram (1997)
16.	Social participation	Scoring procedure followed by Trivedi (1963)
17.	Level of exposure to media	Scoring procedure followed by Karthikeyan (1994)
18.	Attributes of farm machinery	Scoring procedure followed by Thiruthuvadas (1981)
<b>B. Dependent variable</b>		
1.	Awareness	Scoring procedure developed for the study
2.	Use	Scoring procedure developed for the study

### 3.4.1. Independent variables

#### 3.4.1.1. Age

Age was operationalised as the number of completed years by the respondent at the time of enquiry and the chronological age was taken as a measure. The respondents were classified into three categories viz., young, middle and old as followed by Karthikeyan (1994).

Sl.No.	Category	Years
1.	Young	Upto 34 years
2.	Middle	35-45 years
3.	Old	> 45 years

#### 3.4.1.2. Educational status

Educational status was operationalised as the level of literacy possessed by the individual. The respondents were categorised into six groups based on the scoring procedure developed by Mansingh (1993).

Sl.No.	Category	Score
1.	Illiterate	1
2.	Primary education	2
3.	Middle education	3
4.	Secondary education	4
5.	Higher secondary education	5
6.	Collegiate	6

#### 3.4.1.3. Occupational status

Occupation was operationalised as the extent to which a respondent was involved or occupied. The respondents were

categorised into four groups based on the scoring procedure followed by Kathiravan (1994).

Sl.No.	Occupation	Score
1.	Agriculture alone	4
2.	Agriculture + business	3
3.	Agriculture + labour	2
4.	Agriculture + service	1

#### 3.4.1.4. Farming status

##### (a) Type of family

The family type refers to nuclear and joint family. The joint family refers to the group of persons in which all members live under one shed, cook and eat together, and are managed by one family head. It normally consists of two or more living conjugal pairs.

The nuclear family refers to that group of persons in which other characteristics of joint family being the same, the number of living conjugal pair is one. The scoring procedure developed by Trivedi (1963) was used.

Sl.No.	Type of family	Score
1.	Nuclear	1
2.	Joint	2

##### (b) Size of family

The size of the family refers to the number of individuals of both sexes living together in a household. The scoring procedure developed by Trivedi (1963) was used.

Sl.No.	Size of family	Score
1.	Upto 5 members	1
2.	More than 5 members	2

#### 3.4.1.5. Farming experience

Farming experience in the present study refers to the actual completed years of experience of the respondent in farming. The scoring procedure followed is similar to that of Sujatha (1996). One score was allotted to every one year of experience in farming. The farming experience was categorised into three categories viz., low, medium and high using cumulative frequency method.

#### 3.4.1.6. Farm size

Farm size refers to the extent of land an individual farmer possessed and cultivated. The conversion procedure specified by Tamil Nadu Government notification on guidelines of new project (1974) of equating two acres of dryland to an acre of irrigated land was followed to arrive at the total extent of land. The farm size of the respondents was classified into four categories as adopted by Venkatapirabu (1988).

Sl.No.	Particulars	Score
1.	Upto 2.5 acres	1
2.	2.51 to 5 acres	2
3.	5.01 to 10 acres	3
4.	Above 10.00 acres	4

#### 3.4.1.7. Land fragmentation index

Land fragmentation was operationalised in this investigation as a non-contiguous land scattered over into a number of plots at different places. The fragmentation index was arrived at using which was followed by Philip (1983).

$$\text{Land fragmentation index} = \frac{\text{Number of non-contiguous plots}}{\text{Farm size}} \times 100$$

#### 3.4.1.8. Cropping intensity

Cropping intensity refers to the ratio between total and net cropped area expressed in percentage. The formula suggested by the Indian Society of Agronomy (1987) is followed. This indicator becomes an index of an effective utilization of land available for cultivation to the respondents.

$$\text{Cropping intensity} = \frac{\text{Total cropped area in a year}}{\text{Farm size}} \times 100$$

#### 3.4.1.9. Irrigation intensity

This is defined as the fraction of total area irrigated by different sources. The procedure followed by Khan (1994) is used in this study.

$$\text{Irrigation intensity} = \frac{\text{Total area under irrigation in acre}}{\text{Area under cultivation}} \times 100$$

#### 3.4.1.10. Labour availability

Labour availability refers to the extent of availability of labour in time for carrying out farm operation as well as farm equipments - machinery, implements and tools operation and labour for repairing and service. The scoring procedure was developed for the study. Based on the availability, readily, not readily and not at all categories with scores of 3, 2 and 1 were given.

Sl.No.	Availability	Score
1.	Readily	3
2.	Not readily	2
3.	Not at all	1

#### 3.4.1.11. Training undergone

According to Khemmani (1985), "Training is a planned communication process which results in change of attitudes, skills and knowledge in accordance with specified objectives relating to desired pattern of behaviour". Here training refers to training experience undergone by an individual on farm equipments - machinery, implements and tools usage. The scoring procedure is developed for the study. For each training a score of one is given. Based on the cumulative frequency method, the respondents were categorised into three viz., low, medium and high.

#### **3.4.1.12. Hiring agency**

Hiring agency was operationalised, as the Government as well as private institutions which hire farm equipments - machinery, implements and tools for the public for money. The scoring procedure is developed for the study. A score of one was given from each farm equipment - machinery, implement and tools hired for any institution. Based on the cumulative frequency method, the hiring agency was categorised into low, medium and high.

#### **3.4.1.13. Farm power asset**

Farm power asset refers to the hand operated, animal operated, power operated and tractor operated farm equipments - machinery, implements and tools possessed by an individual. Based on the appropriate value of each machinery for every 100 Rupees, a unit score was given. The total score on the farm power was arrived at as the sum of the product of score as for individual farm power category with the number of farm power asset possessed in that category. The scoring procedure followed by Venkattakumar (1997) is used.

#### **3.4.1.14. Material possession**

Material possession refers to the materials owned by the respondent. Based on appropriate value of each material, score was given as followed by Kavitha (1998). The relevant

scores for the items was multiplied with the number of them possessed and score for all items was arrived at.

Sl.No.	Materials	Score
1.	Wall clock	1
2.	Radio	1
3.	Fan	1
4.	Tape recorder	1
5.	Biogas plant/Gas stove	1
6.	Television	2
7.	Two wheelers	2
8.	VCR	2
9.	Telephone	2
10.	Four wheelers	4

#### 3.4.1.15. Contact with extension agency

Contact with extension agency referred to the degree to which an individual had contact with the extension personnel for gaining information on agricultural and non-agricultural aspects. This variable was measured in terms of frequency and purpose of contact with extension personnel. The scoring system followed by Sriram (1997) was adopted.

Frequency of contact	Score
Often	3
Occasional	2
Never	1
Purpose of contact	
Agricultur <sup>e</sup>	2
Non-agricultur <sup>e</sup>	1

### 3.4.1.16. Social participation

Social participation refers to the degree of involvement of respondents in formal organisations either as a member or as an office bearer. The scoring procedure developed by Trivedi (1963) was used for quantification.

Sl.No.	Level of participation	Score
1.	No participation in any organisation	0
2.	Member in one organisation	1
3.	Member in more than one organisation	2
4.	Office bearer in one organisation	3
5.	Office bearer in more than one organisations	4

### 3.4.1.17. Level of exposure to media

Mass media exposure was operationalised as the degree to which a farm machinery user was exposed to mass media communication which included radio, television, newspaper, agricultural bulletins/magazines, participation in extension meetings like agricultural meetings, functions, demonstrations, and agricultural exhibitions for gaining information on operation of machinery/other general aspects. The scoring procedure followed by Karthikeyan (1994) was used.

#### 1. Viewing TV/Hearing radio

Items	Score
(i) Owned	2
(ii) Depend on others	1
(iii) Using regularly	2
(iv) Using occasionally	1
(v) Never	0

2. Reading agricultural bulletins/magazines

- (i) Subscribing 2
- (ii) Borrowing 1

3. Participating in agricultural meetings/  
agricultural functions during last 5 years

One score - one meeting

4. Involving in agricultural demonstrations  
during last 5 years.

One score - one demonstration

5. Seeing agricultural exhibitions during last 5 years

One score - one exhibition

**3.4.1.18. Attributes of farm machinery**

It refers to the qualities looked upon as naturally or necessarily belonging to the farm machinery and equipments. The farmer was asked to rate various attributes of farm machineries on varying points of continuum. The scoring procedure followed by Thiruthuvadas (1981) was used.

Sl. No.	Attributes	Categories	Score
(i)	<b>Cost:</b> It is the expenditure required to be incurred by a farmer to put the machinery into operation. It covers all the costs concerning the equipment	Very high	5
		High	4
		Medium	3
		Low	2
		Very low	1
(ii)	<b>Efficiency:</b> It is the capacity of a machinery to give maximum return in terms of farm production or to save time, money and labour or to give effective control	Very high	5
		High	4
		Medium	3
		Low	2
		Very low	1

		Score
(iii) <b>Trialability:</b> It is the possibility of trying an equipment on a smaller scale	Very high	5
	High	4
	Medium	3
	Low	2
	Very low	1
(iv) <b>Feasibility:</b> It is the possibility of getting suitable conditions to use a machinery	Vast	3
	To certain extent	2
	Limited	1
(v) <b>Availability:</b> It is the degree to which the machinery is available for hire in time	Easy	3
	Difficult	2
	Very difficult	1
(vi) <b>Profitability:</b> It refers to the net financial returns to a farmer resulting from the use of the machinery	Much profitable	3
	Profitable	2
	Not profitable	1

### 3.4.2. Dependent variables

#### 3.4.2.1. Awareness

According to Rogers (1983), "Awareness is a stage when an individual become aware of some new idea. He knows about the existence of the idea, but lacks details about it".

The awareness of the respondents with respect to the 13 recommended farming operation equipments - machinery, implements and tools was enquired. The extent of awareness for each farming operation equipments - machinery, implements and tools was judged on a two point continuum. The scoring procedure to find out for the awareness of each equipment - machinery, implement and tool is developed for the study. that the respondents were grouped into two categories as 'aware'

and 'unaware' as followed by Karthikeyan (1994), with slight modification.

Sl.No.	Statements	Score
1.	Aware of farm equipments - machinery, implements and tools	1
2.	Not aware	0

By summing the score for all the thirteen farming operation equipments - machinery, implements and tools, the total score for the respondents was calculated. The awareness index for each respondent was calculated using the following formula.

$$\text{Awareness index} = \frac{\text{Score obtained by the respondents}}{\text{Possible maximum score}} \times 100$$

#### 3.4.2.2. Use

In this study, use means adoption. According to Rogers (1983), "Adoption is the decision to make full use of a new idea as the best course of action available".

The extent of use of different farming operation equipments - machinery, implements and tools was measured by means of an use index. The scoring procedure for the use of each farm equipment - machinery, implement and tool is developed for the study.

Sl.No.	Statements	Score
1.	Use of own farm equipments - machinery, implements and tools	2
2.	Use of hiring farm equipments - machinery, implements and tools	1
3.	Not used	0

By summing the score for all the thirteen farming operation equipment - machinery, implement and tools, the total score for the respondents was calculated. The use index for each respondents was calculated using the following formula.

$$\text{Use index} = \frac{\text{Respondent total score}}{\text{Total possible score}} \times 100$$

**3.4.2.3. Impact of farm mechanization**

To study the impact of farm mechanization, both operational efficiency and farm productivity have been studied. For any impact study, there should be a specified process/period to be considered in comparison to a base period. Hence, for this study the farmers who had been using implements and tools for last three years were resulted as the respondents.

These respondents on the impact aspect of farm mechanisation was enumerated for analysis.

#### 3.4.2.4. Operational efficiency

The term operational efficiency has been operationalised for the study as the increased efficiency in terms of execution at all farm operations for a crop per season. It was measured in terms of time, cost and quality of work for the impact of farm mechanization.

The procedure was developed for the study. The impact was measured based on the average difference between pre-mechanization and post-mechanization effect on number of labourers, time, cost and quality of work as perceived by all the respondents. The quality of work was measured in two point continuum of satisfaction and not satisfaction.

$$\begin{array}{l} \text{Operational efficiency} \\ \text{(Average labour, time,} \\ \text{cost and quality of work} \end{array} = \begin{array}{l} \text{After mechanisation -} \\ \text{Before mechanisation} \end{array}$$

#### 3.4.2.5. Farm productivity

The term farm productivity was operationalised for the study as increased productivity of the farm as observed farm mechanization which was measured in terms of the yield obtained from the farm.

This procedure was developed for the study. The impact of farm productivity was measured based on the average yield

difference between pre-mechanization and post-mechanization by the respondents.

$$\text{Farm productivity (Average yield/unit)} = \frac{\text{After mechanisation}}{\text{Before mechanisation}}$$

### 3.4.2.6. Selective farm mechanisation

Selective farm mechanisation was operationalised to find out the most suitable farm equipments for any particular farm operation for a specific crop.

In this study, to know the farm power available under different districts of Tamil Nadu, the following conventional formula of different farm implements was used.

Table 8. Conventional formula (Horse power)

Sl.No.	Name of tools, implements and equipments	Horse power (HP)
1.	Hand, leg operated	0.1 HP
2.	Animal operated	1.0 HP
3.	Power operated	
	(a) Oil operated	
	i) Sprayer and duster	1.2 HP
	ii) Pumpset	5 HP
	iii) Pumpset	10 HP
	iv) Tractor	40 HP
	v) Power tiller	10 HP
	(b) Electric operated	
	i) Motor pump	5 HP
	ii) Motor pump	10 HP
	iii) Motor pump	15 HP

To derive the farm power of different districts, the secondary data was obtained which consists of hand operated tools, animal operated implements and power operated equipments of each district of Tamil Nadu. The above explained conventional method was used to find out the total farm power.

### 3.5. Techniques of data collection

Interview schedule was found to be the appropriate device to collect data from the respondents for this study. A detailed interview schedule was constructed based on the specific objectives of the study. Special care and efforts were taken to ensure that the structured questions were unambiguous, clear, coherent, complete and comprehensive. The language of the schedule was in the regional language, Tamil. The interview schedule was pretested among the farmers of non-sample villages. Based on the experience gained during pre-testing of the interview schedule, necessary changes were made and incorporated in the formation of items, questions, then sequences and rectification were carried out in the interview schedule before administering it for final collection of data in the sample area.

The schedule consisted of five parts. The first part was concerned with the socio-economic profile of respondents.

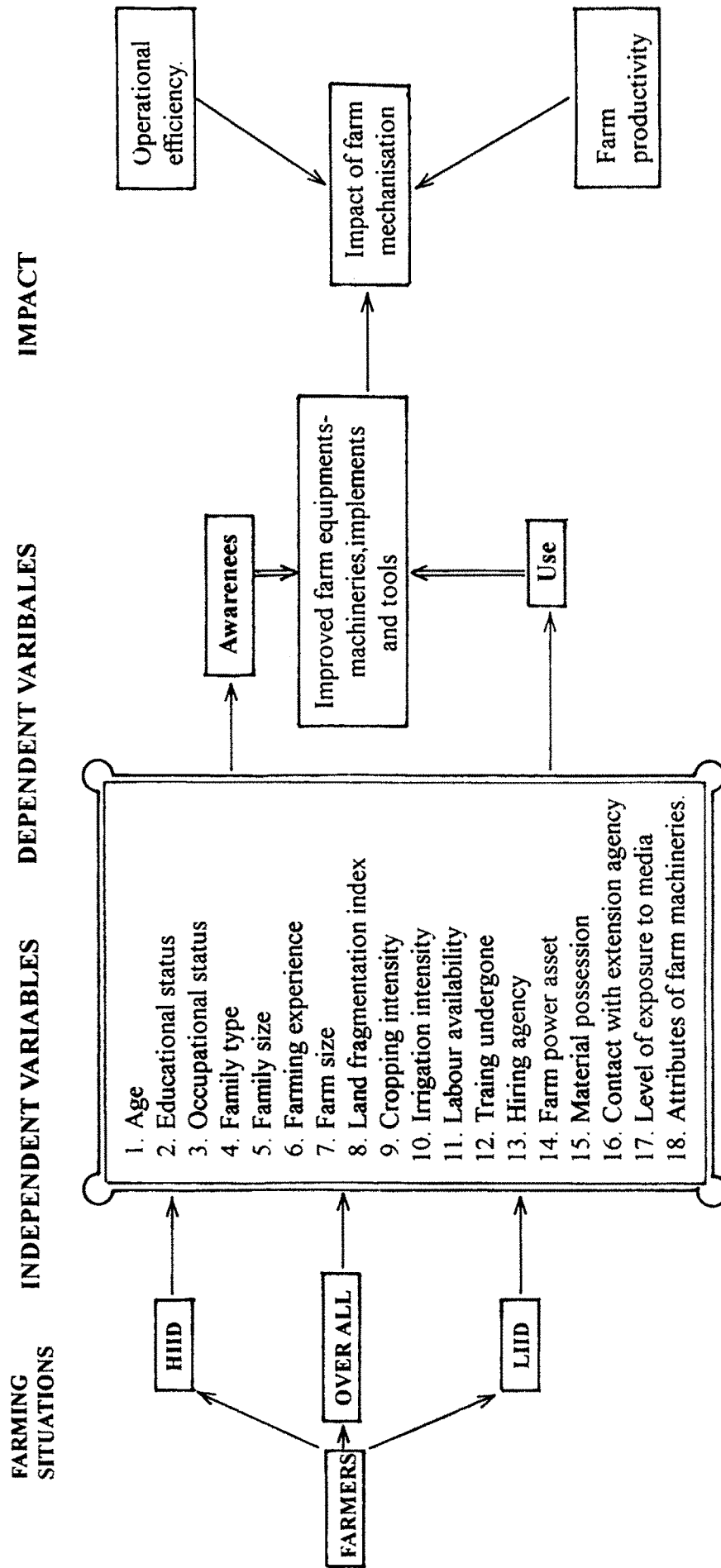
The second part includes the identification of traditional/indigenous farm implements and tools used by farmers for various farm operations in different farming situations viz., HIID, LIID. The third part was aimed to know the extent of awareness and use of improved farm equipments - machinery, implements and tools. The fourth part was concurrence with the impact of farm mechanization on farm productivity and operational efficiency. The last part is to identify the constraints and suggestions in the availability and use of improved farm equipment - machinery, implement and tools.

The researcher stayed in the sample area until the collection of data was over and developed a good rapport with the farm families for easy and effective administration of the interview schedule. Apart from the data collected from the farmers, information from secondary sources like annual reports, research papers, government publications, statistical reports and other published documents were made use of. The collected data were coded and tabulated for statistical analysis.

### **3.6. Statistical tools used**

The data were analysed with the following statistical measures.

Fig. 1. Conceptual Model showing the relationship of independent variables and dependent variables.



1. Percentage analysis
2. Cumulative frequency
3. Zero order correlation
4. Multiple regression
5. Chi-square test ( $X^2$ )
6. Omega test (appendix)
7. Path analysis
8. Mechanization index (appendix)

Having adopted the methodology the data were gathered, tabulated and analysed. The outcome have been reported in the succeeding chapter.

## CHAPTER IV

### FINDINGS AND DISCUSSION

The findings of the present study as per the methodology prescribed in the preceding chapter have been highlighted in accordance with the objectives set forth under the following heads:

- 4.1. Socio-economic profile, association and their effects of respondents
- 4.2. Indigenous/traditional farm implements and tools used by HIID and LIID respondents
- 4.3. Awareness and use of improved farm equipments - machinery, implements and tools in different farm size categories under HIID and LIID
- 4.4. Impact of farm mechanisation on operational efficiency and farm productivity
- 4.5. Constraints faced by the farmers in use and in availability of improved farm equipments - machinery, implements and tools
- 4.6. Suggestions to overcome the constraints
- 4.7. Extent of farm mechanisation in different districts and a suggested strategy for selective farm mechanisation in Tamil Nadu

#### **4.1. Socio-economic profile, association and their effects of respondents**

This part deals with the profile of farmers, which will give a clear picture about their background and the description of the selected independent variables and their association with the dependent variables and the direct and indirect effects of independent variables on the dependent variables. This part is presented under the following sub-heads.

1. Socio-economic profile of farmer-respondents.
2. Independent variables Vs awareness of improved farm equipments - machinery, implements and tools.
3. Independent variable Vs use of improved farm equipments - machinery, implements and tools.

##### **4.1.1. Socio-economic profile of farmer-respondents**

The differential characteristics of the farmers were analysed and presented in Table 9. Chi-square test of significance was employed to find out the prevalence of any differences in the distribution of respondents among the two farming situations.

##### **4.1.1.1. Age**

From the Table 9 highlights that in the High Irrigation Intensity District (HIID) a little less than half

Table 9. Distribution of respondents according to their socio-economic profile

Sl. No.	Profile	HIID (n=80)		LIID (n=80)		Total (n=160)		Chi-square value
		No.	%	No.	%	No.	%	
<b>1. Age</b>								
	Young (0-35)	21	26.25	20	25.00	41	22.63	1.5669 NS
	Middle (36-45)	20	25.00	27	33.75	47	29.37	
	Old (> 45)	39	48.75	33	41.25	72	45.00	
<b>2. Educational status</b>								
	Illiterate	33	41.25	24	30.00	57	35.63	16.4199 NS
	Primary education	6	7.50	22	27.50	28	17.50	
	Middle school education	28	35.00	16	20.00	44	27.50	
	Secondary education	11	13.75	15	18.75	26	16.25	
	Higher secondary	2	2.50	1	1.25	3	1.87	
	Collegiate	-	-	2	2.50	2	1.25	
<b>3. Occupational status</b>								
	Agri + service	2	2.50	5	6.25	7	4.38	1.3740 NS
	Agri + business	11	13.75	11	13.75	22	13.75	
	Agri + labour	10	12.50	9	11.25	19	11.87	
	Agri alone	57	71.25	55	68.75	112	70.00	
<b>Family status</b>								
<b>4. Family type</b>								
	Nuclear family	70	87.50	55	68.75	125	78.13	8.2285 *
	Joint family	10	12.50	25	31.25	35	21.87	

Table 9 (Contd.)

Sl. No.	Profile	HIID (n=80)		LIID (n=80)		Total (n=160)	Chi-square value
		No.	%	No.	%		
<b>5. Family size</b>							
	Less than 5	57	71.25	35	43.75	92	57.50
	More than 5	23	28.75	45	56.25	68	42.50
							12.3785 **
<b>6. Farm size</b>							
	Marginal (0-2.50)	18	22.50	11	13.75	33	20.62
	Small (2.51-5.00)	22	27.50	23	28.75	45	28.13
	Medium (5.01-10.00)	29	36.25	24	30.00	53	33.13
	Big (> 10.0)	11	13.75	22	27.50	33	20.62
							5.8502 NS
<b>7. Farming experience</b>							
	Low (0-12.91)	23	28.75	26	32.50	49	30.63
	Medium (12.92-37.14)	38	47.50	46	57.50	84	52.50
	High (37.15-51.00)	19	23.75	8	10.00	27	16.87
							5.4270 NS
<b>8. Land fragmentation index</b>							
	Low (0-226.14)	6	7.50	39	48.75	45	28.12
	Medium (226.15-400.96)	36	45.00	37	46.25	73	45.61
	High (400.96-880.00)	38	47.50	4	5.00	43	26.87
							51.7375 **
<b>9. Cropping intensity</b>							
	Low (0-74)	5	6.25	21	26.25	26	16.25
	Medium (75-158)	42	52.50	55	68.75	97	60.63
	High (159-350)	33	41.25	4	5.00	37	23.12
							34.3181 **

Table 9 (Contd.)

Sl. No.	Profile	HIID (n=80)		LIID (n=80)		Total (n=160)		Chi-square value
		No.	%	No.	%	No.	%	
<b>10. Irrigation intensity</b>								
	Low (0.40-96)	5	6.25	33	41.25	38	23.75	
	Medium (40.97-74.97)	28	35.00	22	27.50	50	31.25	28.0738 **
	High (74.98-100)	47	58.75	25	31.25	72	45.00	
<b>11. Labour availability</b>								
	Low (0-1.92)	8	10.00	11	13.75	19	11.87	
	Medium (1.93-5.00)	21	26.25	34	42.50	55	34.38	6.5231 *
	High (5.01-52.50)	51	63.75	35	43.75	86	53.75	
<b>12. Training undergone</b>								
	Low (0-1.11)	61	76.25	68	85.00	129	80.63	
	Medium (1.12-3.61)	9	11.25	4	5.00	13	8.12	2.5251 NS
	High (3.62-8.00)	10	12.50	8	10.00	18	11.25	
<b>13. Hiring agency</b>								
	Low (1-3.34)	32	40.00	23	28.75	55	34.38	
	Medium (3.35-5.19)	35	43.75	43	53.75	78	48.75	2.3302 NS
	High (5.20-8.00)	13	16.25	14	17.50	27	16.87	
<b>14. Farm power asset</b>								
	Low (0-158)	42	52.50	59	73.75	101	63.13	
	Medium (159-2096)	19	23.75	15	18.75	34	21.25	4.3719 NS
	High (2096-4103)	19	23.75	6	7.50	25	15.62	

Table 9 (Contd.)

Sl. No.	Profile	HIID (n=80)		LIID (n=80)		Total (n=160)		Chi-square value
		No.	%	No.	%	No.	%	
<b>15. Material possession</b>								
	Low (0-4.43)	28	35.00	22	27.50	50	31.25	
	Medium (4.44-11.25)	34	42.50	31	38.75	65	40.62	2.5892 NS
	High (11.26-29.00)	18	22.50	27	33.75	45	28.13	
<b>16. Extension agency contact</b>								
	Low (0-6.62)	17	21.25	37	46.25	54	33.75	
	Medium (6.63-13.24)	36	45.00	36	45.00	72	45.00	15.4684 **
	High (13.25-28.00)	27	33.75	7	8.75	34	21.25	
<b>17. Social participation</b>								
	Low (0-0.99)	39	48.75	38	47.50	77	48.12	
	Medium (1.00-2.26)	32	40.00	38	47.50	70	43.75	2.4503 NS
	High (2.27-9.00)	9	11.25	4	5.00	13	8.13	
<b>18. Level of exposure to media</b>								
	Low (0-3.97)	24	30.00	31	38.75	55	34.38	
	Medium (3.98-7.84)	38	47.50	24	30.00	62	38.75	5.1917 NS
	High (7.85-14.00)	18	22.50	25	31.25	43	26.87	
<b>19. Attributes of farm machinery - Cont</b>								
	Low (0-1.00)	6	7.50	10	18.50	16	20.00	
	Medium (1.01-2.00)	17	21.25	12	15.00	29	36.25	1.3707 NS
	High (2.01-10.00)	57	71.25	58	72.50	115	71.87	

Table 9 (Contd.)

Sl. No.	Profile	HIID (n=80)		LIID (n=80)		Total (n=160)		Chi-square value
		No.	%	No.	%	No.	%	
<b>20. Efficiency</b>								
	Low (0-9.64)	27	33.75	30	37.50	57	35.63	
	Medium (9.65-12.11)	25	31.75	36	45.00	61	38.12	6.8081 *
	High (12.12-15.00)	28	35.00	14	17.50	42	26.25	
<b>21. Trialability</b>								
	Low (0-1.85)	33	41.25	22	27.50	55	34.37	
	Medium (1.86-3.42)	32	40.00	20	25.00	52	32.50	14.9503 **
	High (3.43-6.00)	15	18.75	38	47.50	53	33.13	
<b>22. Feasibility</b>								
	Low (0-4.54)	27	33.75	18	22.50	45	28.13	
	Medium (4.55-7.39)	44	55.00	52	65.00	96	60.00	2.5192 NS
	High (7.40-9.00)	9	11.25	10	12.50	19	11.87	
<b>23. Availability</b>								
	Low (1)	27	33.75	16	20.00	43	26.87	
	Medium (2)	46	57.50	58	72.50	104	65.00	4.2754 NS
	High (3)	7	8.75	6	7.50	13	8.13	
<b>24. Profitability</b>								
	Low (1)	35	43.75	11	13.75	46	28.75	
	Medium (2)	40	50.00	62	77.50	102	63.75	17.6001 **
	High (3)	5	6.25	7	8.75	12	7.50	

\*\* Significant at 1% level

\* Significant at 5% level

NS - Non-significant





(48.75%) of the respondents were old aged followed by about one-fourth (26.25%) were young and one-fourth (25.00%) were middle aged. Similarly, in Low Irrigation Intensity District (LIID) about two-fifth (41.25%) were old aged followed by about one-third (33.75%) who were middle aged and remaining one-fourth (25.00%) were young aged. For overall data, less than half (45.00%) of the respondents were old aged, a little more than one-fourth (29.37%) of them were middle aged and little less than one-fourth (22.63%) were belonged to young age group. However, the chi-square analysis revealed that there was no significant difference between age of the respondents in both of the farming situations.

This shows that the variable age is not a discriminating factor between HIID and LIID with reference to use of farm machinery. This finding is in line with the findings of Krishnakumar (1996) and in contrast to those of Babu (1990) and Usharani (1998).

#### 4.1.1.2. Educational status

The data reveals that in Table 9 in the HIID about one-third (35.00%), 13.75 per cent and 7.50 per cent of the respondents had an education upto middle school, secondary and primary school respectively. Only a meagre proportion of the respondents had high school and no one had collegiate

education. A large number of respondents (41.25%) were illiterate in the study area.

In the LIID, a little above one-fourth (27.50%), one-fifth (20.00%) and 18.75 per cent of the respondents had primary, middle and secondary school education. A meagre proportion of 2.50 per cent and 1.25 per cent of the respondents had collegiate and high school education, respectively. Exactly 30.00 per cent of respondents belonged to illiterate group.

In total, more than one-fourth (27.50%) and about one-sixth each (17.50% and 16.25%) of the respondents were educated upto middle school, primary school and secondary school respectively. A very few per cent (1.87 and 1.25%) of the respondents were having higher secondary and collegiate education respectively. A little more than one-third (35.63%) of the total sampled respondents were illiterate farmers.

The chi-square value indicated that there was no significant difference between the educational status in the two farming situations.

This observation is in line with the findings of Rajkumar (1992) and Nandini (1995).

#### 4.1.1.3. Occupational status

The Table 9 portrayed that with regard to the occupational status, most (71.25%) of respondents in HIID and

68.75 per cent of the LIID farmers had agriculture alone as a major occupation. This was followed by respondents with agriculture + business for both the situations (13.75%) and agriculture + labour was 17.50 per cent in HIID and 11.25 per cent in LIID. A little proportion of respondents in both the farming situations had agriculture + service as a least occupation.

An overall picture shows that majority of the respondents (70.00%) had agriculture alone as a main occupation followed by 13.75 per cent of them had agriculture and business.

The chi-square revealed that there was no significant difference between the occupational status and irrigation facilities in the study area.

This finding is similar to the findings of Balasubramanian (1992), Ponkathaperumal (1994) and Krishnakumar (1996).

## **Family status**

### **4.1.1.4. Family type**

The data relating to family type as set out in Table 9 indicates that majority of (87.50%) the families were nuclear type in HIID while similar type of family was only to that enough (68.75%) in LIID. This reveals that one-third of the

families (31.25%) were joined type in nature in LIID while about one-eighth of them were joint family type in HIID. The overall picture shows that little above three-fourth of the families were nuclear type while about one-fifth remained to be as joint families.

This shows that there is a significant relationship between family type and nature of irrigation facilities in the study area.

**4.1.1.5. Family size**

The table indicates that when family size is concerned about seventy per cent (71.25%) of the families were with less than five members in HIID while similar situation existed in the LIID areas only around two-fifth (43.75%). The overall trend shows that about sixty per cent (59.50%) of the families were having less than five members. The chi-square test also shows that high degree of significance indicating that there exist relationship between family size and intensity of farming.

**4.1.1.6. Farm size**

The data on farm size picturised that slightly more than one-third (36.25%) and 27.50 per cent of HIID respondents were belonged to medium and small farm holdings. Similarly

about one-third (30.00%) and 28.75 per cent of the LIID respondents were medium and small category farmers. In case of HIID the farmers belonged to marginal category was 22.5 per cent whereas in case of LIID, it was 13.75 per cent. The respondents belonged to big farm size category were 13.75 per cent and 27.50 per cent in HIID and LIID respectively.

In an average about one-third (33.13%) belonged to medium category farmers followed by small (28.13%).

The chi-square analysis revealed that there existed no significant difference in the farm size of the two farming situations viz., HIID and LIID.

These findings are in accordance with the findings of Gopalakrishnan (1994) and Venkattakumar (1997).

**4.1.1.7. Farming experience**

About one-fourth (28.75%) of the HIID respondents had low level of farming experience and a little less than one-third (32.50%) of the LIID respondents had low level of farming experience. The respondents with high level of farming experience was 23.75 per cent in HIID and 10.00 per cent in LIID.

The overall data shows, majority (52.50%) of the respondents had medium level of farming experience followed by

low level of experience (30.63%) and a high level of farming experience (16.87%) respectively.

The chi-square analysis revealed that there was no significant difference between the farming experience of two farming situations. This finding is in line with Krishnakumar (1994).

With regard to farming experience, most of the respondents had medium level. This might be because agriculture is the main occupation for the farmers and they are engaged in this activity for decades together.

#### 4.1.1.8. Land fragmentation index

From the Table 9 it is obvious that in the HIID, nearly half (47.50%) of the respondents were found to have high level of land fragmentation index followed by 45.00 and 7.50 per cent with medium and low level of land fragmentation index respectively.

In the LIID, almost equal percentage of the respondents had low (48.75%) and medium (46.25%) level of land fragmentation index.

The overall picture shows that less than half (45.61%) of the respondents had medium level of land fragmentation index followed by nearly equal (28.12%) and (26.87%) of

respondents with low and high land fragmentation index respectively.

The results of the chi-square analysis indicates that there existed a significant difference in the land fragmentation index of the respondents in the two farming situations.

#### 4.1.1.9. Cropping intensity

The Table 9 highlights that in the HIID, about half (52.50%), two-fifth (41.25%) and a meagre proportion (6.25%) of the respondents had medium, high and low cropping intensity respectively. In the LIID, majority (68.73%) followed by about one-fourth (26.25%) and small portion (5.00%) of the respondents had medium, low and high cropping intensity, respectively.

The overall data shows that, majority (60.63%) of the respondents had medium level of cropping intensity followed by nearly one-fourth (23.12%) and 16.25 per cent of farmers had high and low level cropping intensity, respectively.

The chi-square value indicated that there existed significant difference in the cropping intensity between the two farming situations.

#### 4.1.1.10. Irrigation intensity

High level of irrigation intensity was reported by 58.75 per cent and 31.25 per cent of the HIID and LIID respondents respectively as indicated in Table 9. This was followed by respondents with medium level of irrigation intensity 35.00 per cent in HIID and 27.50 per cent in LIID. About 46.25 per cent of respondents of HIID and 41.25 per cent of respondents in LIID were found to have low level of irrigation intensity.

The overall picture shows that majority of the respondents (45.00%) were having high irrigation intensity which was followed by 31.25 per cent of respondents having medium level irrigation intensity.

From the chi-square analysis it is evident that there existed significant difference in the irrigation intensity between the two farming situations.

#### 4.1.1.11. Labour availability

The study relating to labour availability as set out in the table indicates that majority of the respondents (63.75%) were found to have high labour availability which was followed by 26.25 per cent of the respondents having medium labour availability and 10.00 per cent of the respondents having medium labour availability in HIID.

It is therefore concluded that most of the respondents had medium level of hiring agency utilisation behaviour. This might be due to non-availability of a government hiring agency and a high cost structure by the private hiring agency in the study area.

#### 4.1.1.14. Farm power asset

It is evident from the Table 9 that majority (52.50%) of the respondents were belonged to low level of farm power asset in HIID, while similar type of farm power asset possessed was about three-fourth (73.75%) in LIID. Less than one-fourth (27.75%) of the respondents possessed medium and high level of farm power asset in HIID. About 18.75 and 7.50 per cent of the respondents had possessed medium and high levels of farm power asset in LIID respectively.

The overall trend shows that little less than two-third (63.13%) of respondents had low level of farm power asset while about one-fifth and 15.62 per cent of them had medium and high levels of farm power asset.

It might be concluded that majority (63.13%) of the respondents were found to have low level of farm power asset possession. Low level of farm power possessed might be due to the higher initial cost of the farm equipments - machinery, implements and tools.

When the data was subjected to chi-square analysis, the result revealed that there existed no significant difference between two farming situations.

These findings are in contrast against the findings of Karthikeyan (1984), Chenniappan (1987) and Venkattakumar (1997).

**4.1.1.15. Material possession**

From the Table 9 it is clear that, in the HIID, about two-fifth (42.50%) of respondents had medium level of material possession followed by about one-third (35.00%) and one-fifth (22.50%) of them had low and high levels of material possession respectively.

The overall picture shows that, two-fifth (40.62%) of the respondents had medium level of material possession followed by a little less than one-third (31.25%) and 28.13 per cent of them had low and high levels of material possession.

In the LIID, little less than two-fifth (38.75%) of the respondents had medium level of material possession followed by one-third (33.75%) and one-fourth (27.50%) of the respondents had high and low levels of material possession.

The chi-square analysis revealed that there existed no difference in the possession of materials between two farming situations.

#### 4.1.1.16. Extension agency contact

It is evident from the table that, medium level of contact with extension agency was reported by about two-fifth (42.50%) of the HIID respondents and more than one-third (38.75%) of LIID respondents. About one-fifth (21.25%) of the HIID respondents and little less than half (46.25%) of the LIID respondents had low level of contact with extension agency. Exactly one-third (33.75%) and a meagre proportion (8.75%) of respondents had high level of contact with extension agency.

The overall trend shows that less than half (45.00%) of respondents had medium level of extension agency contact followed by 33.75 per cent had low and 21.25 per cent had high levels of extension agency contact.

The results of the chi-square analysis revealed that there was significant difference in the extension agency contact behaviour among the two farming situations.

#### 4.1.1.17. Social participation

From the Table 9 it is seen that, low level of social participation was reported by 48.75 per cent and 47.50 per cent of HIID and LIID respondents respectively. These were followed by respondents with medium level of social

participation of LIID respondents (47.50%) and HIID respondents (40.00%). High level of social participation was reported by about one-tenth (11.25%) of HIID and 5.00 per cent of the LIID respondents respectively.

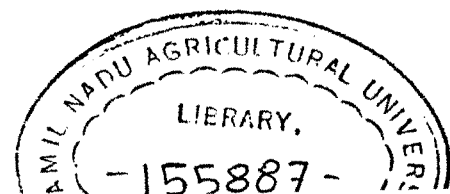
An overall picture shows that little less than half (48.12%) of respondents had low social participation while about two-fifth (43.75%) of them had medium and 8.13 per cent of the respondents had high level of social participation respectively.

From the chi-square analysis it could be inferred that there existed no significant difference in the social participation behaviour between two farming situations.

These findings are similar to the findings of Elangovan (1994) and Venkattakumar (1997).

#### 4.1.1.18. Level of exposure to media

From the Table 9, it is vivid that nearly half (47.50%) of respondents had medium level of exposure to media while three-tenth (30.00%) of them had low level and 22.50 per cent were with high level of exposure to media in HIID. In case of LIID, nearly two-fifth (38.75%) of the respondents had low level of exposure to media while 31.25 per cent were with high level and 30.00 per cent of them had medium level of exposure



to media. The overall trend shows that 38.75 per cent of the respondents were having medium level of exposure to media, while 34.38 per cent of them had low level and 26.87 per cent of them had high level of exposure to media.

From the chi-square analysis, it is evident that there existed no significant difference between two farming situations.

It could be inferred that most (73.13%) of the farmers belonged to low to medium level of exposure to media. The findings are in line with Natarajan (1991) and Kumar (1994).

#### 4.1.1.19. Attributes of farm machinery - Cost

It is evident from the Table 9 that most (71.25%) of the HIID respondents and 72.50 per cent of the LIID respondents had opined the high cost involvement in all expenditure about farm machinery, while about two-fifth (21.25%) of HIID respondents and 15.00 per cent of the LIID respondents had opined the medium level cost of machinery. Only 7.50 per cent of the HIID farmers and nearly two-fifth (18.50%) of the LIID farmers expressed low cost expenditure about farm machinery. The overall picture shows that about 71.87 per cent of the respondents had high cost followed by slightly more than one-third (36.25%) and two-fifth of the

respondents had medium and low cost involvement in all expenditure about farm machinery respectively.

The chi-square analysis revealed that there was no significant difference between the attributes of cost involved in machinery in the two farming situations.

It might be concluded that three-fourth (71.87%) of the respondents had expressed the high cost involved in farm machinery. These findings are in accordance with the findings of Chennakesavan (1978) and Thiruthuvadas (1981).

#### **4.1.1.20. Attributes of farm machinery - Efficiency**

The Table 9 highlights that in HIID, almost an equal percentage of the respondents were having farm machinery with high (35.00%), low (33.75%) and medium (31.75%) level of efficiency. In LIID, about 45.00 per cent of the farmers were having farm machinery with medium level of efficiency followed by low (37.50%) and high (17.50%) level of efficiency. The overall data indicates that nearly two-fifth (38.12%) of the respondents had farm machinery with medium level of efficiency followed by 35.63 per cent in low and 26.25 per cent in high level of efficiency.

The chi-square analysis revealed that there existed significant difference in the attribute efficiency of farm machinery between the two farming situations.

#### 4.1.1.21. Attributes of farm machinery - Trialability

The Table 9 reveals that a little more than two-fifth (41.25%) of the respondents expressed that had farm machinery with low level of trialability of followed by two-fifth (40.00%) of them had farm machinery with medium and 18.75 per cent of them had farm machinery with high level of trialability. In LIID, little less than half (47.50%) of the respondents had farm machinery with high level of trialability followed by 27.50 per cent in low and one-fourth (25.00%) of them had farm machinery with medium level of trialability. The overall data shows that nearly an equal percentage of respondents expressed about the trialability of farm machinery.

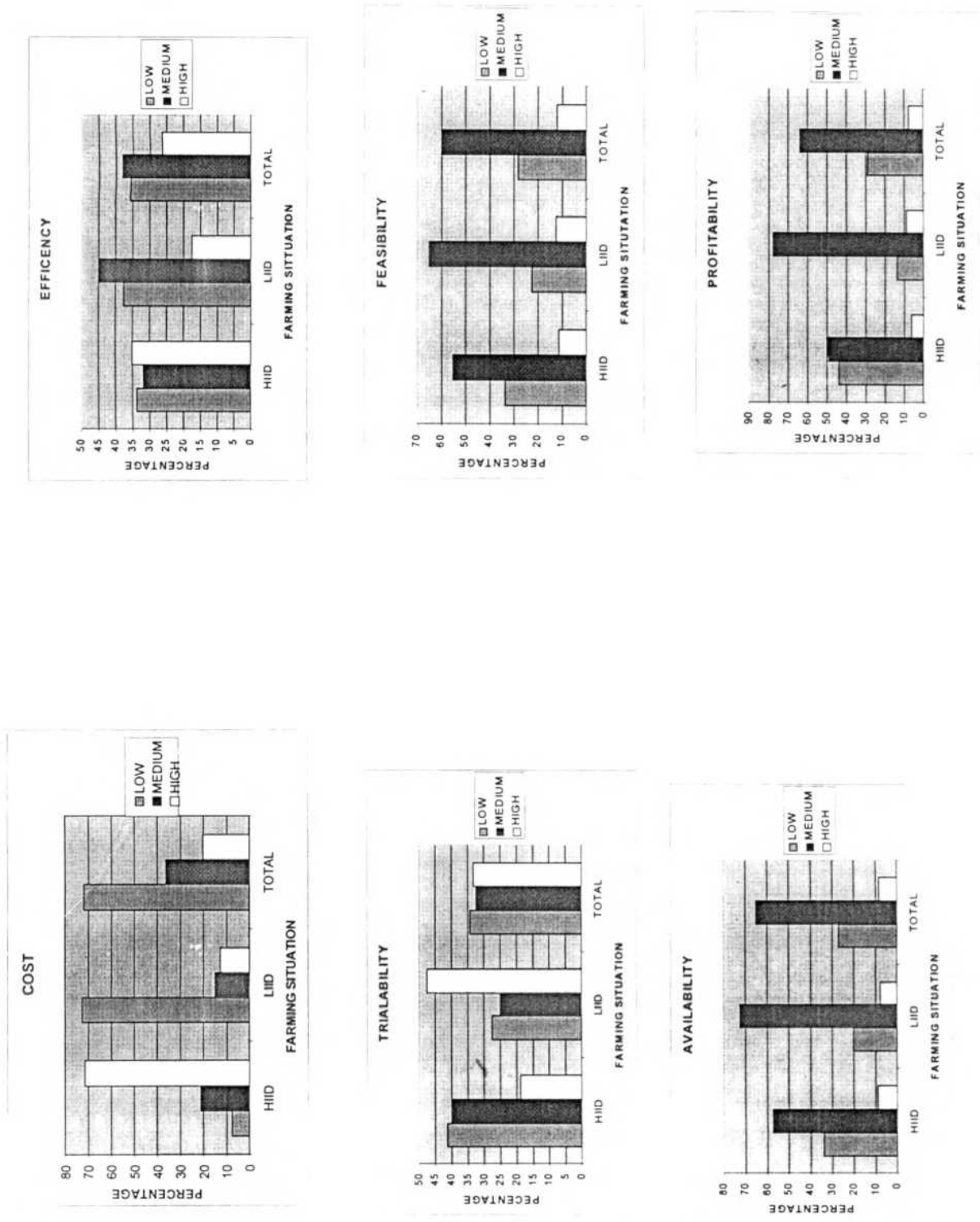
From the chi-square analysis it is seen that there was significant difference between the two farming situations relating to trialability of farm machinery.

It could be concluded that majority (66.87%) of the respondents had low to medium level of trialability of farm machinery. This might be due to that farmers do not have a high level of risk orientation.

#### 4.1.1.22. Attributes of farm machinery - Feasibility

The Table 9 indicates that more than half (55.00%) of the respondents found medium level of feasibility of farm

FIG. 3. DISTRIBUTION OF RESPONDENTS ACCORDING TO THEIR PROFILE OF ATTRIBUTES OF FARM MACHINERIES



machinery followed by one-third (33.75%) of them found low level and only 11.25 per cent of them found high level of feasibility of farm machinery in HIID, while in LIID, majority (65.00%) of the respondents had medium feasibility followed by 22.50 per cent and 12.50 per cent of the respondents found low and high levels of feasibility of machinery respectively. An overall picture shows that majority (60.00%) of them found medium level of feasibility of farm machinery.

From the chi-square analysis it could be inferred that there existed no significant difference in the feasibility of the low farming situations. These findings are in contrast against the findings given by Chennakesavan (1978) and Thiruthuvadas (1981).

#### 4.1.1.23. Attributes of farm machinery - Availability

From the Table 9, it could be understood that in HIID about 57.50 per cent of respondents had expressed the medium level of availability of farm machinery followed by one-third (33.75%) of them had expressed the low level and only 8.75 per cent of them had expressed the high level of availability of farm machinery. In LIID, most (72.50%) of them had expressed the medium level of availability followed by one-fifth (20.00%) of them had low level and only 7.50 per cent of them had expressed the high level of availability of farm

machinery. The overall data shows that majority (65.00%) of them had medium level of availability of farm machinery.

From the chi-square analysis it is evident that there existed no significant difference in the availability of farm machinery in both the farming situations.

#### 4.1.1.24. Attributes of farm machinery - Profitability

It is evident from the Table 9 that in HIID, half (50.00%) of the respondents had expressed the medium level of profitability of farm machinery followed by 43.75 per cent of them had expressed the low level and only 6.25 of them had expressed the high level of profitability of farm machinery. In LIID, majority of them had expressed the medium level of profitability of farm machinery followed by 13.75 per cent of respondents had expressed the low level and 8.75 per cent of them had expressed the high level of profitability of farm machinery. In the case of overall data, majority (63.75%) of them had expressed the medium level of profitability of farm machinery.

The chi-square value indicates that there existed significant difference in the profitability in both the farming situations.

#### 4.1.2. Independent variables Vs awareness of improved farm equipments - machinery, implements and tools

##### 4.1.2.1. Zero order correlation coefficient

In order to understand the association between the selected characteristics of the farmers and their awareness of improved farm equipments - machinery, implements and tools, zero order correlation was computed and the results are furnished in the Table 10.

The Table 10 clearly indicates that out of the 24 characteristics studied in pooled analysis, except six characteristics viz., occupational status, family size, land fragmentation index, labour availability, training undergone and hiring agency, all others showed significant association with the farmers awareness. Of these, 18 characteristics viz., age, cropping intensity, attributes of farm machinery - cost and efficiency were found to be significant at 5 per cent level and the rest were significant at 1 per cent level. The significant variables showed positive and significant association with the awareness of the farmers.

In case of HIID, out of 24 characteristics studied, 11 characteristics viz., family type, farming experience, farm power asset, material possession, extension agency contact, social participation, level of exposure to media, attributes

Table 10. Zero order correlation showing the relationship of profile respondents with their awareness

Variable No.	Variables	Correlation coefficient		
		HIID (n=80)	LIID (n=80)	Total (n=160)
X <sub>1</sub>	Age	.20106 NS	.14606 NS	.17777 *
X <sub>2</sub>	Educational status	.18585 NS	.42723 **	.28410 **
X <sub>3</sub>	Occupational status	.02816 NS	-.11233 NS	-.01826 NS
X <sub>4</sub>	Family type	.28502 *	.28721 **	.24554 **
X <sub>5</sub>	Family size	.18118 NS	.01746 NS	.12971 NS
X <sub>6</sub>	Farm size	.19863 NS	.27900 *	.25941 **
X <sub>7</sub>	Farming experience	.37797 **	.45900 **	.35905 **
X <sub>8</sub>	Land fragmentation index	-.15508 NS	-.36687 NS	-.02740 NS
X <sub>9</sub>	Cropping intensity	.12897 NS	-.03397 NS	.17706 *
X <sub>10</sub>	Irrigation intensity	.12733 NS	.27275 *	.30101 **
X <sub>11</sub>	Labour availability	-.12202 NS	-.36376 NS	-.11481 NS
X <sub>12</sub>	Training undergone	.14983 NS	.07092 NS	.13861 NS
X <sub>13</sub>	Hiring agency	-.11661 NS	.07201 NS	-.07848 NS
X <sub>14</sub>	Farm power asset	.36997 **	.52137 **	.45339 **
X <sub>15</sub>	Material possession	.47501 **	.71002 **	.58119 **
X <sub>16</sub>	Extension agency contact	.38697 **	.35215 **	.42553 **
X <sub>17</sub>	Social participation	.40736 **	.32259 **	.36149 **
X <sub>18</sub>	Level of exposure to media	.26248 *	.40393 **	.16592 *
X <sub>19</sub>	Attributes of machineries - Cost	.00658 NS	.31991 **	.31029 **
X <sub>20</sub>	Efficiency	.07079 NS	.17922 NS	.19470 *
X <sub>21</sub>	Trialability	.31465 **	.20095 NS	.22459 **
X <sub>22</sub>	Feasibility	.33319 **	.37444 **	.29921 **
X <sub>23</sub>	Availability	.43331 **	.41519 **	.37735 **
X <sub>24</sub>	Profitability	.33926 **	.55748 **	.29673 **

\*\* Significant at 1% level

\* Significant at 5% level

NS - Non-significant

of trialability, feasibility, availability and profitability showed positive significant association with the awareness of farmers. Of the 11 characteristics, family type and level of exposure to media were found to be significant at 5 per cent level and the rest were significant at 1 per cent level.

In the LIID, out of 24 characteristics studied, 13 characteristics viz., educational status, family type, farm size, farming experience, irrigation intensity, farm power asset, material possession, extension agency contact, social participation, level of exposure to media, attributes of cost, feasibility and availability showed positive significant association with the awareness of farmers. Of the 13 characteristics farm size and irrigation intensity were found to be significant at 5 per cent level and rest were significant at 1 per cent level.

#### 4.1.2.2. Multiple regression analysis

Multiple regression analysis was used to find out the effect of different independent variables on the dependent variable viz., the extent of awareness of improved farm equipments - machinery, implements and tools. The results are presented in Table 11.

From the Table 11, it could be seen that the pooled analysis,  $R^2$  value of 0.4658 was found to be significant at 1 per cent level of probability. The variable extension agency

Table 11. Multiple regression analysis of independent variables with awareness of respondents

Variable No.	Variables	HIID (n=80)			LIID (n=180)			Total (n=160)		
		Regression coefficient	Std. error	't' value	Regression coefficient	Std. error	't' value	Regression coefficient	Std. error	't' value
X <sub>1</sub>	Age	-0.5452	1.1665	-0.467 NS	-1.2194	0.7906	-1.542 NS	-0.4643	0.6844	-0.678 NS
X <sub>2</sub>	Educational status	0.0896	0.6078	0.147 NS	-0.0871	0.4129	-0.211 NS	0.8872	0.3398	1.139 NS
X <sub>3</sub>	Occupational status	-0.2907	0.8536	-0.341 NS	-0.7151	0.4257	-1.680 NS	-0.4865	0.4233	-1.149 NS
X <sub>4</sub>	Family type	2.1524	2.0499	1.050 NS	-0.2113	1.1874	-0.178 NS	1.1105	1.1147	0.996 NS
X <sub>5</sub>	Family size	-0.2200	1.6000	-0.138 NS	0.3240	0.9965	0.325 NS	-0.0092	0.8723	-0.011 NS
X <sub>6</sub>	Farm size	0.0693	0.0775	0.894 NS	0.0639	0.0511	1.248 NS	0.488	0.0456	1.071 NS
X <sub>7</sub>	Farming experience	-0.5484	1.1605	-0.473 NS	0.1174	0.5352	0.219 NS	0.3865	0.9469	0.707 NS
X <sub>8</sub>	Land fragmentation index	0.0014	0.0040	0.345 NS	-0.0121	0.0046	-2.665 *	0.0039	0.0026	1.481 NS
X <sub>9</sub>	Cropping intensity	0.0127	0.0124	1.024 NS	-0.0018	0.0105	-0.174 NS	0.0083	0.0071	1.156 NS
X <sub>10</sub>	Irrigation intensity	-0.0381	0.0418	-0.912 NS	0.0208	0.0164	1.272 NS	0.0124	0.0163	0.761 NS
X <sub>11</sub>	Labour availability	-0.1062	0.1140	-0.931 NS	-0.6520	0.2495	-2.613 *	-0.1509	0.0885	-1.705 NS
X <sub>12</sub>	Training undergone	-0.1267	0.4277	-0.296 NS	-0.1226	0.2891	-0.424 NS	-0.0569	0.2511	-0.227 NS
X <sub>13</sub>	Hiring agency	-0.1560	0.4148	-0.376 NS	0.0478	0.2654	0.180 NS	0.1519	0.2359	0.644 NS
X <sub>14</sub>	Farm power asset	-8.7408E-04	0.0010	-0.837 NS	8.28818E-04	6.10164E-04	1.358 NS	1.69383E-04	5.56324E-04	0.304 NS
X <sub>15</sub>	Material possession	0.2180	0.1565	1.393 NS	0.0932	0.1030	0.904 NS	0.0558	0.0855	0.653 NS
X <sub>16</sub>	Extension agency contact	0.0280	0.1388	0.201 NS	0.3296	0.1171	2.815 **	0.2221	0.0955	2.325 *
X <sub>17</sub>	Social participation	0.7885	0.4272	1.846 NS	0.1163	0.4077	0.285 NS	0.5176	0.2930	1.767 NS
X <sub>18</sub>	Level of exposure to media	0.1118	0.2121	0.527 NS	0.0306	0.1308	0.234 NS	-0.0025	0.1166	-0.021 NS
X <sub>19</sub>	Attributes of machinery-Cost	0.8886	1.0089	0.881 NS	-0.1449	0.4067	-0.356 NS	0.2541	0.3893	0.653 NS
X <sub>20</sub>	Efficiency	-0.0733	0.2923	-0.251 NS	-0.1601	0.1518	-1.054 NS	0.1833	0.1374	1.337 NS
X <sub>21</sub>	Triability	0.5868	0.5233	1.121 NS	-0.8033	0.3612	-2.224 *	-0.1309	0.3150	-0.416 NS
X <sub>22</sub>	Feasibility	0.1091	0.4222	0.258 NS	0.1287	0.3108	0.414 NS	-0.0195	0.2661	-0.073 NS
X <sub>23</sub>	Availability	1.6327	1.4555	1.122 NS	0.6168	1.1720	0.526 NS	0.6919	0.9306	0.743 NS
X <sub>24</sub>	Profitability	0.6750	1.2477	0.541 NS	2.0906	1.2975	1.611 NS	0.7281	0.8756	0.832 NS

R<sup>2</sup>  
Multiple r  
f

0.4026  
-0.6345  
1.544

0.7585  
0.8709  
7.196

0.4658  
0.6825  
4.904

\* - Significant at 5% level; \*\* - Significant at 1% level; NS - Non-significant

contact was found to be positively significant at 5 per cent level of probability.

From the Table 11, it could be seen that an unit increase in the extension agency contact would bring an increase in the awareness level by 2.325 units *ceteris paribus*.

The prediction equation fitted is as follows:

$$\hat{Y} = -2.0012 - 0.4643 X_1 + 0.8872 X_2 - 0.4865 X_3 + 1.1105 X_4 - \\ 0.0092 X_5 + 0.4880 X_6 + 0.3865 X_7 + 0.0038 X_8 + 0.0083 X_9 \\ + 0.0124 X_{10} - 0.1509 X_{11} - 0.0569 X_{12} + 0.1519 X_{13} + \\ 0.0006 X_{14} + 0.0558 X_{15} + 0.2221 X_{16} + 0.5176 X_{17} - \\ 0.0025 X_{18} + 0.2541 X_{19} + 0.1835 X_{20} - 0.1309 X_{21} - \\ 0.0195 X_{22} + 0.6919 X_{23} + 0.0728 X_{24}$$

It could be seen from the Table 11 that the respondents of the HIID that all the 24 independent variables put together were able to explain 40.26 per cent of variation in the dependent variable namely awareness of improved farm equipments - machinery, implements and tools. The 'F' value 1.544 was not found to be non-significant.

In the LIID, all the 24 independent variables put together were able to explain 75.85 per cent of variation in the dependent variable namely awareness level. The 'F' value 7.196 was also found to be significant at 1 per cent level.

The Table 11 further shows that out of the 24 variables taken for the analysis only one variable, the extension agency contact contributed significantly towards the awareness of improved farm equipments - machinery, implements and tools. The variables land fragmentation index, labour availability and trialability negatively influenced their awareness level.

From the Table 11 it could be observed that an unit increase in the extension agency contact would increase the awareness level by 0.3296 units *ceteris paribus*. This means that the higher the contact with extension agency, higher would be the awareness level.

One unit increase in land fragmentation index would decrease 0.0121 units *ceteris paribus* of awareness level. This means that higher level of land fragmentation index would prefer less awareness of improved farm equipments - machinery, implements and tools.

One unit increase in labour availability would bring a decrease in the level of awareness by 0.65220 units *ceteris paribus*. This might be due to the large family size of the respondents which would prefer less awareness.

Similarly, one unit increase in attributes of trialability would decrease the awareness level by 0.8035 units *ceteris paribus*.

The regression equation fitted is as follows:

$$\hat{Y} = 11.0918 - 1.2194 X_1 - 0.0871 X_2 - 0.7151 X_3 - 0.2113 X_4 + \\ 0.3240 X_5 + 0.0638 X_6 + 0.1174 X_7 + 0.0121 X_8 + 0.0018 X_9 \\ + 0.0208 X_{10} - 0.6520 X_{11} - 0.1226 X_{12} + 0.0478 X_{13} + \\ 0.0008 X_{14} + 0.0932 X_{15} + 0.3296 X_{16} + 0.1163 X_{17} + \\ 0.0306 X_{18} - 0.1449 X_{19} - 0.1601 X_{20} - 0.8035 X_{21} - \\ 0.1287 X_{22} + 0.6168 X_{23} + 2.0906 X_{24}$$

#### 4.1.2.3. Path coefficient of characteristics towards awareness of improved farm equipments - machinery, implements and tools

The results of path analysis are presented in Table 12.

From the Table 12 it could be inferred that in total, the extension agency contact influenced the awareness level of farmers with a greater magnitude of 0.3141.

Social participation, land fragmentation index, farming experience, cropping intensity and labour availability also showed a higher and positive direct effect.

Farm power asset, extension agency contact, exposure to media, farm size, attributes of availability, feasibility, irrigation intensity, material possession and age also showed higher and positive indirect effect.

Table 12. Path co-efficient of profile towards the awareness level of respondents

Variable No.	HLID (n=80)			LIID (n=80)				
	Direct effect	Substantial indirect effect	Substantial indirect effect	Direct effect	Indirect effect	Substantial indirect effect		
		I	II	III	I	II	III	
X <sub>1</sub> Age	-0.1046	0.3057	0.1635(X <sub>1</sub> )	0.0772(X <sub>1</sub> )	0.0635(X <sub>1</sub> )	0.1464(X <sub>1</sub> )	0.1033(X <sub>1</sub> )	0.0494(X <sub>1</sub> )
X <sub>2</sub> Educational status	-0.0021	0.1879	0.6973(X <sub>2</sub> )	0.0481(X <sub>2</sub> )	0.0440(X <sub>2</sub> )	0.1987(X <sub>2</sub> )	0.1112(X <sub>2</sub> )	0.0445(X <sub>2</sub> )
X <sub>3</sub> Occupational status	-0.1823	0.2105	0.0488(X <sub>3</sub> )	0.0462(X <sub>3</sub> )	0.0385(X <sub>3</sub> )	0.0479(X <sub>3</sub> )	0.0398(X <sub>3</sub> )	0.0277(X <sub>3</sub> )
X <sub>4</sub> Family type	0.1971	0.0879	0.0931(X <sub>4</sub> )	0.0387(X <sub>4</sub> )	0.0383(X <sub>4</sub> )	0.1413(X <sub>4</sub> )	0.0454(X <sub>4</sub> )	0.0438(X <sub>4</sub> )
X <sub>5</sub> Family size	-0.0881	0.2693	0.0976(X <sub>5</sub> )	0.7408(X <sub>5</sub> )	0.0727(X <sub>5</sub> )	0.0954(X <sub>5</sub> )	0.0600(X <sub>5</sub> )	0.0573(X <sub>5</sub> )
X <sub>6</sub> Farming experience	0.2170	-0.0184	0.0995(X <sub>6</sub> )	0.0890(X <sub>6</sub> )	0.7886(X <sub>6</sub> )	0.1538(X <sub>6</sub> )	0.1371(X <sub>6</sub> )	0.0520(X <sub>6</sub> )
X <sub>7</sub> Farm size	-0.0630	0.4410	-0.1895(X <sub>7</sub> )	0.1855(X <sub>7</sub> )	0.1083(X <sub>7</sub> )	0.2082(X <sub>7</sub> )	0.7549(X <sub>7</sub> )	0.0546(X <sub>7</sub> )
X <sub>8</sub> Land fragmentation index	0.0245	-0.1796	-0.1011(X <sub>8</sub> )	0.0885(X <sub>8</sub> )	0.0401(X <sub>8</sub> )	0.0863(X <sub>8</sub> )	0.0292(X <sub>8</sub> )	0.0271(X <sub>8</sub> )
X <sub>9</sub> Cropping intensity	0.1677	-0.0387	0.0654(X <sub>9</sub> )	0.0625(X <sub>9</sub> )	0.0298(X <sub>9</sub> )	0.0519(X <sub>9</sub> )	0.0397(X <sub>9</sub> )	0.0344(X <sub>9</sub> )
X <sub>10</sub> Irrigation intensity	-0.1195	0.2498	0.0877(X <sub>10</sub> )	0.0680(X <sub>10</sub> )	0.0411(X <sub>10</sub> )	0.1313(X <sub>10</sub> )	0.0831(X <sub>10</sub> )	0.0626(X <sub>10</sub> )
X <sub>11</sub> Labour availability	-0.1618	0.0398	0.0363(X <sub>11</sub> )	0.0328(X <sub>11</sub> )	0.1756(X <sub>11</sub> )	0.0701(X <sub>11</sub> )	0.0676(X <sub>11</sub> )	0.0274(X <sub>11</sub> )
X <sub>12</sub> Training undergone	-0.0839	0.2337	0.0614(X <sub>12</sub> )	0.5685(X <sub>12</sub> )	0.0389(X <sub>12</sub> )	0.1009(X <sub>12</sub> )	0.0365(X <sub>12</sub> )	0.0241(X <sub>12</sub> )
X <sub>13</sub> Hiring agency	-0.1008	-0.0158	0.0706(X <sub>13</sub> )	0.0472(X <sub>13</sub> )	0.0455(X <sub>13</sub> )	0.0539(X <sub>13</sub> )	0.0490(X <sub>13</sub> )	0.0474(X <sub>13</sub> )
X <sub>14</sub> Farm power asset	-0.2857	0.6557	0.1964(X <sub>14</sub> )	0.0886(X <sub>14</sub> )	0.0845(X <sub>14</sub> )	0.2521(X <sub>14</sub> )	0.0652(X <sub>14</sub> )	0.0623(X <sub>14</sub> )
X <sub>15</sub> Material possession	0.0771	0.3099	0.1666(X <sub>15</sub> )	-0.1521(X <sub>15</sub> )	0.1128(X <sub>15</sub> )	0.2198(X <sub>15</sub> )	0.0682(X <sub>15</sub> )	0.0553(X <sub>15</sub> )
X <sub>16</sub> Extension agency contact	0.2659	0.2091	-0.2110(X <sub>16</sub> )	0.1031(X <sub>16</sub> )	0.0812(X <sub>16</sub> )	0.0861(X <sub>16</sub> )	0.0808(X <sub>16</sub> )	0.0775(X <sub>16</sub> )
X <sub>17</sub> Social participation	0.2658	0.1416	0.1031(X <sub>17</sub> )	0.0953(X <sub>17</sub> )	0.0639(X <sub>17</sub> )	0.1288(X <sub>17</sub> )	0.0542(X <sub>17</sub> )	0.0442(X <sub>17</sub> )
X <sub>18</sub> Level of exposure to media	0.0735	0.1890	0.1025(X <sub>18</sub> )	0.0661(X <sub>18</sub> )	0.0559(X <sub>18</sub> )	0.2572(X <sub>18</sub> )	0.0469(X <sub>18</sub> )	0.0456(X <sub>18</sub> )
X <sub>19</sub> Attributes of machinery-Cost	0.1252	-0.1318	0.0464(X <sub>19</sub> )	0.0302(X <sub>19</sub> )	0.0253(X <sub>19</sub> )	0.1426(X <sub>19</sub> )	0.0746(X <sub>19</sub> )	0.0381(X <sub>19</sub> )
X <sub>20</sub> Efficiency	-0.0628	0.1336	-0.0886(X <sub>20</sub> )	0.0521(X <sub>20</sub> )	0.3499(X <sub>20</sub> )	0.0939(X <sub>20</sub> )	0.0569(X <sub>20</sub> )	0.0528(X <sub>20</sub> )
X <sub>21</sub> Trialability	0.2589	0.0557	0.0834(X <sub>21</sub> )	0.0788(X <sub>21</sub> )	0.6094(X <sub>21</sub> )	0.1710(X <sub>21</sub> )	0.0577(X <sub>21</sub> )	0.0476(X <sub>21</sub> )
X <sub>22</sub> Feasibility	0.0126	0.3206	0.0982(X <sub>22</sub> )	0.0981(X <sub>22</sub> )	0.0733(X <sub>22</sub> )	0.1504(X <sub>22</sub> )	0.1253(X <sub>22</sub> )	0.0470(X <sub>22</sub> )
X <sub>23</sub> Availability	0.1762	0.2571	0.1158(X <sub>23</sub> )	0.1107(X <sub>23</sub> )	0.1079(X <sub>23</sub> )	0.1685(X <sub>23</sub> )	0.1309(X <sub>23</sub> )	0.0758(X <sub>23</sub> )
X <sub>24</sub> Profitability	0.0854	0.2539	-0.1314(X <sub>24</sub> )	0.0899(X <sub>24</sub> )	0.0874(X <sub>24</sub> )	0.1707(X <sub>24</sub> )	0.0509(X <sub>24</sub> )	0.0482(X <sub>24</sub> )

Table 12 (Contd.)

		Total (n=160)		
Direct effect	Indirect effect	Substantial indirect effect		
		I	II	III
-0.0854	0.2632	0.1001(X <sub>15</sub> )	0.0951(X <sub>1</sub> )	0.0231(X <sub>16</sub> )
0.0822	0.2019	0.1136(X <sub>15</sub> )	0.0363(X <sub>6</sub> )	0.0181(X <sub>7</sub> )
-0.0816	0.0633	0.0250(X <sub>15</sub> )	0.0188(X <sub>8</sub> )	0.0175(X <sub>7</sub> )
0.0758	0.1697	0.1041(X <sub>6</sub> )	0.0255(X <sub>17</sub> )	0.0190(X <sub>16</sub> )
-0.0626	0.1323	0.0651(X <sub>15</sub> )	0.0571(X <sub>6</sub> )	0.0398(X <sub>8</sub> )
0.1297	0.1297	0.1104(X <sub>15</sub> )	0.0626(X <sub>6</sub> )	0.0728(X <sub>9</sub> )
0.0545	0.3045	0.1824(X <sub>15</sub> )	0.0273(X <sub>2</sub> )	0.0268(X <sub>16</sub> )
0.1371	-0.1645	0.0685(X <sub>1</sub> )	0.0300(X <sub>24</sub> )	0.02982(X <sub>9</sub> )
0.1154	0.0617	0.0416(X <sub>15</sub> )	0.0354(X <sub>24</sub> )	0.0193(X <sub>1</sub> )
0.0154	0.2856	0.0856(X <sub>15</sub> )	0.0587(X <sub>8</sub> )	0.0311(X <sub>16</sub> )
-0.1136	-0.0012	0.0326(X <sub>15</sub> )	0.0194(X <sub>9</sub> )	0.0110(X <sub>16</sub> )
-0.0136	0.1522	0.0750(X <sub>8</sub> )	0.0165(X <sub>15</sub> )	0.0139(X <sub>1</sub> )
0.0569	-0.1354	0.0572(X <sub>15</sub> )	0.0224(X <sub>6</sub> )	0.0219(X <sub>16</sub> )
0.0271	0.4263	0.2120(X <sub>15</sub> )	0.0474(X <sub>16</sub> )	0.0412(X <sub>6</sub> )
0.0783	0.3472	0.1767(X <sub>15</sub> )	0.0444(X <sub>6</sub> )	0.0433(X <sub>16</sub> )
0.3141	0.2671	0.0494(X <sub>17</sub> )	0.0456(X <sub>1</sub> )	0.0441(X <sub>1</sub> )
0.1466	0.2209	0.1103(X <sub>15</sub> )	0.0266(X <sub>23</sub> )	0.0241(X <sub>16</sub> )
-0.0056	0.3159	0.1560(X <sub>15</sub> )	0.0433(X <sub>17</sub> )	0.0321(X <sub>16</sub> )
0.0542	0.1117	0.0620(X <sub>10</sub> )	0.0548(X <sub>17</sub> )	0.0276(X <sub>1</sub> )
0.0382	0.1065	0.0388(X <sub>15</sub> )	0.02392(X <sub>17</sub> )	0.02284(X <sub>8</sub> )
-0.0227	0.2473	0.1096(X <sub>15</sub> )	0.0328(X <sub>23</sub> )	0.0229(X <sub>6</sub> )
-0.0005	0.2997	0.0948(X <sub>15</sub> )	0.0531(X <sub>24</sub> )	0.0457(X <sub>17</sub> )
0.0770	0.3005	0.1237(X <sub>15</sub> )	0.0493(X <sub>24</sub> )	0.0486(X <sub>23</sub> )
0.0861	0.2106	0.0998(X <sub>15</sub> )	0.0477(X <sub>8</sub> )	0.0440(X <sub>17</sub> )

Out of the 72 substantial indirect effects 21 routed through material possession ( $X_{15}$ ), 13 routed through extension agency contact ( $X_{16}$ ), 11 routed through farming experience ( $X_7$ ), 7 routed through land fragmentation index ( $X_8$ ) and social participation ( $X_{17}$ ), 4 routed through attributes of availability ( $X_{23}$ ), 3 routed through attributes of profitability ( $X_{24}$ ), 2 routed through age ( $X_1$ ) and cropping intensity ( $X_9$ ) and one each through education ( $X_2$ ) and farm size ( $X_6$ ).

In the high HIID areas extension agency contact and social participation influenced on the awareness level of farmers with a higher magnitude of 0.2659 and 0.2658.

Attributes of trialability, farming experience, family type, attributes of availability also showed a positive and higher direct effect.

Farm power asset, farm size, attributes of feasibility, material possession, age, family size, attributes of availability and profitability also showed a higher and positive indirect effect.

Out of 72 substantial indirect effects 19 routed through material possession ( $X_{15}$ ), 11 routed through farm power asset ( $X_{14}$ ), 8 each routed through social participation ( $X_{17}$ ), farming experience ( $X_7$ ) and attributes of trialability ( $X_{21}$ ), 7 routed through attributes of availability ( $X_{23}$ ), 5 routed through family type ( $X_4$ ) and each one routed through

occupational status ( $X_3$ ), irrigation intensity ( $X_{10}$ ) and attributes of cost ( $X_{19}$ ).

In the LIID, extension agency contact showed the highest direct effect of 0.4224, thereby establishing a major share in shaping the awareness of improved farm equipments - machinery, implements and tools.

Similarly the variables like educational status and attributes of trialability had shown higher indirect effect than other variables.

Out of the 72 substantial indirect effects, 20 effects each routed through material possession ( $X_{15}$ ), 9 each routed through attributes of trialability ( $X_{21}$ ) and profitability ( $X_{24}$ ), 7 routed through land fragmentation index ( $X_8$ ), 6 each routed through farming experience ( $X_7$ ) and farm power asset ( $X_{14}$ ), 5 each routed through age ( $X_1$ ) and irrigation intensity ( $X_{10}$ ), 3 routed through labour availability ( $X_{11}$ ) and 2 routed through occupational status ( $X_3$ ).

The analysis showed that the independent variables viz., extension agency contact, social participation, land fragmentation index, farming experience and labour availability acted as crucial variables for increasing the awareness of improved farm equipments - machinery, implements and tools.

#### 4.1.3. Independent variables Vs use of improved farm equipments - machinery, implements and tools

##### 4.1.3.1. Zero order correlation coefficient

The relationship of socio-economic characteristics with the extent of use of improved farm equipments - machinery, implements and tools were worked out by means of correlation analysis and the results are furnished in Table 13.

From the Table 13 it could be observed that, out of the 24 independent variables studied in pooled analysis, except six characteristics viz., occupational status, family size, land fragmentation index, labour availability, hiring agency and cost of attributes, all showed significant association. With the extent of use of farmers and all the association characteristics were found to be positive. Of these, only four characteristics namely family type, cropping intensity, training undergone and attributes of efficiency were found to be significant at 5 per cent level and the rest were significant at 1 per cent level.

In the HIID, out of the 24 characteristics studied, five characteristics viz., educational status, family size, cropping intensity, irrigation intensity, and exposure to media were found to be significant at 5 per cent level and age, family type, farming experience, farm size, training undergone, farm power asset, material possession, extension agency contact, social participation, attributes of

Table 13. Zero order correlation showing relationship of profile of respondents with their extent of use

Variable No.	Variables	Correlation coefficient		
		HIID (n=80)	LIID (n=80)	Total (n=160)
X <sub>1</sub>	Age	.29572 **	.15516 NS	.23040 **
X <sub>2</sub>	Educational status	.27908 *	.35917 **	.31442 **
X <sub>3</sub>	Occupational status	-.09395 NS	-.06815 NS	-.07073 NS
X <sub>4</sub>	Family type	.29342 **	.15892 NS	.21125 *
X <sub>5</sub>	Family size	.22798 *	-.11841 NS	.06023 NS
X <sub>6</sub>	Farm size	.30466 **	.26011 *	.28958 **
X <sub>7</sub>	Farming experience	.57737 **	.31512 **	.43068 **
X <sub>8</sub>	Land fragmentation index	-.27464 NS	-.19913 NS	-.15668 NS
X <sub>9</sub>	Cropping intensity	.24817 *	.13171 NS	.20794 *
X <sub>10</sub>	Irrigation intensity	.27709 *	.44829 **	.36079 **
X <sub>11</sub>	Labour availability	-.10739 NS	-.24479 NS	-.11572 NS
X <sub>12</sub>	Training undergone	.31013 **	.02264 NS	.18441 *
X <sub>13</sub>	Hiring agency	-.15175 NS	-.09157 NS	-.13446 NS
X <sub>14</sub>	Farm power asset	.68008 **	.63158 **	.65699 **
X <sub>15</sub>	Material possession	.69342 **	.66397 **	.68049 **
X <sub>16</sub>	Extension agency contact	.52460 **	.50359 **	.50417 **
X <sub>17</sub>	Social participation	.34211 **	.34465 **	.34403 **
X <sub>18</sub>	Level of exposure to media	.27299 *	.43528 **	.35300 **
X <sub>19</sub>	Attributes of machineries - Cost	-.05492 NS	.27922 *	.14689 NS
X <sub>20</sub>	Efficiency	.11214 NS	.25031 *	.19194 *
X <sub>21</sub>	Trialability	.45961 **	.29177 **	.37267 **
X <sub>22</sub>	Feasibility	.37885 **	.39320 **	.37175 **
X <sub>23</sub>	Availability	.59990 **	.47112 **	.53068 **
X <sub>24</sub>	Profitability	.34947 **	.50356 **	.36306 **

\*\* Significant at 1% level  
 \* Significant at 5% level  
 NS - Non-significant

trialability, feasibility, availability and profitability were found to be significant at 1 per cent level. All the significant characteristics were found to be positive.

In the LIID out of 24 characteristics studied, variables namely farming experience, attributes of cost and efficiency showed 5 per cent level of significant relationship with extent of use and educational status, farm size, irrigation intensity, farm power asset, material possession, extension agency contact, social participation, exposure to media, attributes of trialability, feasibility, availability and profitability were found to be significant at 1 per cent level in use of improved farm equipments - machinery, implements and tools, rest of the characteristics had a non-significant association with the extent of use.

#### 4.1.3.2. Multiple regression analysis

The hitherto dependent variables the extent of use of improved farm equipments - machinery, implements and tools was subjected to multiple regression with the independent variables in order to know the extent of relationship of use level. The results are presented in Table 14.

The Table 14 exactly shows that all the 24 independent variables together explained 68.61 per cent of variation in the level of using the improved farm equipments - machinery,

Table 14. Multiple regression analysis of independent variables with use of respondents

Variable No.	HIID (n=80)				LIIID (n=180)				Total (n=160)			
	Regression coefficient	Std. error	't' value	Regression coefficient	Std. error	't' value	Regression coefficient	Std. error	't' value	Regression coefficient	Std. error	't' value
X1 Age	1.0458	0.6977	1.499 NS	-0.4097	0.7446	-0.550 NS	0.1170	0.4770	0.245 NS			
X1 Educational status	0.0538	0.3635	0.148 NS	-0.0118	0.3889	-0.030 NS	0.2109	0.2369	0.890 NS			
X2 Occupational status	-0.4084	0.5105	-0.800 NS	-0.2287	0.4010	-0.570 NS	-0.4878	0.2950	-1.653 NS			
X3 Family type	-1.2741	1.2261	-1.039 NS	-0.6286	1.1184	-0.562 NS	0.0514	0.7770	0.066 NS			
X4 Family size	0.0566	0.9569	0.059 NS	-1.0767	0.9385	-1.147 NS	-0.9425	0.6080	-1.550 NS			
X5 Farm size	-0.0530	0.0464	-1.142 NS	0.0413	0.0481	0.858 NS	0.0113	0.0318	0.355 NS			
X6 Farming experience	0.9539	0.6941	1.374 NS	0.5089	0.5041	1.010 NS	0.8422	0.3812	2.210 NS			
X7 Land fragmentation index	-0.0015	0.0024	-0.639 NS	-0.0064	0.0043	-1.500 NS	-0.0024	0.0018	-1.323 NS			
X8 Cropping intensity	0.0201	0.0074	2.711 **	0.0091	0.0099	0.927 NS	0.0082	0.0050	1.651 NS			
X9 Irrigation intensity	0.0067	0.0250	0.228 NS	0.0299	0.0154	1.938 NS	0.0304	0.0114	2.673 **			
X10 Labour availability	-0.0762	0.0682	-1.117 NS	-0.5603	0.2350	-2.384 NS	-0.1167	0.0617	-1.892 NS			
X11 Training undergone	0.5671	0.2558	2.217 *	-0.2914	0.2723	-1.070 NS	0.1405	0.1750	0.803 NS			
X12 Hiring agency	0.4130	0.2481	1.665 NS	-0.2504	0.2500	-1.000 NS	0.1221	0.1644	0.743 NS			
X13 Farm power asset	0.0024	6.2475E-04	3.844 **	0.0014	5.74695E-04	2.446 **	0.0017	3.87749E-04	4.351 **			
X14 Material possession	-0.0166	0.0936	-0.177 NS	0.1159	0.1103	1.051 NS	0.0572	0.0666	0.859 NS			
X15 Extension agency contact	-0.0043	0.0830	-0.051 NS	0.1725	0.0971	1.778 NS	0.0322	0.0596	0.541 NS			
X16 Social participation	0.1478	0.2555	0.579 NS	0.2216	0.3840	0.577 NS	0.1513	0.2042	0.741 NS			
X17 Level of exposure to media	-0.1151	0.1269	-0.907 NS	0.0883	0.1232	0.176 NS	0.0103	0.0813	0.127 NS			
X18 Attributes of machinery-Cost	0.0626	0.6034	0.104 NS	-0.1478	0.3830	-0.386 NS	0.0978	0.2713	0.360 NS			
X19 Efficiency	0.0846	0.1748	0.484 NS	0.0520	0.1430	0.363 NS	0.0642	0.0958	0.671 NS			
X20 Trialability	0.4248	0.3130	1.357 NS	-0.4462	0.3402	-1.311 NS	0.1671	0.2196	0.761 NS			
X21 Feasibility	0.1575	0.2525	0.624 NS	-0.1545	0.2928	0.528 NS	0.0651	0.1855	0.351 NS			
X22 Availability	1.7915	0.8705	2.058 *	0.8016	1.1039	0.726 NS	1.7251	0.6486	2.660 **			
X23 Profitability	-0.9890	0.7463	-1.325 NS	0.7703	1.2221	0.630 NS	-0.5905	0.6102	-0.968 NS			

r<sup>2</sup>

Multiple r

f

r <sup>2</sup>	0.7704	0.7466	0.6861
Multiple r	0.8777	0.8640	0.8293
f	7.690	6.750	12.292

\* - Significant at 5% level; \*\* - Significant at 1% level; NS - Non-significant

implements and tools. The 'F' value was also found to be significant at 1 per cent level.

It could be observed from the Table 14 that the regression coefficient of the variable farming experience was found to be positively significant at 5 per cent level of probability, whereas the other three variables viz., irrigation intensity, farm power asset and attributes of availability were found to be significant at 1 per cent level of probability.

Higher farming experience would have gained more knowledge on the use of improved machinery, implements and tools which in turn would have led to extent of use.

One unit increase of irrigation intensity would increase the level of use by 0.034 units *ceteris paribus*, high level of farm power asset and attributes of availability which would bring higher use of farm equipments - machinery, implements and tools.

The regression equation fitted is as follows.

$$\hat{Y} = -0.4986 + 0.1170 X_1 + 0.2109 X_2 - 0.4878 X_3 + 0.0514 X_4 - 0.9425 X_5 + 0.0113 X_6 + 0.8422 X_7 - 0.0024 X_8 + 0.0082 X_9 + 0.0304 X_{10} - 0.1167 X_{11} + 0.1405 X_{12} + 0.1221 X_{13} + 0.0017 X_{14} + 0.0572 X_{15} + 0.0322 X_{16} + 0.0513 X_{17} + 0.0103 X_{18} + 0.0978 X_{19} + 0.0642 X_{20} + 0.1671 X_{21} + 0.0651 X_{22} + 1.7251 X_{23} - 0.5905 X_{24}$$

From the Table 14 it could be observed that in the HIID, out of 24 independent variables studied, four variables namely cropping intensity, training undergone, farm power asset, and availability showed a positive and significant relationship with the extent of use of improved farm equipments - machinery, implements and tools.

The Table 14 shows that the coefficient of multiple determination viz., R was 0.7704, which was found to be significant at 1 per cent level of probability. This means that 77.04 per cent of variations in the dependent variable was explained by the independent variables chosen for the study.

The prediction equation fitted in this, was given below:

$$\begin{aligned} \hat{Y} = & -3.6044 + 1.0458 X_1 + 0.0538 X_2 - 0.4084 X_3 - 1.2741 X_4 + \\ & 0.0566 X_5 - 0.0530 X_6 + 0.9539 X_7 - 0.0015 X_8 + 0.0201 X_9 \\ & + 0.0057 X_{10} - 0.0762 X_{11} + 0.5671 X_{12} + 0.4130 X_{13} + \\ & 0.0024 X_{14} - 0.0166 X_{15} - 0.0043 X_{16} + 0.1478 X_{17} - \\ & 0.1151 X_{18} + 0.0626 X_{19} + 0.0846 X_{20} + 0.4248 X_{21} + \\ & 0.1575 X_{22} + 1.7015 X_{23} - 0.9890 X_{24} \end{aligned}$$

This revealed that an unit increase in the cropping intensity would increase the extent use of farm equipments - machinery, implements and tools to a degree of 0.0201 units *ceteris paribus*. Likewise, an unit increase in the training

undergone would increase the extent of use to a degree of 0.5671 units *ceteris paribus*.

Higher farm power asset and attributes of availability which would lead to higher use of farm equipments - machinery, implements and tools.

In the LIID, all the 24 characteristics put together were able to explain 74.66 per cent of variation in the dependent variable namely the extent of use. The 'F' value 6.750 was also found to be significant at 1 per cent level.

The Table 14 further shows that out of the 24 variables taken for analysis only one variable farm power asset had a positive relation which was significant at 1 per cent level. This means that an unit increase in the farm power asset would increase the extent of use level by 0.0014 unit *ceteris paribus*. This might be due to the higher possession of farm power asset which would influence the higher use of farm equipments - machinery, implements and tools.

The regression equation fitted is as follows.

$$\begin{aligned} \hat{Y} = & 5.7248 - 0.4097 X_1 - 0.0118 X_2 - 0.2287 X_3 - 0.6286 X_4 - \\ & 1.0767 X_5 + 0.0413 X_6 + 0.6089 X_7 - 0.0064 X_8 + 0.0091 X_9 \\ & + 0.0299 X_{10} - 0.5603 X_{11} - 0.2914 X_{12} - 0.2504 X_{13} + \\ & 0.0014 X_{14} + 0.1159 X_{15} + 0.1725 X_{16} + 0.2216 X_{17} + \\ & 0.0883 X_{18} - 0.1478 X_{19} + 0.0520 X_{20} - 0.4462 X_{21}, + \\ & 0.1545 X_{22} + 0.8016 X_{23} + 0.7703 X_{24} \end{aligned}$$

4.1.3.3. Path coefficient of characteristics towards the extent of use of improved farm equipments - machinery, implements and tools

In order to know the direct and indirect effects of the independent variables on the dependent variable, path analysis was carried out and the results are shown in Table 15.

Data in Table 15 reveals that in total out of the 24 variables, farm power asset had accounted more direct effect than other variables. The variable material possession contributed the maximum indirect effects in the use of improved farm equipments - machinery, implements and tools.

For better understanding, substantial indirect effects were computed. Out of the 72 substantial indirect effects 21 effects passed through farm power asset ( $X_{14}$ ), 18 passed through farm size ( $X_6$ ), 13 passed through attributes of availability ( $X_{23}$ ), 7 passed through material possession ( $X_{15}$ ), 4 passed through family size ( $X_5$ ), 2 passed through cropping intensity ( $X_9$ ) and each one passed through land fragmentation index ( $X_8$ ) and educational status ( $X_2$ ).

The farm size, cropping intensity, land fragmentation index and educational status were the other variables which acted in an important manner to explain the use.

Table 15. Path co-efficient of profile towards the extent use of respondents

Variable No.	HIID (n=80)			LIID (n=80)						
	Direct effect	Indirect effect	Substantial indirect effect	Direct effect	Indirect effect	Substantial indirect effect				
	I	II	III	I	II	III				
Age	0.1708	0.1249	0.0882(X <sub>1</sub> )	0.0818(X <sub>1</sub> )	0.0741(X <sub>1</sub> )	-0.0692	0.2244	0.0919(X <sub>1</sub> )	0.0726(X <sub>1</sub> )	-0.0584(X <sub>1</sub> )
Educational status	-0.0100	0.2891	0.0832(X <sub>2</sub> )	0.0811(X <sub>2</sub> )	0.0729(X <sub>2</sub> )	0.0001	0.3592	0.0760(X <sub>2</sub> )	0.6460(X <sub>2</sub> )	0.0356(X <sub>2</sub> )
Occupational status	-0.1804	0.0864	0.0419(X <sub>3</sub> )	0.0407(X <sub>3</sub> )	0.0327(X <sub>3</sub> )	-0.0429	-0.0253	-0.0443(X <sub>3</sub> )	0.0366(X <sub>3</sub> )	-0.0291(X <sub>3</sub> )
Family type	-0.0427	0.3361	0.2120(X <sub>4</sub> )	0.0899(X <sub>4</sub> )	0.0440(X <sub>4</sub> )	-0.0549	0.2138	0.0541(X <sub>4</sub> )	0.9403(X <sub>4</sub> )	-0.0549(X <sub>4</sub> )
Family size	-0.0562	0.2842	0.1982(X <sub>5</sub> )	0.0781(X <sub>5</sub> )	0.0747(X <sub>5</sub> )	-0.1179	0.0005	-0.0422(X <sub>5</sub> )	-0.0343(X <sub>5</sub> )	0.0329(X <sub>5</sub> )
Farming experience	-0.1171	0.4218	0.1722(X <sub>6</sub> )	0.1287(X <sub>6</sub> )	0.0912(X <sub>6</sub> )	0.1018	0.1583	0.0979(X <sub>6</sub> )	0.0588(X <sub>6</sub> )	-0.0493(X <sub>6</sub> )
Farm size	0.2368	0.3406	0.3279(X <sub>7</sub> )	0.0729(X <sub>7</sub> )	0.0672(X <sub>7</sub> )	0.1124	0.2027	0.0796(X <sub>7</sub> )	0.0613(X <sub>7</sub> )	-0.0449(X <sub>7</sub> )
Land fragmentation index	-0.0656	-0.2090	0.1531(X <sub>8</sub> )	0.0899(X <sub>8</sub> )	0.0284(X <sub>8</sub> )	-0.1446	-0.0545	-0.0598(X <sub>8</sub> )	0.0554(X <sub>8</sub> )	-0.0330(X <sub>8</sub> )
Cropping intensity	0.2734	-0.0252	0.0365(X <sub>9</sub> )	0.0254(X <sub>9</sub> )	0.0241(X <sub>9</sub> )	0.0841	0.0476	0.0824(X <sub>9</sub> )	-0.0415(X <sub>9</sub> )	-0.0367(X <sub>9</sub> )
Irrigation intensity	-0.0461	0.3232	0.1430(X <sub>10</sub> )	0.0468(X <sub>10</sub> )	0.0354(X <sub>10</sub> )	0.0203	0.2280	0.0708(X <sub>10</sub> )	0.0621(X <sub>10</sub> )	0.0502(X <sub>10</sub> )
Labour availability	-0.1294	0.0220	0.0359(X <sub>11</sub> )	0.0281(X <sub>11</sub> )	0.0270(X <sub>11</sub> )	-0.2200	-0.0248	-0.0393(X <sub>11</sub> )	0.3774(X <sub>11</sub> )	-0.0268(X <sub>11</sub> )
Training undergone	0.1292	0.1809	0.0488(X <sub>12</sub> )	0.0424(X <sub>12</sub> )	0.0376(X <sub>12</sub> )	-0.0810	0.1036	0.0386(X <sub>12</sub> )	0.0263(X <sub>12</sub> )	0.0239(X <sub>12</sub> )
Hiring agency	0.1261	-0.2778	0.0685(X <sub>13</sub> )	0.2616(X <sub>13</sub> )	0.0255(X <sub>13</sub> )	-0.0899	0.0017	-0.0923(X <sub>13</sub> )	0.0498(X <sub>13</sub> )	-0.0334(X <sub>13</sub> )
Farm power asset	0.4943	0.1858	0.1571(X <sub>14</sub> )	0.0776(X <sub>14</sub> )	0.0685(X <sub>14</sub> )	0.2714	0.3602	0.0964(X <sub>14</sub> )	0.0840(X <sub>14</sub> )	0.0504(X <sub>14</sub> )
Material possession	-0.0599	0.7533	0.3651(X <sub>15</sub> )	0.1653(X <sub>15</sub> )	0.0813(X <sub>15</sub> )	0.1615	0.5025	0.0925(X <sub>15</sub> )	0.0684(X <sub>15</sub> )	0.0554(X <sub>15</sub> )
Extension agency contact	0.0321	0.4925	0.2631(X <sub>16</sub> )	0.1410(X <sub>16</sub> )	0.0786(X <sub>16</sub> )	0.1778	0.3258	0.0877(X <sub>16</sub> )	0.0840(X <sub>16</sub> )	-0.0467(X <sub>16</sub> )
Social participation	0.0717	0.2704	0.1649(X <sub>17</sub> )	0.0965(X <sub>17</sub> )	0.0726(X <sub>17</sub> )	0.0542	0.2905	0.04925(X <sub>17</sub> )	0.0373(X <sub>17</sub> )	0.0349(X <sub>17</sub> )
Level of exposure to media	-0.0716	0.3446	0.0954(X <sub>18</sub> )	0.0945(X <sub>18</sub> )	0.0636(X <sub>18</sub> )	0.0764	0.3589	0.0983(X <sub>18</sub> )	0.0859(X <sub>18</sub> )	0.0849(X <sub>18</sub> )
Attributes of machinery-Cost	0.0213	-0.0762	0.0399(X <sub>19</sub> )	0.0398(X <sub>19</sub> )	0.0288(X <sub>19</sub> )	-0.0267	0.3059	0.0537(X <sub>19</sub> )	0.0545(X <sub>19</sub> )	0.0433(X <sub>19</sub> )
Efficiency	0.0216	0.0905	0.0760(X <sub>20</sub> )	0.0546(X <sub>20</sub> )	0.0462(X <sub>20</sub> )	0.0301	0.2202	0.0476(X <sub>20</sub> )	0.0449(X <sub>20</sub> )	0.0359(X <sub>20</sub> )
Trialability	0.2321	0.2369	0.1524(X <sub>21</sub> )	0.0896(X <sub>21</sub> )	0.0717(X <sub>21</sub> )	-0.1197	0.4115	0.0916(X <sub>21</sub> )	0.0654(X <sub>21</sub> )	0.0583(X <sub>21</sub> )
Feasibility	0.0374	0.3415	0.1697(X <sub>22</sub> )	0.1116(X <sub>22</sub> )	0.0859(X <sub>22</sub> )	0.0550	0.3382	0.0803(X <sub>22</sub> )	0.0749(X <sub>22</sub> )	0.0575(X <sub>22</sub> )
Availability	0.2003	0.3996	0.1917(X <sub>23</sub> )	0.0993(X <sub>23</sub> )	0.0862(X <sub>23</sub> )	0.0897	0.3814	0.0875(X <sub>23</sub> )	0.0786(X <sub>23</sub> )	0.0644(X <sub>23</sub> )
Profitability	-0.1254	0.4749	0.2273(X <sub>24</sub> )	0.1022(X <sub>24</sub> )	0.0979(X <sub>24</sub> )	0.0771	0.4265	0.0882(X <sub>24</sub> )	0.0765(X <sub>24</sub> )	0.0653(X <sub>24</sub> )

Table 15 (Contd.)

		Total (n=160)		
Direct effect	Indirect effect	Substantial indirect effect		
		I	II	III
0.0724	0.2080	0.0879( $X_{14}$ )	0.0462( $X_7$ )	0.0349( $X_7$ )
0.0599	0.2545	0.0557( $X_{14}$ )	0.0489( $X_5$ )	0.0350( $X_7$ )
0.0890	0.0183	0.0236( $X_{14}$ )	0.0133( $X_{14}$ )	0.0122( $X_{15}$ )
0.0020	0.2092	0.1250( $X_{14}$ )	0.0433( $X_7$ )	0.0334( $X_{10}$ )
-0.0991	0.1593	0.0768( $X_{14}$ )	0.0433( $X_7$ )	0.0202( $X_{15}$ )
0.0384	0.2512	0.1330( $X_{14}$ )	0.0521( $X_7$ )	0.0436( $X_{15}$ )
0.1674	0.2633	0.1568( $X_{14}$ )	0.0562( $X_{15}$ )	0.0556( $X_5$ )
-0.0840	-0.0727	0.0603( $X_7$ )	0.0282( $X_9$ )	0.0279( $X_7$ )
0.1092	0.0987	0.0860( $X_7$ )	0.0500( $X_{14}$ )	0.0345( $X_{14}$ )
0.1690	0.1918	0.0727( $X_{10}$ )	0.0556( $X_9$ )	0.0452( $X_7$ )
-0.0560	-0.0597	0.0199( $X_{14}$ )	0.0188( $X_{23}$ )	0.0184( $X_{23}$ )
0.0426	0.1418	0.0297( $X_8$ )	0.0263( $X_{23}$ )	0.0231( $X_{10}$ )
0.0509	-0.1854	0.1673( $X_{14}$ )	0.0271( $X_{14}$ )	0.0185( $X_{15}$ )
0.3642	0.2928	0.0723( $X_{14}$ )	0.0721( $X_{23}$ )	0.0653( $X_7$ )
0.0967	0.5838	0.2458( $X_{14}$ )	0.0972( $X_7$ )	0.0636( $X_{15}$ )
0.0466	0.43588	0.1914( $X_{14}$ )	0.0670( $X_{10}$ )	0.0609( $X_{23}$ )
0.0431	0.3009	0.1005( $X_{14}$ )	0.0734( $X_{23}$ )	0.0588( $X_7$ )
0.0033	0.3497	0.0856( $X_{14}$ )	0.0710( $X_{23}$ )	0.0558( $X_7$ )
0.0206	0.1263	0.0411( $X_{14}$ )	0.0326( $X_7$ )	0.0191( $X_{15}$ )
0.0305	0.1614	0.0622( $X_{14}$ )	0.0445( $X_{23}$ )	0.0370( $X_{10}$ )
0.0443	0.3284	0.0913( $X_{14}$ )	0.0899( $X_{23}$ )	0.0337( $X_{10}$ )
0.0269	0.3449	0.1263( $X_{14}$ )	0.1076( $X_{23}$ )	0.0452( $X_{15}$ )
0.2124	0.2183	0.1240( $X_{14}$ )	0.0438( $X_{14}$ )	0.0381( $X_7$ )
-0.0699	0.4330	0.1217( $X_{23}$ )	0.1202( $X_{14}$ )	0.0634( $X_{15}$ )

In the HIID, out of 24 independent variables, farm power asset and irrigation intensity had higher and positive direct effects than the other variables. Variables viz., material possession, attributes of profitability and feasibility accounted maximum indirect effects than other variables.

Out of 72 substantial indirect effects, 19 effects passed through farm power asset ( $X_{14}$ ), 18 passed through farm size ( $X_6$ ), 13 passed through attributes of availability ( $X_{23}$ ), 9 passed through attributes of trialability ( $X_{21}$ ), 4 passed through age ( $X_1$ ), 3 passed through cropping intensity ( $X_9$ ), 2 passed through occupational status ( $X_3$ ) and each one passed through extension agency contact ( $X_{16}$ ), irrigation intensity ( $X_{10}$ ), farming experience ( $X_7$ ) and attributes of profitability ( $X_{24}$ ).

In the LIID, farm power asset had maximum influence upon the use of farm equipments - machinery, implements and tools and positive direct effect. In the case of indirect effects material possession had a higher and positive influence to the extent of use.

Out of the 72 substantial indirect effects 17 passed through material possession ( $X_{15}$ ), 15 passed through farm power asset ( $X_{14}$ ), 12 passed through irrigation intensity, 8 passed through extension agency contact ( $X_{16}$ ), 6 passed

through labour availability ( $X_{11}$ ), each 4 passed through farm size ( $X_6$ ) and land fragmentation index ( $X_8$ ), 3 passed through family size ( $X_5$ ) and each one passed through farming experience ( $X_7$ ), educational status ( $X_2$ ) and cropping intensity ( $X_9$ ).

Hence it might be concluded that farm power asset, material possession, farm size, attributes of availability acted as crucial variables in explaining the variation in the use of improved farm equipments - machinery, implements and tools.

#### **4.2. Indigenous/traditional farm implements and tools used by HIID and LIID respondents**

The traditional tools and techniques should be studied systematically and an organised effort be made for improving their efficiency and productivity.

In this study, 62 indigenous/traditional farm implements and tools were identified under 17 different farming operations in HIID and LIID. These are documented and presented in Table 16.

##### **I. Preparation of land**

It could be seen from the Table 16 that for land preparation three indigenous implements/tools were identified

Table 16. Indigenous/traditional farm implements and tools used by the respondents

Sl. No.	Name of the implement/tool (Farming operation)	HIID (n=80)		LIID (n=80)		Total (n=160)		't' value (Omega test)
		No.	%	No.	%	No.	%	
<b>I. Preparation of land</b>								
1.	Nattu kalappai (country plough)	36	45.00	39	48.75	75	46.87	-0.3801 NS
2.	Bose kalappai	40	50.00	-	-	40	25.00	9.9335 **
3.	Mammati	72	90.00	61	76.25	133	83.12	2.4131 *
<b>II. Levelling</b>								
4.	Perambu palagai	31	38.75	34	42.50	65	40.62	-0.5160 NS
5.	Gundy	39	48.75	-	-	39	23.37	9.6803 **
<b>III. Bund forming</b>								
6.	Salkalappai	28	35.00	9	11.25	37	23.12	3.7306 **
7.	Moyakotthi	47	58.75	-	-	47	29.37	10.9504 **
<b>IV. Puddling</b>								
8.	Urralai	42	52.50	17	20.12	59	36.31	-3.8165 **
<b>V. Sowing</b>								
9.	Sorru plough	39	48.75	-	-	39	24.37	9.680 **
10.	Kilangu Narukki	-	-	46	57.50	46	28.75	-9.0444 **
11.	Vethai potti	29	36.25	68	85.00	97	60.25	-6.6885 **
12.	Vethai koodai	17	21.25	71	88.75	88	55.00	-9.3727 **
13.	Kadapparai (crow bar)	52	65.00	63	78.75	115	71.87	-1.8306 NS
<b>VI. Irrigation</b>								
14.	Nattu yettam	-	-	4	5.00	4	2.50	-2.8505 **
<b>VII. Desilting</b>								
15.	Singapore yettam	2	2.50	2	2.50	4	2.50	-
<b>VIII. Weeding and intercultural</b>								
16.	Palu	21	26.25	-	-	21	13.12	6.7663 **
17.	Kalaikotthi (Hand hoe)	49	61.25	64	80.00	113	70.62	-2.6671 **
18.	Kattavetti	-	-	33	41.25	33	20.62	-8.7885 **
19.	Konthalam	-	-	39	48.75	39	24.37	-9.680 **
20.	Pickaxe	-	-	46	57.50	46	28.75	-10.8225 **
21.	Yeni	28	35.00	43	53.75	71	44.37	-2.3067 *

Table 16 (Contd.)

Sl. No.	Name of the implement/tool (Farming operation)	HIID (n=80)		LIID (n=80)		Total (n=160)		't' value (Omega test)
		No.	%	No.	%	No.	%	
<b>IX. Fertilizer application</b>								
22.	Valli	27	33.75	-	-	27	16.87	7.7394 **
23.	Marunthu koodai	52	65.00	-	-	52	32.50	11.8609 **
24.	Thattu koodai	61	76.25	76	95.00	137	85.86	-3.6224 **
25.	Irumbu chatti	19	23.75	47	58.75	66	41.25	-4.6240 **
<b>X. Pest control</b>								
26.	Kuttu kole	-	-	38	47.50	38	23.75	-9.9542 **
27.	Lanthar	7	8.75	9	11.25	16	10.00	-0.6493 NS
28.	Mann chatti	3	3.75	34	42.50	37	23.12	-6.7180 **
<b>XI. Rat control</b>								
29.	Kitti	11	13.75	21	26.25	32	20.00	-2.1019 *
30.	Rat box	14	17.50	29	36.25	43	26.87	-2.7637 **
<b>XII. Beating birds</b>								
31.	Kavanu	-	-	17	21.25	17	10.62	-6.0230 **
32.	Drum	14	17.50	24	30.00	38	23.75	-1.9552 NS
<b>XIII. Harvesting</b>								
33.	Aruval (Sickles)	72	90.00	69	86.25	141	88.12	0.7763 NS
34.	Koduval	66	82.50	74	92.50	140	87.50	-1.9149 NS
35.	Kambaru katthi	-	-	51	63.75	51	31.87	-11.5980 **
36.	Pudi katthi	-	-	46	57.50	46	28.75	-10.8225 **
37.	Thorattu katthi	29	36.25	33	41.25	62	38.75	-0.6493 NS
38.	Kai kodari	28	35.00	9	11.25	37	23.12	3.7306 **
<b>XIV. Threshing</b>								
39.	Uri kadaparai	-	-	34	42.50	34	21.25	-8.9165 **
40.	Kunthani	31	38.75	12	15.00	43	26.87	3.3612 **
41.	Irumbu uralai	8	10.00	34	42.50	42	26.25	-4.8549 **
42.	Wooden sticks	-	-	46	57.50	46	28.75	-10.8225 **
<b>XIV. Transport</b>								
43.	Mattu vandi (Bullock cart)	42	52.50	36	45.00	78	48.75	0.8863 NS
44.	Kothani	23	28.75	28	35.00	51	31.87	-0.9534 NS
45.	Sallai chadu	32	40.00	67	83.75	99	61.87	-5.6316 **

Table 16 (Contd.)

Sl. No.	Name of the implement/tool (Farming operation)	HIID (n=80)		LIID (n=80)		Total (n=160)		't' value (Omega test)
		No.	%	No.	%	No.	%	
<b>XVI. Storage</b>								
46.	Kudhir	12	15.00	8	10.00	20	12.50	+0.9776 NS
47.	Thazhi	-	-	32	40.00	32	20.00	-8.6598 **
48.	Earthen pot - Oil	41	51.25	57	71.25	101	63.12	-2.6144 **
49.	Earthen pot - Seed	33	41.25	48	60.00	81	50.62	-2.4185 *
50.	Gunny bags (Chakku)	78	97.50	76	95.00	154	96.25	0.6520 NS
<b>XVII. Increase the value of product</b>								
51.	Ariyakallu	7	8.75	39	48.75	46	28.75	-6.0543 **
52.	Aruvalmanai	-	-	31	38.75	31	19.37	-8.4004 **
53.	Thattam	-	-	56	70.00	56	35.00	-12.5362 **
54.	Olakkai	31	38.75	48	60.00	79	49.37	-2.8067 **
55.	Drum	41	51.25	23	28.75	64	40.00	3.0070 **
56.	Koppari	-	-	11	13.75	11	6.87	-4.6644 **
57.	Salladai-paddy	67	83.75	-	-	67	41.87	14.4915 **
58.	Salladai-Groundnut	24	30.00	56	70.00	80	50.00	-5.2055 **
59.	Muram	73	91.25	75	93.75	148	92.50	-0.4677 NS
60.	Marakkal	57	71.25	-	-	57	35.62	12.6740 **
61.	Vallam	-	-	59	36.87	59	36.87	-8.1372 **
62.	Kellai kozhil	-	-	37	23.12	37	23.12	-6.3262 **

\*\* Significant at 1% level

\* Significant at 5% level

NS - Non-significant

viz., Nattu kalappai, Bose kalappai and Mammati, of which Mammati was used by most of the respondents (83.12%) followed by Nattu kalappai (46.87%) and finally Bose kalappai used by one-fourth (25.00%) of the respondents.

Nearly equal number (45.00% and 48.75%) of the respondents had used Nattu kalappai both in HIID and LIID. Whereas Bose kalappai was used by half (50.00%) of the respondents in HIID alone but none of the respondents used it in LIID. This is due to the reason that it is used for puddling purpose only. Majority (90.00%) of the HIID respondents used Mammati for land preparation whereas three-fourth (76.25%) of them used it in LIID.

## II. Levelling

It could be seen from the Table 16 that two indigenous tools were identified by the farmers for levelling operation namely, Perambu palagai and Gunndy. Exactly two-fifth respondents (40.62%) had used Perambu palagai followed by little more than one-fourth (23.37%) of them used it for levelling the main field.

Nearly equal percentage (38.75 and 42.50) of the farmers used Perambu palagai both in HIID and LIID. In HIID it was used for levelling the main field of paddy; whereas in the LIID it was used to level the pulverised soils. Nearly

half (48.75%) of HIID respondents used the Gundry as a levelling tool for paddy cultivation, whereas it cannot be used in LIID. It might be due to the cultural difference between the two farming situations.

### III. Bund forming

It could be inferred from the Table 16 that, for the bund formation Salkalappai (23.12%) which is a traditional implement and Moyakotthi (29.37%) which is a traditional tool were used in the study area.

About one-third of HIID farmers used Salkalappai for sugarcane bund formation, whereas a meagre proportion (11.25%) of the LIID farmers used for cotton, chillies and sugarcane field bund formation.

More than half of the respondents (58.75%) used Moyakotthi as a traditional tool used for bund formation in wetlands.

### IV. Puddling

It could be seen from the Table 16 that more than one-third (36.31%) of respondents used Urralai as a traditional implement for puddling operation. About half (52.50%) of the respondents used Urralai in the HIID and exactly one-fifth (20.12%) in the LIID. Since the LIID, some of them have a

good water flow in the wells so they can also used urrelai for puddling operation in paddy crops.

#### V. Sowing

Among the different farm operations, sowing is an important one. For sowing operation Kadapparai (71.87%), Vethai potti (60.25%), Vethai koodai (55.00%), Kilangu narukki (28.75%) and Gorru plough (24.37%) were the traditional tools and implements used in the study area.

Nearly half (48.75%) of the HIID respondents used Gorru kalappai as a traditional implement for sowing paddy grain behind the plough (direct planting) on premonsoon season.

More than half (57.50%) of the LIID respondents used Kilangu narukki whereas no one used in the HIID. Since it is especially used for cutting the tapioca sets at appropriate lengths for cultivation of tapioca in the LIID.

About one-third (36.25%) of the HIID farmers and majority (85.00%) of the LIID respondents used the bamboo made tool Vethai potti, whereas little more than one-fifth (21.25%) of HIID respondents used the Vethai koodai. The usage of these tools were higher in LIID because they used it as a sowing tool for sorghum, cumbu, gingelly, groundnut and tapioca sets. Whereas in the HIID it is used only for paddy seed sowing. Nearly two-third (65.00%) of the HIID

respondents and 78.75 per cent of LIID respondents used Kadapparai as an indigenous tool for sowing the vegetable in kitchen garden. It is also used for transplanting of sorghum, cumbu, ragi seedlings.

#### VI. Irrigation

It could be seen from the Table 16 that Nattu yettam was used by a meagre proportion (2.50%) of the respondents in LIID to lift the water from wells, whereas it was not used in HIID study respondents.

#### VII. Desilting

It could be seen from the Table 16 that a meagre equal percentage (2.50 and 2.50) of the respondents used Singapore yettam as a desilting implement in both the farming situations.

#### VIII. Weeding and intercultural operations

It could be observed from the Table 16 that for weeding and intercultural operations six indigenous tools were identified viz., Palu, Kalikotthi, Kattavetti, Yeni, Konthalam, and Pickaxe. Of which Kalaikotthi was used by most of the respondents (70.62%) followed by Yeni (44.37%), Pickaxe (28.75%), Konthalam (24.37%), Kottavetti (20.92%) and Palu (13.12%) respectively.

Kalaikotthi was the most used tool by the HIID (61.25%) and LIID (80.00%) farmers whereas Yeni was used by more than one-third (35.00%) of respondents of HIID and about half (53.75%) of the LIID farmers.

Palu was the implement used by the HIID (26.25%) respondents whereas Pickaxe (57.50%), Konthalam (48.75%) and Kothukozhal (47.50%) were the tools used in LIID. These were mostly used for weeding and earthing up operations for tapioca, cotton and chilli.

#### IX. Fertiliser application

Four indigenous tools used by the respondents in the study area were identified viz., Valli, Maruntha koodai, Thatta koodai and Irummbu chatti.

Thattu koodai was used by majority (85.50%) of respondents followed by Irummbu chatti (41.25%), Marunthu koodai (32.50%) and Vally (16.87%). Among this Vally (33.75%) and Marunthu koodai (65.00%) were used only in HIID and not in the LIID. It might be due to the reason that they were unaware of location-specific tools.

Majority of the HIID respondents (76.25%) and LIID respondents (95.00%) used Thattu koodai. This was followed by Irummbu chatti was used by more than half of the respondents (58.75%) in HIID and nearly one-fourth (23.75%) of respondents

in LIID. Since the tools viz., Vally, Irummbu chatti and Marunthu Koddai were made up of iron, they were costly.

#### X. Pest control

It could be seen from the Table 16 that for pest control operation three traditional tools viz., Kuttu kole (23.75%), Mannchatti (23.12%) and Lanthar (10.00%) were identified. Among them Lanthar and Mannchatti were used by both the respondents of the HIID and LIID but Kuttukole was used by LIID respondents only.

Mannchatti was used by slightly more than two-fifth (42.50%) of LIID farmers and 3.75 per cent of HIID farmers used to control the coconut rhinoceros beetle. Whereas about one-tenth (11.25%) of LIID farmers and 8.75 per cent of HIID farmers used lanthar to collect and kill the adult moths for the different field crops.

Kottu kole was used by nearly half of (47.50%) the LIID farmers. It is used for pulling out the beetle from coconut crown and control the rodents in the field.

#### XI. Rat control

It could be observed from the Table 16 that two tools were identified for rat control viz., rat box and kitti. Rat box was used by more than one-fourth (26.87%) followed by exactly one-fifth (20.00%) of the respondents used Kitti. It

was used by both the respondents of the HIID and LIID. Rat box was used by 26.87 per cent followed by 20.00 per cent for Kitti.

Rat box was used by more than one-third (36.25%) of the respondents in the LIID whereas a little less than one-fifth (17.50%) of farmers used in the HIID. Similarly, one-fourth (26.25%) of respondents had used Kitti in LIID followed by 13.75 per cent in HIID farmers.

## **XII. Beating birds**

It could be inferred from the Table 16 that for bird scaring two indigenous tools were identified viz., Kavanu and empty drum. Empty drum was used by nearly one-fourth (23.75%) of the respondents whereas Kavanu was used by a meagre percentage (10.62%) of respondents. The drum was used in both areas i.e., HIID (17.50%) and LIID (30.00%). Empty drum was used by most of the LIID respondents because sorghum, cumbu, groundnut, chilli are major crops grown in LIID which are highly affected by birds.

Kavanu is an indigenous tool used by slightly more than one-fifth (21.25%) of the LIID respondents. It is attached with leather rope used for throwing the small stones to control the birds damaging the field crops. It is not practised in HIID. This might be due to the cultural difference between the two farming situations.

### XIII. Harvesting

Final operation in the field is harvesting the produce. Six harvesting tools have been identified from the study and presented in Table 16. They are Aruval, Kodduval, Kambara katthi, Pudi katthi, Thorattu katthi and Kai kodari.

Among these, Aruval was used by major respondents (88.12%) followed by Koduval (87.50%), Thorattu katthi (38.75%), Kambara katthi (31.87%), Pudi katthi (28.75%) and Kai kodari (23.12%).

Aruval was predominant tool used in both the situations of HIID (90.00%) and LIID (86.25%) respondents respectively. This is mainly used for harvesting the produce of paddy, sorghum, ragi, cumbu and gingelly. Koduval is another tool used in HIID (92.50%) and LIID (82.50%) for harvesting the sugarcane crops and for cutting the trees for green manure purpose.

Three types of Katthi, viz., Thorattu katthi, Pudi Katthi and Kambara katthi were used in the study area. Among these Thorattu katthi was used both in HIID (36.35%) and LIID (41.25%) farmers. The main purpose of it was harvesting the coconut, tamarind and similar fruits from trees. But Kambara katthi (63.75%) and Pudi katthi (57.50%) were predominately used in the LIID alone. It is mainly used for harvesting the earheads of cereal crops.

Kai kodari is a tool used in both the areas, about one-third (35.00%) of the respondents in HIID and two-fifth (41.25%) of farmers in LIID respectively. It is mainly used for harvesting the sugarcane and cutting the trees for wood and fuel purposes.

#### XIV. Threshing

It could be inferred from the Table 16 that there are four indigenous tools identified namely, Urikadaparai, Kunthani, Irummbu urralai and Wooden sticks.

Kunthani was used by little less than two-fifth (38.75%) of the respondents in HIID and 15.00 per cent of respondents in LIID. It is mainly used for threshing the paddy grains. Irummbu urralai was used by about two-fourth (42.50%) of LIID farmers and only 10.00 per cent by the HIID farmers. About half (57.50%) of respondents in LIID used Wooden sticks. These two tools were mainly used for threshing the sorghum earheads (Irummbu urralai) and beating the harvested gingelly (Wooden sticks).

Urikadaparai was predominantly used by LIID respondents (42.50%) which was mainly used for removing the outer skin of the coconut, but in HIID, instead of Urikadaparai, Spade was used for removing the coconuts out skin.

## XV. Transport

For carrying the produce three indigenous implements were identified. They are Mattu vandi, Kothani and Sallai chadu. Among these, about three-fifth (61.68%) of respondents used Sallai chadu followed by nearly half (48.75%) of respondents used Mattu vandi and nearly one-third (31.87%) of them used Kothani.

Sallai chadu was used in both the farming situations. About four-fifth (83.75%) of respondents in LIID and exactly two-fifth (40.00%) in HIID. In the LIID, respondents mainly used the Sallai chadu for transporting the produce.

Slightly more than half (52.50%) of the respondents in the HIID and 45.00 per cent of the respondents in the LIID used Mattu vandi as a transporting implement. The remaining respondents used trucks, lorry, bus, cycle and van for transporting the produce.

About one-third (35.00%) of the LIID farmers and little more than one-fourth (28.75%) of HIID farmers used Kothani which could be attached with a Mattu vandi which is used for transporting organic manures, clay soil to field and harvested produce to the threshing floor drying yard or storing place.

## XVI. Storage

It could be revealed from the Table 16 that for storing operations five tools were used viz., Khudir, Thazhi, Earthern pot - oil, Earthern pot seed and Chakku. Among these Chakku (gunny bags) was used by most (96.25%) of the farmers followed by little less than two-third (63.12%) of respondents used Earthern pot for oil storing and half (50.62%) of the respondents used Earthern pot for seed storing. Exactly one-fifth (20.00%) respondents used Thazhi for food grain storage and 12.50 per cent of respondents used Khudir for storing the cereal grains.

Two-fifth (40.00%) of the LIID respondents used Thazhi and no one used in the HIID because of the differences in the cultural practices. But Chakku was used by almost all group of the respondents in both the farming situations. There was a slight difference which was noticed in the usage of Earthern pots and Khudir by the HIID and LIID farmers.

## XVII. Increase the value of product

It could be seen from the Table, for this operation, 12 traditional/indigenous implements and tools were identified. Among these muram a traditional tool was used by majority (92.50%) of the respondents followed by groundnut salladai (50.00%), Olakkai (49.37%), salladai for paddy (41.87%), two-fifth (40.00%) used drum for parboiling paddy, one-third

(36.87%) used vallam as a weighing material, equal percentage (35.62 and 35.00) of the respondents used marakkal for measuring the grain and thattam as a sundrying tool for grain. About one-fourth (28.75%) of respondents used ariyakallu as a tool for removing husks from pulses, little more than one-fifth (23.12%) of respondents used kellai kole for spreading threshed paddy straw, nearly one-fifth (19.37%) of respondents used Aruval manai for cutting of persistent calix in chilli fruits and a meagre proportion (6.87%) of respondents used Kopparai for parboiling the turmeric rhizomes.

Among these ariya kallu, olakkai, drum, salladai for groundnut, muram were used in both areas but aruval mannai, thattam, kopparai, vallam, kellai kole were used in LIID alone. Similarly marakkal, salladai-paddy were used only in the HIID.

The level use of indigenous/traditional farm implements and tools on various farm operation was found out and the significance of difference between the two farming situations was calculated. The results are furnished in Table 16. The omega values showed that the HIID respondents and LIID respondents could be discriminated based on use of indigenous/traditional farm implements and tools.

Among the 17 farming operations identified, there were 62 indigenous/traditional farm implements and tools were used in both the farming situations. Out of these, 49 farm implements and tools were significant, which inferred in their use of indigenous/traditional implements and tools were differed to the HIID and LIID. Out of 49 farm implements and tools, 14 were positively significant and rest 35 were negatively significant. All the farm implements and tools were significant at 1 per cent level except the Mammati, Yeni and Earthern pot for seed were significant at 5 per cent level.

The Table 16 further shows that 13 farm implements and tools were non-significant in HIID and LIID, which includes Nattu kalappai, Perambu palagai, Kadaparai, Lanthar, Drum (beating), Aruval, Koduval, Thorattu katthi, Mattu vandi, Kothani, Kudhir, Chakku (gunny bags) and Muram.

This might be due to both the farming situation respondents used nearly equal number of indigenous farm implements and tools.

Table 17. Description of indigenous/traditional farm implements and tools

Sl. No. Name of the farm implement/tool	Description	Farming situation
I. Preparation of land		
1. Nattu kalappai (country plough)	Nattu kalappai is a bullock drawn implement used for breaking the hard pan, breaking the clods, ploughing the land to recover the soil tilth since it is manually operated it can cover nearly one acre per day	HIID and LIID
2. Bose plough	Bose plough is made up of iron and drawn by a pair of bullock. It is used for puddling wetlands and can cover an area of 0.50 - 0.75 acre/day	HIID
3. Mammati	Mammati is a multipurpose tool made of iron spade attached with a wooden handle	HIID and LIID
II. Levelling		
4. Perambu palagai	Perambu palagai is made up of a wooden board attached with iron chain. It is also drawn by a pair of bullocks which is used for levelling the unlevelled fields	HIID and LIID
5. Gunndy	Gunndy is made of a wooden board. It is attached behind the Gorrukallappai to cover the paddy seeds with soil in the premonsoon season	HIID
III. Bund forming		
6. Sal kalappai	Sal kalappai is made of iron blade attached with yoke and drawn by bulls. It is mainly used for formation of bunds for field crops	HIID and LIID

Table 17 (Contd.)

Sl. No. Name of the farm implement/tool	Description	Farming situation
7. Moyakothi	Moyakothi is a crow bar like tool with broad plate like base. It is used in wetlands for the formation of bunds between the field or within the fields	HIID
IV. Puddling		
8. Urralai	Urralai is a traditional tool made of iron blades in the shape of a barrel. It is used for puddling the soil and also for drampling the green manure	HIID and LIID
V. Sowing		
9. Gorru plough	Gorru plough is an indigenous implement made of iron attached with yoke and a seed drum. It is used for sowing the paddy seeds in pre monsoon season	HIID
10. Kilangu narukki	Kilangu narukki is a traditional tool made of wooden platform attached with sharp edged blade. It is used for cutting the tapioca sets for sowing operation	LIIDs
11. Vethai potti	The seeds of paddy, sorghum, cumbu are sown by Vethai potti, it is made up of bamboo and palmyrah leaves. The capacity of a vethai potti is 2 to 4 kgs	HIID and LIID
12. Vethai koodai	Vethai koodai is an indigenous tool used for seed sowing which is bigger in size. It is made up of bamboo and palmyrah leaves. The capacity of a Vethai koodai is 6 to 8 kgs	HIID and LIID

Table 17 (Contd.)

Sl. No.	Name of the farm implement/tool	Description	Farming situation
13.	Kadapparai	Kadapparai is a long stick like tool made up of iron. It is used to drill holes in the soil to plant ragi and sorghum seedlings	HIID and LIID
VI. Irrigation			
14.	Nattu yattam	Nattu yattam is a traditional implement made up of wooden pillar attached with urralai, rope and pari (karalai) which is drawn by a pair of bullocks. Mainly for lifting the water from wells and deep water sources	LIID
VII. Desilting			
15.	Singapore yettam	Singapore yettam is a modern type of yettam made of wooden pillars tied with an iron rope attached to an urralai, drawn by a pair of bullocks. It is mainly used to desilt the water sources, mainly wells	HIID and LIID
VIII. Weeding and intercultural			
16.	Palu	Palu is a wooden block with holes along the length inserted with iron rods. It is drawn with the help of a pair of bullock. It is used in the groundnut fields to stir up the soil and to have weeding.	HIID
17.	Kalai kotthi (Hand hoe)	Kalai kotthi is a multipurpose tool used for cutting the weeds in field crops. It is used for earthing up for cotton, sugarcane, chilly etc.	HIID and
18.	Kattavetti	Kattavetti is a traditional tool, made up of sharp iron blade attached with a wooden hand. It is mainly used for weeding and earthing up for sugarcane and tapioca	LIID

Table 17 (Contd.)

Sl. No. Name of the farm implement/tool	Description	Farming situation
19. Konthalam	Konthalam is a traditional tool used for digging the pits and to remove the weeds of field crops	LIID
20. Pickaxe	Pickaxe is another tool used for weeding and earthing up operation for tapioca	LIID
21. Yeni	Yeni is made up of bamboo poles mainly used as a support material to climb over trees	HIID and LIID
<b>IX. Fertilizer application</b>		
22. Valli	Valli is an iron bucket used for broadcasting manures and fertilizers	HIID
23. Marunthu koodai	Marunthu koodai is an iron drum with a handle. Its purpose is for broadcasting inorganic fertilizers	HIID
24. Thatta koodai	It is an indigenous tool made of palmyrah leaf. It is used to bring down the harvested materials from field to the threshing floor and also used for spreading fertilizer and organic manures	HIID and LIID
25. Erummbu chatti	It is a multipurpose tool used for various purposes in agriculture	HIID and LIID
<b>X. Pest control</b>		
26. Kuttu kole	Kuttu kole is made up of a long wooden bamboo pole attached with a sharpened iron hook at the end. It is mainly used for hooking the rhinoceros beetle and to kill the rodents in fields	LIID

Table 17 (Contd.)

Sl. No.	Name of the farm implement/tool	Description	Farming situation
27.	Lanthal	Lanthal is a traditional light. It is used to attract the adult moths attacking the field crops	HIID and LIID
28.	Man chatti	Man chatti is a small size earthen pot filled with 3 parts of water and 1 part of castor cake. This is to attract the rhinoceros beetle and other beetles in coconut and other field crops	HIID and LIID
XI. Rat control			
29.	Kitti	Kitti is made up of neem sticks which is used to control rats and rodents in the fields	HIID and LIID
30.	Rat box	A rat box is made up of wood attached with the spring and there is a provision to attach a bait in it. It is used to control the white rats in field	HIID and LIID
XII. Beating birds			
31.	Kavanu	Kavanu is made up of a thick thread with leather rope which is used for throwing stones on groundnut. It is used in sorghum fields to scare the birds	LIID
32.	Drum	Beating empty iron drum to ward off birds in cholam, groundnut and cumbu	HIID and LIID
XIII. Harvesting			
33.	Aruval (Sickles)	Matured produce of the crops like paddy, sorghum, cumbu, gingelly are harvested by sickles	HIID and LIID
34.	Koduval	Koduval is used for harvesting sugarcane and coconuts	HIID and LIID

Table 17 (Contd.)

Sl. No.	Name of the farm implement/tool	Description	Farming situation
35.	Kambara	Kambara is used for harvesting the earheads of sorghum, cumbu and ragi	LIID
36.	Pudi	Pudi is another tool used for harvesting the earheads of sorghum, cumbu and ragi	LIID
37.	Thorattu	Thorattu is made of a long stick attached with a sharp kathi. It is used for harvesting coconuts, tamarind etc.	HIID and LIID
38.	Kai kodari	Kai kodari is used for harvesting sugarcane crop in irrigated areas and is also used for cutting trees for firewood in dryland areas	HIID and LIID
XIV. Threshing			
39.	Uri kadapari	Uri kadapari is used to remove the outer skin of coconuts	LIID
40.	Kunthani	Kunthani is used as a platform to thrash harvested paddy	HIID and LIID
41.	Erummbu urralai	Harvested crops after spreading them on the threshing yard, the bullocks are tied with erummbu urralai and allowed to trample	HIID and LIID
42.	Wooden sticks	The farmers hold the wooden sticks with their hands and beat the harvested crop to separate the grains from the earheads	HIID and LIID
XV. Transport			
43.	Mattu vandi (Bullock cart)	Mattu vandi is the most traditional transport vehicle drawn by a pair of bull. It is mainly used to carry the things used for agricultural purpose	HIID and LIID

Table 17 (Contd.)

Sl. No.	Name of the farm implement/tool	Description	Farming situation
44.	Kothani	Kothani is an indigenous tool, made of bamboo and palmyrah leaf. It is used for transporting the bulk organic manures and soil to the field. It is attached with a mattu vandi	HIID and LIID
45.	Sallai chadu	Sallai chadu is a traditional tool made up of bamboo and palmyrah leaf and fitted with iron sticks. It is mainly used for transporting the harvested earheads, nuts, grains etc. It has a capacity to load 25 to 40 kg in a trip	HIID and LIID
<b>XVI. Storage</b>			
46.	Kudhir	Kudhir is an indigenous barrel like tool made up of cowdung and clay. It's height is 3 m and a breadth of 1 meter. It's main purpose is storing the paddy grain and supplemently protects the grain from storage pest and rodents	HIID and LIID
47.	Thazhi	Thazhi is a tool made with a mixture of cement and stone. It is used for storing the food grains along with neem leaves	LIID
48.	Earthern pot (oil)	An earthern pot is made up of clay soil. It is especially used for storing coconut, castor and gingelly oils for years	irrigated and LIID
49.	Earthern pot (seed)	Earthern pot is also made up of clay soil. It is used for storing grains, pulses and also used for transporting the grains from one place to another place	HIID and LIID

Table 17 (Contd.)

Sl. No.	Name of the farm implement/tool	Description	Farming situation
50.	Chakku (Gunny bags)	Gunny bags are known as chakku pai in Tamil. It is used for storing grains, pulses and also used for transporting the grains from one place to another place	HIID and
XVII. Increase the value of product			
51.	Ariya kallu	Ariya kallu is a traditional tool made up of two equal stones, round in shape. The upper stone will have a handle and hole in the centre. It is used to remove the husk from grains and pulses	HIID and LIID
52.	Aruvalmanni	Aruvalmanni is a multipurpose traditional tool. It is used to cut the calyx from the fruits of chillies	LIID
53.	Thattam	Thattam is made up of bamboo and palmyrah leaves. It is mainly used for sundrying the grains and pulses	LIID
54.	Olakkai	Olakkai is a traditional tool made up of a long modern block which is attached with an iron poones on either ends. It is mainly used to remove the husk from grains	HIID and LIID
55.	Drum	Drum is made up of iron. It is square in shape, mainly used to parboil the paddy	HIID and LIID
56.	Koppari	Koppari is also made of iron. It is barrel shaped and used for boiling turmeric rhizomes	LIID

Table 17 (Contd.)

Sl. No.	Name of the farm implement/tool	Description	Farming situation
57.	Paddy jalladai	Paddy jalladai is used to remove dust, immature seeds, stones etc., from the threshed grains. Jalladai is made up of steel	HIID and dryland
58.	Groundnut jalladai	It is used to remove the immature and broken seeds from the produce	HIID and LIID
59.	Muram	It is a wooden plate like structure used for winnowing	HIID and LIID
60.	Marakkal	Marakkal is made up of steel. It is used for weighing the paddy grains	HIID
61.	Vallam	It is made up of steel. It is used for weighing grains, pulses etc.	LIID
62.	Killai kole	It is an indigenous tool made up of bamboo poles. The base of the pole will be bended, so that it can spread the paddy straw while drying	LIID

#### 4.3. Awareness and use of improved farm equipments - machinery, implements and tools

Even though traditional/indigenous farm implements and tools were used by farmers and some of the farmers might have switched to modern technologies. Greater scarcity of labour and animal power at present it is urgent that a necessitate step has to be taken out to solve the problems. Hence, the awareness and use of improved farm equipments - machinery, implements and tools were studied and presented in Table 17 and 18. In this study, improved means those which having modification over the existing farm equipments - machinery, implements and tools to have greater field efficiency with in a shorter period and which requires less manpower.

In this study 38 improved farm equipments - machinery, implements and tools were studied, under the 13 different farming operations in both the farming situations (HIID and LIID). This part is presented under the following heads.

- 4.3.1. Overall awareness about improved farm equipments -  
machinery, implements and tools.
- 4.3.2. Overall use of improved farm equipments - machinery,  
implements and tools.
- 4.3.3. Awareness about improved farm equipments - machinery,  
implements and tools in different farm size categories  
under HIID and LIID.

4.3.4. Use of improved farm equipments - machinery, implements and tools in different farm size categories under HIID and LIID.

4.3.1. Overall awareness about improved farm equipments - machinery, implements and tools

The awareness level of respondents on the improved farm equipments - machinery, implements and tools were collected and the respondents were classified into low, medium and high as given in Table 18.

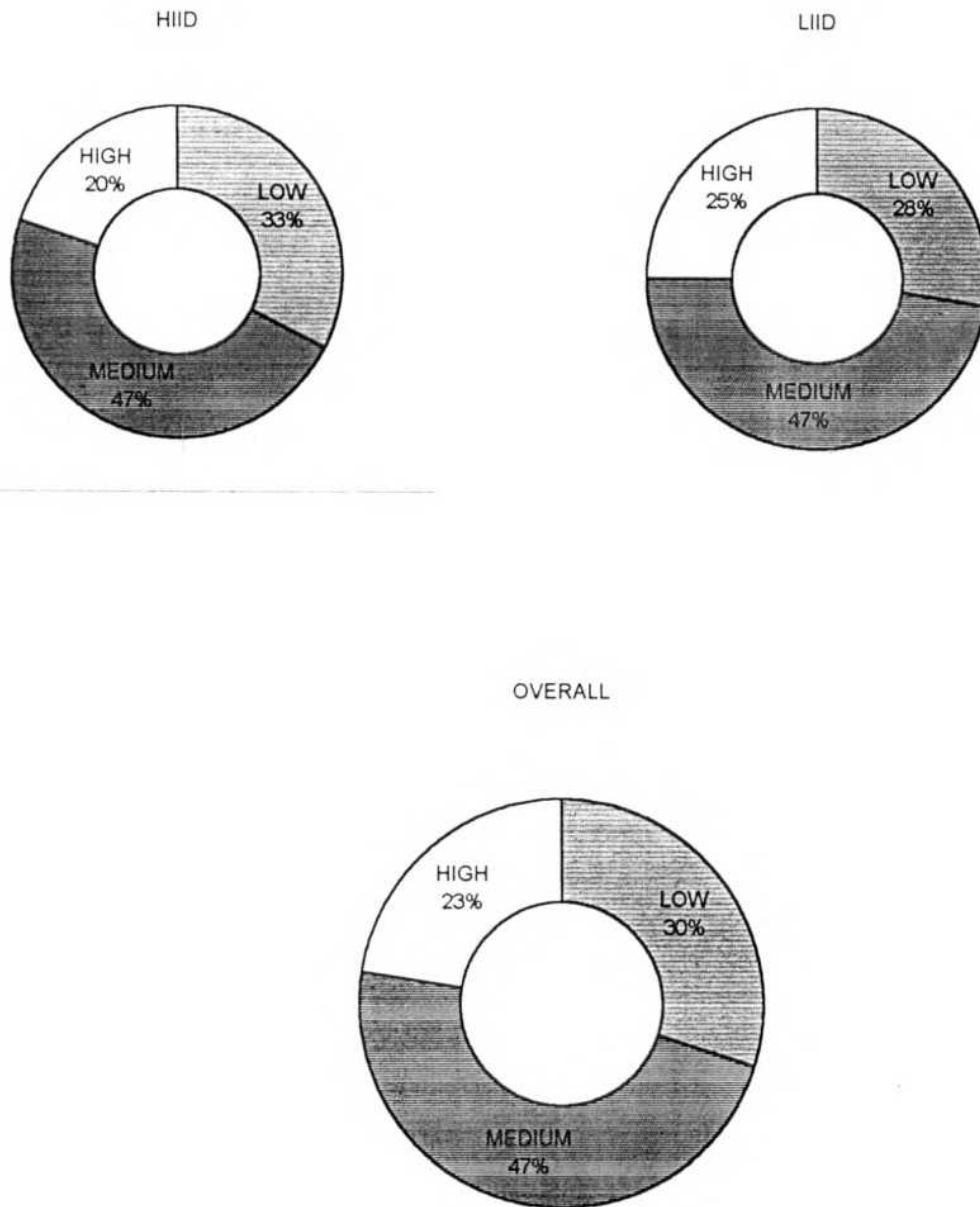
Table 18. Distribution of respondents based on their level of awareness

Sl.No.	Category	HIID (n=80)		LIID (n=80)		Total (n=160)	
		No.	%	No.	%	No.	%
1.	Low	26	32.50	22	27.50	48	30.00
2.	Medium	38	47.50	38	47.50	76	47.50
3.	High	116	20.00	20	25.00	36	22.50
	Total	80	100.00	80	100.00	160	100.00

The table clearly indicates that nearly half (47.50%) of the respondents had medium level of awareness followed by low (30.00%) and high (22.50%) levels in overall farming situation.

In both the HIID and LIID, an equal percentage of respondents had medium level of awareness (47.50). This was

**FIG.4.DISTRIBUTION OF RESPONDENTS BASED ON THEIR LEVEL OF AWARENESS**



followed by low (32.50%), high (20.00%) in HIID and low (27.50%), high (25.00%) in LIID.

It could be inferred that majority (77.50%) of the respondents had low to medium level of awareness. The probable reason for this might be due to that they had a medium level utilisation of hiring agency, contact with extension agency and exposure to media.

#### 4.3.2. Overall use of improved farm equipments - machinery, implements and tools

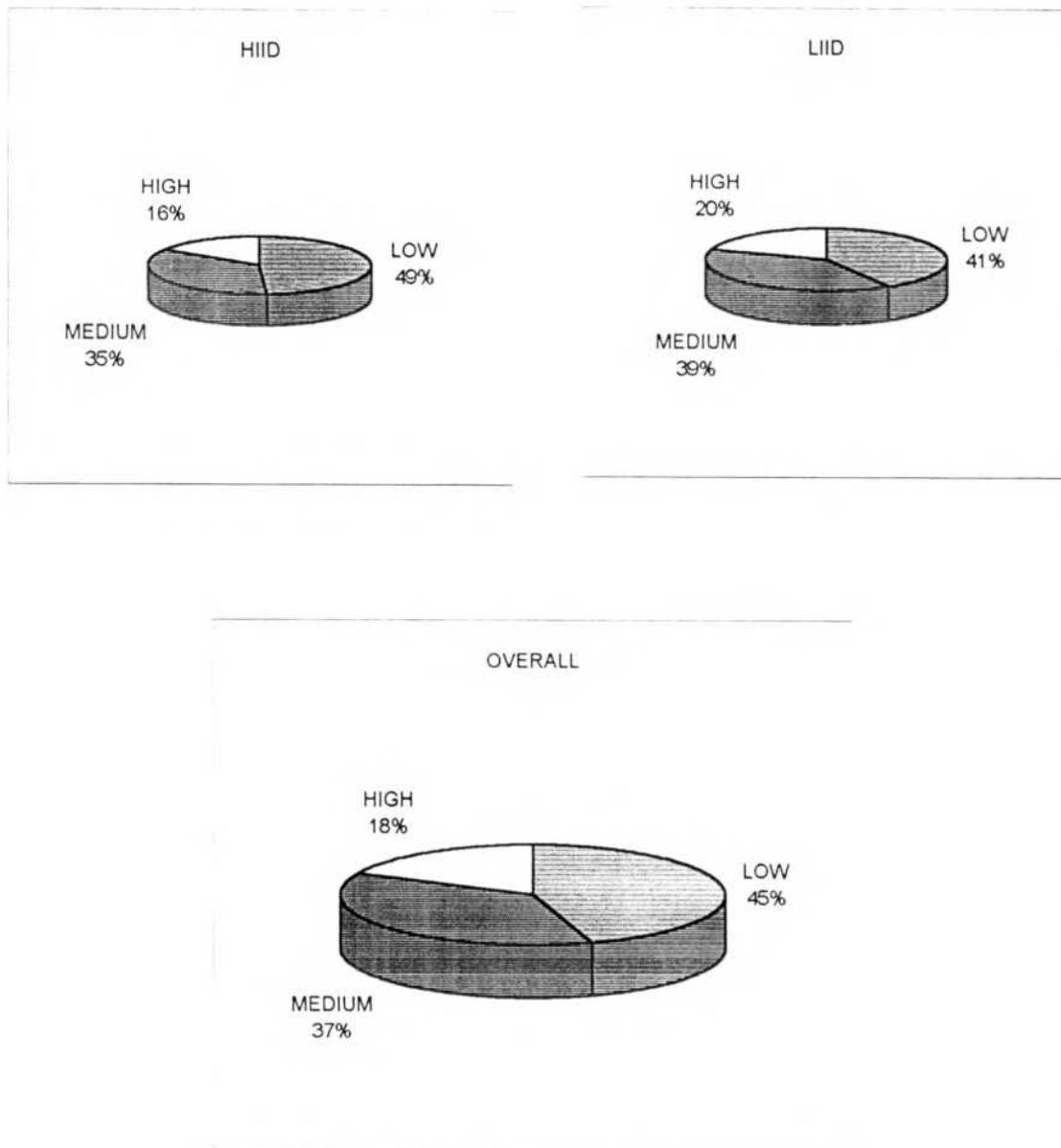
Data were collected on how many respondents were using the selected farm equipments - machinery, implements and tools, they were analysed and the results are presented in Table 19.

Table 19. Distribution of respondents based on their use of improved farm equipments - machinery, implements and tools

Sl.No.	Category	HIID (n=80)		LIID (n=80)		Total (n=160)	
		No.	%	No.	%	No.	%
1.	Low	39	48.75	33	41.25	72	45.00
2.	Medium	28	35.00	31	38.75	59	36.88
3.	High	13	16.25	16	20.00	29	18.12
	Total	80	100.00	80	100.00	160	100.00

The Table 19 revealed that more than two-fifth (45.00%) of respondents belonged to low level use of improved farm

FIG.5.DISTRIBUTION OF RESPONDENTS BASED ON THEIR USE



equipments - machinery, implements and tools followed by medium (36.88%) and low (18.12%) levels in overall farming situation.

In the HIID, nearly half (48.75%) of the respondents were low level use of improved farm equipments - machinery, implements and tools followed by medium (35.00%) and high (16.25%). Likewise, in the LIID about two-fifth (41.25%) of the respondents were low followed by medium (38.75%) and high level (20.00%). It could be concluded that the majority (81.88%) of the respondents belonged low to medium level of using improved farm equipments - machinery, implements and tools. Probably the reason might be due to the lack of awareness and higher initial cost for purchase of farm machinery. The results are in line with the results of Venkattakumar (1997).

#### 4.3.3. Awareness about improved farm equipments - machinery, implements and tools in different farm size categories under HIID and LIID

To study the awareness level of improved farm equipments - machinery, implements and tools which were used by different categories of farmers for various agricultural operations were taken for analysis. The findings are discussed under each major operation viz., preparation of land, levelling, bund forming, puddling, sowing and

Table 20. Distribution of respondents based on their awareness level of improved farm equipments - machinery, implements and tools in different farm size categories under HIID and LIID

No. Improved farm equipments - machinery, implements and tools (farming operation viz.)	Awareness level																			
	HIID				LIID				Total											
	Marginial (n=18)	Small (n=22)	Medium (n=29)	Big (n=11)	Total (n=80)	Marginial (n=11)	Small (n=23)	Medium (n=24)	Big (n=22)	Total (n=80)	%	No.								
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%						
<b>I. Preparation of Land</b>																				
Tractor drawn																				
1. Improved iron plough	2	11.11	2	9.09	9	31.03	6	54.54	19	23.75	1	9.09	7	30.43	3	12.50	7	31.81	18	22.50
2. Mould board plough	-	-	2	9.09	1	3.44	-	-	3	3.75	-	-	4	17.39	2	8.33	2	9.09	8	10.00
3. Cultivator	18	100.00	22	100.00	29	100.00	11	100.00	80	100.00	11	100.00	23	100.00	24	100.00	22	100.00	80	100.00
4. Chisel plough	1	5.55	3	13.63	-	-	1	9.09	5	6.25	1	9.09	-	-	2	8.33	1	4.54	4	5.00
5. Disc plough	3	16.66	9	40.90	16	55.17	4	36.36	32	40.00	3	27.27	7	30.43	9	37.50	16	72.27	35	43.75
<b>ii. Levelling</b>																				
6. Leveller (tractor drawn)	14	77.77	16	72.72	22	75.86	7	63.63	59	73.75	1	9.09	3	13.04	7	29.10	8	36.36	19	23.75
<b>iii. Bund forming</b>																				
7. Bund former	2	11.11	6	27.27	6	20.68	4	36.36	18	22.50	1	9.09	4	17.39	4	16.66	6	27.27	15	18.75
8. Ridger	3	16.66	5	22.27	7	24.13	2	18.18	19	23.75	1	9.09	1	4.34	2	8.33	3	13.63	7	8.75
<b>IV. Puddling</b>																				
9. Puddler	15	83.33	8	36.36	24	82.75	10	90.90	67	83.75	3	27.27	6	26.08	10	41.66	13	59.09	32	40.00
10. Cage wheel	15	83.33	17	77.27	23	79.31	10	90.90	65	81.25	1	9.09	8	34.78	12	50.00	13	59.09	34	42.50
11. Power tiller	8	44.44	15	68.18	18	62.06	8	72.72	49	61.25	-	-	3	13.04	-	-	7	31.81	10	12.50

Table 20 (Contd.)

Sl. No.	Improved farm equipments - machinery, implements and tools (farming operation viz.)	Awareness level											
		HIED						LIID					
		Marginal (n=18)	Small (n=22)	Medium (n=29)	Big (n=11)	Total (n=80)	Marginal (n=11)	Small (n=23)	Medium (n=24)	Big (n=22)	Total (n=80)		
		No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %
<b>V. Sowing and transplanting</b>													
12.	Seed drill	4 22.22	5 22.72	6 20.68	3 27.27	18 22.50	- -	- -	2 8.33	2 9.09	4 5.00	- -	- -
13.	Seed planter	2 11.11	3 13.63	4 13.79	3 27.27	12 15.00	- -	- -	1 4.16	4 18.18	5 6.25	- -	- -
14.	Broadcasting machine	1 5.55	1 4.54	2 6.89	1 9.09	5 6.25	- -	- -	- -	- -	- -	- -	- -
<b>VI. Irrigation</b>													
15.	Electric motor pump	18 100.00	22 100.00	29 100.00	11 100.00	80 100.00	11 100.00	23 100.00	24 100.00	22 100.00	80 100.00	100.00	100.00
16.	Drip and sprinkler	1 5.55	2 9.09	6 20.68	10 90.90	19 23.75	1 9.09	2 8.69	3 12.50	5 22.72	11 13.75	- -	- -
<b>VII. Weeding</b>													
17.	Long handled weeder	1 5.55	1 4.54	4 13.79	1 9.09	7 8.75	1 9.09	1 4.34	- -	2 9.09	4 5.00	- -	- -
18.	Power operated weeder	- -	- -	1 3.44	1 9.09	2 2.50	- -	- -	1 4.16	- -	1 1.25	- -	- -
<b>VIII. Spraying, dusting and traps</b>													
19.	Power sprayer	15 83.33	16 72.72	26 89.65	9 81.18	66 82.50	9 81.18	10 43.47	21 87.50	14 63.63	54 67.50	- -	- -
20.	Knapsack sprayer	8 44.44	10 45.45	20 68.96	10 90.90	48 60.00	5 45.45	10 43.47	11 45.83	15 68.18	41 51.25	- -	- -
21.	Tree sprayer	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
22.	Buster	3 16.66	2 9.09	2 6.89	2 18.18	9 11.25	- -	- -	- -	6 27.27	6 7.50	- -	- -
23.	Pheromone traps	1 5.55	3 13.63	2 6.89	2 18.18	8 10.00	- -	- -	- -	2 9.09	2 2.50	- -	- -
<b>IX. Harvesting</b>													
24.	TNBU paddy harvester	2 11.11	7 31.81	6 20.68	5 45.45	20 25.00	- -	- -	1 4.16	3 13.63	4 5.00	- -	- -
25.	Combine harvester	2 11.11	6 27.27	12 41.37	8 72.72	28 35.00	1 9.09	1 4.34	5 20.83	1 4.54	8 10.00	- -	- -

Table 20 (Contd.)

Sl. No.	Improved farm equipments - machinery, implements and tools (farming operation viz.)	Awareness level																					
		HIII						LIII															
		Marginal (n=18)	Small (n=22)	Medium (n=29)	Big (n=11)	Total (n=80)	Marginal (n=11)	Small (n=23)	Medium (n=24)	Big (n=22)	Total (n=80)												
		No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %										
26.	Fruit plucking device	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
27.	Digger	2	11.11	1	4.54	3	10.34	5	45.45	11	13.75	-	-	1	9.09	1	4.34	-	-	1	4.54	3	3.75
	<b>X. Threshing</b>																						
28.	Power thresher	6	33.33	12	54.54	16	55.17	10	90.90	44	55.00	2	18.18	10	43.47	9	37.50	15	68.18	36	45.00		
29.	Winnower	4	22.22	7	31.81	12	41.37	2	18.18	25	31.25	-	-	5	21.73	2	8.33	11	50.00	18	22.50		
30.	Decorticator	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	9.09	2	2.50	
31.	Stripper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
32.	Dehusker	10	55.55	10	45.45	12	41.37	8	72.72	50	62.50	4	36.36	15	65.27	16	66.66	22	100.00	58	72.50		
33.	Juice extractor	9	50.00	12	54.54	16	55.17	9	81.81	46	57.50	-	-	1	4.34	-	-	-	-	1	1.25		
	<b>XI. Transport</b>																						
34.	Tractor-Trailer	16	88.88	21	95.45	27	93.10	11	100.00	75	93.75	10	90.90	22	95.65	24	100.00	22	100.00	78	97.50		
	<b>XII. Storage</b>																						
35.	Storage bins	6	33.33	8	36.36	13	44.82	3	27.27	30	37.50	1	9.09	3	13.04	4	16.66	7	31.81	15	18.75		
	<b>XIII. Increase the value of product</b>																						
36.	Paddy par boiling unit	5	27.27	8	36.36	11	37.93	3	27.27	27	33.75	1	9.09	2	8.69	3	12.50	2	9.09	8	10.00		
37.	Bhal mill	2	11.55	1	4.54	4	13.78	3	27.27	10	12.50	1	9.09	3	13.04	3	12.50	3	13.63	10	12.50		
38.	Seed dryer	-	-	-	-	1	3.44	2	18.18	3	3.75	-	-	-	-	4	16.66	5	22.72	9	11.25		

transplanting, irrigation, weeding, spraying, dusting, trapping, harvesting, threshing, transport, storage and increase the value of product in the Table 20.

## I. Preparation of land

### 1. Tractor drawn improved iron plough

It could be observed from the table that under HIID. Majority (54.54%) of the big farmers were aware about the tractor drawn improved iron plough which was followed by medium category farmer (31.03%). In case of LIID farmers, 31.81 per cent of the farmers belonged to big category and 30.43 per cent of small category were aware about the improved iron plough respectively.

### 2. Mould board plough

As regard to mould board plough, very few percentage of small (9.09%) and medium (3.44%) category farmers of HIID were having awareness about this implement. Similarly, 31.81 per cent and 30.43 per cent of the LIID big and small farmers were aware about the mould board plough respectively.

### 3. Cultivator

In relation to awareness about the cultivator implement, cent per cent of all the categories of HIID farmers had awareness, similar case was reported by all the categories of LIID farmers.

#### 4. Chisel plough

Very few of the respondents of small (13.63%) and big (9.09%) farmers under HIID were aware about the chisel plough, similarly 9.09 and 8.33 per cent of the marginal and medium category LIID farmers were aware about the chisel plough respectively.

#### 5. Disc plough

With regard to disc plough, more than half (55.17%) of the medium category and 40.90 per cent of the small category HIID farmers were aware. In case of LIID farmers, big farmer (72.27%) and medium farmer (37.50%) were aware about the same.

### II. Levelling

#### 6. Leveller (Tractor drawn)

The leveller was used for levelling the ploughed field by both the HIID and LIID farmers. It can be noticed from the table that majority of the respondents from all the categories (63.63 to 77.77%) under HIID had awareness about the leveller, whereas in case of LIID farmers only big farmer (36.36%) and medium farmer (29.10%) had awareness about the same. Higher awareness in HIID might be due to its indispensable use in paddy cultivation.

### III. Bund farming

#### 7. Bund farmer

It could be seen from the table that 36.36 and 27.27 per cent of the farmers of big and small categories were aware about the bund former under HIID. Similarly big and small category farmers of LIID were aware about the same implement, the percentage being 27.27 and 17.39, respectively.

#### 8. Ridger

With regard to ridger, 27.13 per cent of the medium and 18.18 per cent of the big category farmers had awareness under HIID. Big and marginal category farmer who were aware about the ridger were 13.63 and 9.09 per cent respectively under LIID.

### IV. Puddling

#### 9. Puddler

With regard to puddler, most of the farmers (90.90%) of big category of farmers, followed by 82.75 per cent of medium category farmers were aware about puddler under HIID. Similarly more than (59.09%) of the big category farmers followed by 41.66 per cent of medium category farmers under LIID were aware about the implement.

#### 10. Cage wheel

In regard to cage wheel, 90.90 per cent of big category respondents and 83.33 per cent of the marginal category

farmers were aware about cage wheel in HIID. The similar trend was noticed in LIID also, the percentage of awareness among the big and medium category farmers were 59.09 and 50.00 respectively.

#### 11. Power tiller

About 72.72 per cent of big category farmers followed by 68.18 per cent of the small category farmers had awareness about the power tiller under HIID. Half (50%) of the respondents belonged to medium category and 34.48 per cent of the respondents belonged to small category farmers were aware about the power tiller and LIID.

It might be concluded that the farmers had a higher awareness level about the puddling equipment in HIID, because the farmer had paddy as a primary crop in which puddling is the most important operation.

#### V. Sowing and transplanting

##### 12. Seed drill

Only 27.27 per cent of the big category and 22.72 per cent of the small category of HIID farmers were aware about the seed drill. In the case of LIID farmers, only 9.09 per cent of the big category and 8.33 per cent of the medium category of farmers were aware about the seed drill.

### 13. Seed planter

Only a meagre proportion of big category farmers (27.21%) and medium category farmers (13.17%) belonged to HIID were aware about the seed planter. Similarly only 18.18 per cent of the big category and 4.16 per cent of the medium category farmers under LIID were aware about the seed planter.

### 14. Broadcasting machine

Very few farmers belonged to big category (9.09%) and medium category (6.89%) were aware about the broadcasting machine under HIID. In case of LIID only 18.18 per cent and 4.16 per cent big and medium category farmers were aware about the broadcasting machine respectively.

It could be concluded that low awareness of sowing equipment might be due to the less popularisation of the equipment in the study area.

## VI. Irrigation

### 15. Electric motor pump

Cent per cent of the respondents of all the categories under both the situations viz., HIID and LIID were aware about the electric motor pump.

### 16. Drip and sprinkler

Most of the farmers (90.90%) belonged to big category were aware about the drip and sprinkler followed by 20.68 per cent of medium category farmers under HIID were aware about

the same. In case of LIID, only 22.72 and 12.50 per cent of the farmers belonged to big and medium category were aware about the drip and sprinkler respectively.

## VII. Weeding

### 17. Long handled weeder

Very few of the farmers belonged to medium and big category were aware about the long handled weeder, the percentage being 9.09 per cent and 3.44 per cent respectively under HIID. Similarly, equal percentage of marginal and big category farmers belonged to HIID were aware about the long handled weeder (9.09%).

### 18. Power operated weeder

Only 9.09 and 3.44 per cent of the big and medium category farmers respectively were aware about the power operated weeder in case of HIID, whereas, in case of LIID, only 4.16 per cent of the medium category farmers were aware about the power operated weeder. Since the respondents in the study area mostly used hand hoe as weed removing tool, this might be the reason that unaware about weeding equipments.

## VIII. Spraying, dusting and traps

### 19. Power sprayer

Most of the farmers belonged to medium category (89.65%) and marginal category (83.33%) farmers under HIID were aware about the power sprayer. Similarly, most of the

farmers belonged to medium category (81.50%) and marginal category (87.18%) under LIID were aware about the power sprayer.

#### **20. Knapsack sprayer**

Majority (90.90%) of the respondents belonged to big category and 68.96 per cent of the medium category farmers were aware about the knapsack sprayer under HIID. Similarly 68.18 per cent of the big category and 75.83 per cent of the medium category farmers were aware about the knapsack sprayer under LIID.

#### **21. Tree sprayer**

None was reported to be aware about the tree sprayer under both HIID and LIID.

#### **22. Duster**

Very few respondents (18.18%) belonged to big category and 9.09 per cent belonged to small category were aware about the duster under HIID. Similarly 27.27 per cent of LIID, big category farmers reported to have awareness about duster.

#### **23. Pheromone trap**

About 18.18 and 13.63 per cent of the respondents belonged to big and small category farmers were aware about the pheromone trap under HIID respectively, whereas, only 9.09 per cent of the farmers belonged to big category farmers under LIID were aware.

## IX. Harvesting

### 24. TNAU paddy harvester

Under HIID more than forty five per cent of the farmers belonged to big category were aware about TNAU paddy harvester followed by 31.87 per cent of the medium category farmers having awareness about TNAU paddy harvester. In case of LIID only 13.63 and 4.16 per cent of the farmers belonged to big category and medium category were aware about TNAU paddy harvester respectively.

### 25. Combined harvester

Majority (72.72%) of the respondents belonged to big category farmers were aware about combined harvester followed by 41.37 per cent of the medium category farmers being awareness about combined harvester under HIID. In case of LIID, only 20.83 and 9.09 per cent belonged to medium and marginal category farmers were aware about the same.

### 26. Fruit plucking device

None was reported to have awareness about fruit plucking device under HIID whereas, 9.09 and 4.54 per cent of the respondents belonged to marginal and big category farmers were aware about fruit plucking device under LIID.

### 27. Digger

More than 45 per cent and 11.11 per cent of the respondents belonged to big and small category were aware

Whereas in LIID, almost equal percentage of the respondents were having high (43.75%) and medium (42.50%) labour availability. A few per cent (13.75%) of respondents had low labour availability in LIID.

The overall picture indicates that slightly more than half of the respondents (53.75%) had high labour availability followed by medium (34.38%) and low (11.87%) labour availability.

From the results of the chi-square it indicates that there existed significant difference in the labour availability of the HIID and LIID.

#### 4.1.1.12. Training undergone

The table indicates that in both the farming situations, most (76.25%) of the respondents had a low level of training undergone followed by high (12.50%) and medium (11.25%) levels of training undergone among the respondents.

The overall trend shows that, most (80.63%) of the respondents had low level of training undergone. About 11.25 and 8.12 per cent of them having high and medium levels of training undergone respectively.

It could be inferred that exactly four-fifth (80.63%) of the farmers had a low level of training undergone. It might

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be due to the non-availability of training centres and lack of motivation towards training aspects.

There was no difference in the training undergone by the respondents in the two farming situations as revealed from the results of chi-square.

#### 4.1.1.13. Hiring agency

It is understood from the Table 9 that a little more than two-fifth (43.75%) of respondents had medium level of hiring agency utilization followed by two-fifth (40.00%) of them had low level of hiring agency utilization in HIID. Only 16.25 per cent of them were having low level of hiring agency utilization in HIID. Similarly in LIID, a little more than half (53.75%) of the respondents had medium level of hiring agency utilization followed by 28.75 per cent had low and 17.50 per cent of farmers were utilising low and high level of hiring agency utilization.

The overall picture shows that less than half (48.75%) and about one-third (34.38%) of the respondents had medium and high level of hiring agency utilization.

The results of chi-square analysis revealed that no significant difference in the hiring agency utilisation behaviour among the two farming situations.

about digger under HIID respectively. Under LIID, 31.81 and 8.33 per cent of the respondents belonged to big and medium category were aware about the digger respectively.

## X. Threshing

### 28. Power thresher

Majority (90.90%) of the big category and 55.17 per cent of the medium category farmers were having awareness about power thresher under HIID. Similarly, 68.18 and 43.47 per cent of the big and small category LIID farmers were having awareness about power thresher.

### 29. Winnower

More than 41 per cent and 31.87 per cent of the medium and small category HIID farmers had awareness about winnower. Under LIID, 50 and 21.13 per cent of the big and small category farmers were having awareness about winnower.

### 30. Decorticator

None was reported to have had aware about decorticator except 9.09 per cent of big category LIID farmer.

### 31. Stripper

None was reported to have had aware about stripper in both the situations.

**32. Dehusker**

Most (72.72%) of the big category respondents and 55.55 per cent of the small category respondents under HIID were aware about the dehusker. Similarly cent per cent of the big category LIID respondents and 66.66 per cent of the medium category LIID respondents were having awareness about dehusker.

**33. Juice extractor**

Most (81.87%) of the big category and 55.17 per cent of medium category of HIID respondents were aware about juice extractor, whereas only 4.94 per cent of the small category LIID respondents reported to have aware about juice extractor.

**XI. Transport****34. Tractor-trailer**

Most (88.88 to 100%) of the respondents belonged to all categories of HIID were reported to have aware about transport trailer. Similarly in case of LIID also, majority (90.90 to 100%) of all the category of farmers were aware about the tractor-trailer due to the well popularisation and easily availability for hiring in study areas.

## XII. Storage

### 35. Storage bin

About 44.82 and 36.36 per cent of the respondents belonged to medium and small category under HIID were aware about storage bin respectively whereas, 31.81 and 16.66 per cent of the respondents belonged to big and medium category were aware about the same respectively.

## XIII. Increase the value of products

### 36. Paddy par boiling unit

Under HIID 37.93 and 36.36 per cent of the respondents belonged to medium and small category were aware about paddy par boiling unit respectively whereas only 13.63 and 12.50 per cent of the big and medium categories LIID farmers were aware about the same respectively.

### 37. Dhal mill

27.27 and 13.78 per cent of the big and medium category of HIID farmers were aware about dhal mill respectively. Similarly 13.63 and 12.60 per cent of big and medium category of LIID farmers were aware about the dhal mill respectively.

### 38. Seed dryer

Only 18.18 per cent of big category HIID farmers were aware about seed dryer followed by 3.44 per cent of the medium category of HIID farmers were aware about seed dryer. Similarly only 22.72 per cent of big category LIID farmers and

16.66 per cent of the medium category LIID farmers were reported to have aware about seed dryer.

#### 4.3.4. Use of improved farm equipments - machinery, implements and tools in different farm size categories under HIID and LIID

Use of each item was analysed and presented in Table 21.

### I. Preparation of land

#### 1. Tractor drawn improved iron plough

Table 21 reveals that only meagre per cent of medium farmers (13.79%) had used the improved iron plough. No marginal, small and big farmers had used the improved iron plough under HIID condition. Under LIID condition only meagre proportion of small (8.69%), big (4.54%) and medium (4.16%) farmers had used the improved iron plough for preparation of land marginal farmers were not used improved iron plough.

#### 2. Mould board plough

Table 21 shows that only very meagre proportion (3.44%) of medium farmers had used the mould board plough for preparation of land. Marginal, small and big farmers were not used the mould board plough for preparation of land under HIID condition. Under LIID condition, meagre proportion of small (8.69%), medium (4.16%) farmers had used mould board plough.

Table 21. Distribution of respondents based on their use of improved farm equipments - machinery, implements and tools in different farm size categories under HIID and LIID

Sl. No.	Improved farm equipments - machinery, implements and tools (farming operation viz.)	Use																			
		HIID					LIID														
		Marginal (n=18)	Small (n=22)	Medium (n=29)	Big (n=11)	Total (n=80)	Marginal (n=11)	Small (n=23)	Medium (n=24)	Big (n=22)	Total (n=80)										
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%				
<b>I. Preparation of land</b>																					
Tractor drawn																					
1.	Improved iron plough	-	-	4	13.79	-	-	4	5.00	-	-	2	8.69	1	4.16	1	4.54	4	5.00		
2.	Mould board plough	-	-	1	3.44	-	-	1	1.25	-	-	2	8.69	1	4.16	-	-	3	3.75		
3.	Cultivator	11	61.11	10	45.45	21	72.41	11	100.00	43	53.75	10	90.90	22	95.83	19	86.36	74	92.50		
4.	Chisel plough	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
5.	Disc plough	1	5.55	8	36.66	7	24.13	2	18.18	18	22.50	3	27.27	4	17.39	8	33.33	6	27.27	21	26.25
<b>II. Levelling</b>																					
6.	Leveller (tractor drawn)	6	33.33	5	27.27	7	24.13	2	18.18	20	25.00	1	9.09	2	8.69	6	25.00	8	36.36	17	21.25
<b>III. Band forming</b>																					
7.	Band former	-	-	-	-	-	-	2	18.18	2	2.50	-	-	1	4.34	1	4.16	2	9.09	4	5.00
8.	Ridger	-	-	-	-	1	3.44	2	18.18	3	3.75	-	-	-	-	1	4.16	1	4.54	2	2.50
<b>IV. Puddling</b>																					
9.	Puddler	8	44.44	9	40.90	17	58.62	8	72.72	42	52.50	3	27.97	3	13.04	4	16.66	7	31.81	17	21.25
10.	Cage wheel	7	38.88	9	40.90	14	48.27	10	90.90	40	50.00	1	9.09	3	13.04	4	16.66	8	36.36	16	20.00
11.	Power tiller	4	22.22	6	27.27	9	31.03	6	54.54	25	31.25	-	-	1	4.34	-	-	1	4.54	2	2.50



Table 21 (Contd.)

SI. No.	Improved farm equipments - machinery, implements and tools (farming operation viz.)	Use																			
		HUID						LIID													
		Marginal (n=18)	Small (n=22)	Medium (n=29)	Big (n=11)	Total (n=80)	Marginal (n=11)	Small (n=23)	Medium (n=24)	Big (n=22)	Total (n=80)										
No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%						
26.	Fruit plucking device	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
27.	Digger	-	-	-	-	3	27.27	3	3.75	-	-	-	-	-	-	-					
<b>X. Threshing</b>																					
28.	Power thresher	-	-	3	10.34	1	9.09	4	5.00	-	-	3	13.04	2	8.33	7	31.81	12	15.00		
29.	Winnower	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
30.	Decorticator	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	9.09	2	2.50		
31.	Stripper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
32.	Dehusker	-	-	1	4.54	2	6.89	8	72.72	11	13.75	-	-	2	8.69	3	12.50	4	18.18	9	11.25
33.	Juice extractor	2	11.11	2	9.09	6	20.68	6	54.54	18	22.50	-	-	-	-	-	-	-	-	-	-
<b>XI. Transport</b>																					
34.	Tractor-Trailer	3	16.66	9	40.90	14	48.27	7	63.63	33	41.25	2	18.18	9	39.13	12	50.00	22	100.00	45	56.25
<b>XII. Storage</b>																					
35.	Storage bins	-	-	-	-	3	10.34	-	3	3.75	-	-	-	-	-	-	-	-	-	-	-
<b>XIII. Increase the value of product</b>																					
36.	Paddy par boiling unit	2	11.11	7	31.81	4	13.79	3	27.27	16	20.00	-	-	1	4.34	1	4.16	1	4.54	3	3.75
37.	Dhal mill	-	-	1	4.54	1	3.44	-	-	2	2.50	-	-	2	8.69	1	4.16	3	13.63	6	7.50
38.	Seed dryer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

No marginal and big farmers used this implement for preparation of land.

### 3. Tractor drawn cultivator

It could be seen from table that cent per cent of big farmers had used tractor drawn cultivator followed by nearly three-fourth (72.41%) of medium farmers, nearly two-third (61.16%) of the marginal farmers, more than two-fifth (45.75%) of small farmers had used tractor drawn cultivator for preparation of land under HIID. Almost equal per cent of medium (95.83%) and small (95.65%) farmers had used tractor drawn cultivator followed by more than four-fifth of marginal farmers (90.90%) and big farmers (86.36%) had used tractor drawn cultivator for preparation of land under LIID condition.

### 4. Chisel plough

It could be observed from table that no farmer in all categories used chisel plough in both HIID and LIID condition. It may be due to that chisel plough is not necessary for ploughing in loose soil (HIID condition).

### 5. Disc plough

Table 21 indicate that more than one-third of small farmers (36.66%) had used disc plough followed by more than one-fifth (24.13%) of medium farmers and nearly one-fifth (18.18%) of big farmers had used this implement. Only meagre

proportion of marginal farmers (5.55%) had used disc plough for preparation of land under HIID condition. Under LIID condition one-third of medium farmers (33.33%) had used disc plough. Equal proportion of marginal and big farmers (27.27%) had used the disc plough. More than one-sixth (17.39%) of small farmers had used disc plough for preparation of land.

It can be concluded from the study that tractor drawn cultivator is used by majority of the farmers in different categories in both HIID and LIID condition followed by disc plough users in different categories is higher in both HIID and LIID condition.

## II. Leveller

For levelling, only leveller was studied by respondents. The result of the study is presented in Table 21.

### 6. Leveller

It can be observed from the table that one-third of marginal farmers (33.33%) followed by more than one-fourth (27.27%) of small farmers, nearly one-fourth (24.13%) of medium farmers and nearly one-fifth (18.18%) of big farmers had used the tractor drawn leveller for levelling the land under HIID condition. Under LIID condition more than one-third (36.36%) of big farmers had used leveller followed by one-fourth of medium farmers, meagre proportion of marginal

(9.09%) and small (8.69%) farmers had used the tractor drawn leveller for levelling the land.

It can be inferred from the study that the users were distributed in all categories of farmers under HIID condition. Under LIID condition more or less equal proportion of respondents distributed under big and medium category.

## II. Bund forming

For the bund formation bund former and ridger were the two implements studied. The findings of the study is presented in Table 21.

### 7. Bund former

It could be observed from the table that nearly one-fifth (18.18%) of big farmers had used bund former. No farmer in marginal, small and medium category had used bund former under HIID condition. Under LIID condition meagre proportion of big (9.09%), small (4.34%) and medium (4.16%) farmers had used bund former. Marginal farmers were not used bund former for formation of bund.

### 8. Ridger

In case of ridger, nearly one-fifth (18.18%) of big farmers had used ridger. Only meagre proportion (3.44%) of medium farmer used ridger. No farmers in marginal and small category had used ridger.

In general, it can be inferred that only less number of farmers were used bund former and ridges in both HIID and LIID condition. It may be due to the reason that majority of respondents having spade as a traditional tool for formation of bunds and ridges in the study area.

#### IV. Puddling

Puddler, cage wheel and power tillers were the three implements studied for puddling and the details of the result is presented in Table 21.

##### 9. Puddler

It can be noted that nearly three-fourth (72.72%) of big farmers had used puddler followed by more than half (58.62%) of the medium farmers, more than one-third (44.44%) of marginal and small (40.90%) farmers had used puddler under HIID condition. Under LIID condition nearly one-third (31.81%) of big farmers, more than one-fourth (27.27%) of marginal farmers and more or less equal proportion of medium (16.66%) and small (13.04%) had used puddler for puddling.

##### 10. Cage wheel

In case of cage wheel, it can be observed from the table that majority of big farmers (90.90%) had used cage wheel. Nearly half of the medium farmers (48.27%) had used cage wheel. More or less equal proportion of small (40.90%) and marginal (38.88%) had used cage wheel under HIID

condition. Under LIID condition, more than one-third of big farmers had used cage wheel followed by medium (16.66%), small (13.14%) and marginal (9.09%) farmers had used cage wheel.

#### 11. Power tiller

In case of power tiller, it can be noted that more than half of the big farmers (54.54%) had used power tiller. More than one-fourth of medium (31.03%) and small (27.27%) farmers had used power tiller. Nearly one-fourth (22.22%) of small farmers had used power tiller under HIID condition. Under LIID condition, only meagre proportion of big (4.54%) and small (4.34%) farmers had used power tiller. No farmer in marginal and medium category had used power tiller.

It can be concluded from the study that equipments for puddling is mostly used by different categories of farmers under HIID condition. It may be reasoned that puddling is required mostly for rice cultivation in wetland condition.

#### V. Sowing and transplanting

In sowing and transplanting operation, seed drill, seed planter and broadcast machines were studied both in HIID and LIID condition. The details of the study is presented in Table 21.

#### 12-14. Seed drill, seed planter and broadcasting machines

It could be observed from the table that in HIID condition, only seed planter was used among the three implements considered by 2.44 per cent of big farmer for sowing/transplanting. LIID farmers neither used seed drill nor seed planter nor broadcast machine for sowing/transplanting. It could be concluded from the results, majority of the respondents both in HIID and LIID situation. They used cultivator for sowing and used manpower for transplanting in the study area.

#### VI. Irrigation

Electric motor pump and drip and sprinklers were the two irrigation equipments considered for the study. The details of the finding are presented in the Table 21.

#### 15. Electric motor pump

It could be found from the table that cent per cent of big and medium farmers had used electric motor pump followed by more than one-fourth (77.27%) of small farmers and one-third of marginal farmers (33.33%) had used electric motor pump for irrigation under HIID condition. Under LIID condition, majority of big farmers (81.81%), medium farmers (70.83%) and small farmers (65.21%) had used electric motor pump more than one-third (36.36%) of marginal farmers had used electric motor pump for irrigation.

#### 16. Drip and sprinkler

Only meagre proportion (4.34%) of small farmers under LIID condition had used drip and sprinkler irrigation.

It could be pointed out that use of drip and sprinkler is still meagre by the farmers of both HIID and LIID and motor pump is the mostly used by farmers for lifting the water from wells.

#### VII. Weeding

##### 17 & 18. Long handled weed, power operated weeder

It could be seen from the table that cent per cent of the farmers reported to be not using the improved implements for weeding under both the situation. It is the reason that most of them unaware about the weeding implements as well as majority of them used indigenous tool 'hand hoe' as a weed controlling device.

#### VIII. Spraying, dusting and traps

For spraying, dusting and trapping, five improved implements were considered and studied which are mentioned in the Table 21.

##### 19. Power sprayer

It could be seen from the table that majority of big (81.81%), medium (79.31%), small (72.27%) and marginal (61.11%) farmers had used power sprayer under HIID condition.

Under LIID condition nearly one-fourth (72.72%) of marginal farmers had used power sprayer followed by two-third (66.66%) of medium farmers, more or less equal proportion of big (45.45%) and small (43.47%) had used power sprayer.

#### 20 & 21. Knapsack sprayer, tree sprayer

In case of knapsack sprayer, it is noted that more than half of the medium farmers had used knapsack sprayer. Equal proportion (36.36%) of small and big farmers had used knapsack sprayer followed by marginal farmers (38.88%) under HIID condition. Under LIID condition more than half of the big farmers had used knapsack sprayer more than one-third of medium (37.50%) and small (34.78%) had used knapsack sprayer. Only meagre proportion (9.89%) of small farmers had used knapsack sprayer for spraying. Nobody used this sprayer in both condition.

#### 22. Duster

In case of duster, it could be seen from the table that only meagre proportion of big (9.09%) and small (4.54%) farmers had used duster for dusting under HIID condition. Under LIID condition meagre proportion of big (4.54%) and medium (4.16%) had used duster for dusting.

### 23. Pheromone traps

In case of pheromone traps, it is noted that only meagre proportion of small farmers (4.54%) had used pheromone traps under HIID condition.

It could be inferred from the study that power sprayer is the mostly used sprayer followed by knapsack sprayer. Pheromone trap is used by negligible per cent of small farmers under HIID condition instead of eco-friendly control measures against pests. Training and extension activities are required to make tree sprayer and pheromone trap familiar with farmers.

### IX. Harvesting

TNAU paddy harvester, combine harvester, fruit plucking device and digger were the four machinery considered for the study as improved implements for harvesting. The findings of the study are discussed below.

#### 24-27. TNAU paddy harvester, combine harvester, fruit plucking device, digger

It could be seen from the table that digger was the only improved harvesting implement used by 27.27 per cent of the big farmer under HIID condition. Cent per cent was found to be not used the harvesting implements like TNAU paddy harvester and fruit plucking device by the respondents in both farming situation.

It could be inferred from the study that cent per cent of the respondents are not using any implements for harvesting except digger which is used by 3.75 per cent of farmers of HIID due to the reason that the lack of higher purchasing power and small fragmented holdings.

#### X. Threshing

Under threshing, the six implements namely power thresher, winnower, decorticator, stripper, dehusker and juice extractor were studied and results are discussed in Table 21.

##### 28. Power thresher

It could be inferred from the table that more or less equal proportion of medium (10.34%) and big (9.09%) farmers had used power thresher. Cent per cent of marginal and small farmers had not used power thresher under HIID condition. Under LIID condition, nearly one-third (31.81%) of big farmers had used followed by small (13.04%) and medium (8.33%). No marginal farmers used power thresher.

##### 29. Winnower

In case of winnower, no farmer had used in both the farming situations.

##### 30. Decorticator

In case of decorticator, only meagre proportion (9.09%) of big farmers had used decorticator under LIID situation.

### 31. Stripper

In case of stripper, cent per cent of farmers had not used in both HIID and LIID conditions.

### 32. Dehusker

In case of dehusker, it could be observed that nearly three-fourth (72.72%) of big farmers used followed by meagre proportion of medium (6.89%) and small (4.54%) had used dehusker. Cent per cent of marginal farmer were not used dehusker under HIID condition. Under LIID condition, nearly one-fifth (18.18%) of big farmers had used dehusker followed by medium (12.50%) and small (8.69%).

### 33. Juice extractor

In case of juice extractor, more than half of big farmers (54.54%) had used followed by medium (20.68%), marginal (11.11%) and small (9.09%) under HIID condition. Under LIID condition cent per cent of marginal, small, medium and big farmers had not used juice extractor.

It could be said that negligible number of farmers in both the conditions were using improved threshing implements. It may be due to lack of purchasing power, high man power availability and domination of indigenous/traditional tools and implements in study area.

## IX. Transport

Tractor-trailer was only the equipment studied under machinery for transport. The result of the findings are presented in the Table 21.

### 34. Tractor-trailer

It could be observed from table that majority of big farmers (63.63%) had used tractor-trailer followed by medium (48.27%) of small (40.90%) and marginal (16.66%) under HIID condition. Under LIID condition, cent per cent of big farmers had used tractor-trailer followed by medium (50.00%), small (39.13%) and marginal (18.18%) were used tractor-trailer for transport.

It could be inferred that, majority of big and medium farmers in both the situations used tractor-trailer for transport whereas, majority of marginal and small farmers in both the situations not depend on the improved tractor-trailer. They were using instead of tractor-trailer, traditional tools in the study area.

## XII. Storage

### 35. Storage bin

It could be stated from the table that only 10.34 per cent of medium farmers of HIID condition had used storage bin. Non-use was reported by cent per cent of the marginal, small

and big farmers in HIID condition and marginal, small medium and big farmers of LIID condition.

This study indicates lack of awareness about the utility of storage bins by majority of the respondents and almost all the respondents having gunny bags as a storage device.

### XIII. Increase the value of product

Under this operation, three equipments were considered and studied. The details of the study are presented in Table 21.

#### 36. Paddy par boiling unit

It could be stated from the table that nearly one-third (31.81%) of small farmers had used paddy par boiling unit followed by 27.27, 13.79 and 11.11 per cent of big, medium and marginal farmers respectively under HIID condition. Under LIID condition, more or less equal proportion of big (4.54%), small (4.34%) and medium (4.16%) had used paddy par boiling unit. Cent per cent of marginal farmers had not used the paddy par boiling unit.

#### 37. Dhal mill

In case of dhal mill, it is observed that only meagre proportion of small (4.54%) and medium (3.44%) farmers had used dhal mill. Cent per cent of marginal and big farmers

were not used under HIID condition. Under LIID condition, more than one-tenth (13.63%) of big farmers had used dhal mill followed by 8.59, 4.16 per cent of small and medium farmers respectively. Non-use was reported by cent per cent of marginal farmers.

### **38. Seed dryer**

In case of seed dryer, cent per cent of farmers reported that they had not used seed dryer under HIID and LIID. It could be inferred that probable reason for non-use of these machines, the respondent expressed that after harvesting the produce they immediately sent to the market/merchants, they have not stored for future purpose and increase the value of the product.

### **4.4. Impact of farm mechanisation on operational efficiency and farm productivity**

In this study impact of farm mechanisation referred to the actual change in the operational efficiency and farm productivity which may be a positive change (or) negative change due to the influence of mechanisation the farm over a period of time. Here the impact of farm mechanisation on operational efficiency and farm productivity were measured in the aspects of change in number of labourers used, changing average working time in hours, average cost involved for

Table 22. Distribution of respondents according to their impact of farm mechanisation on operational efficiency

Sl. No.	Crop	Average number of labour used				Average working time (in hours)				Average cost involved (in Rs.)				Quality of work						
		B	A	D	I	B	A	D	I	B	A	D	I	S	MS	I	A	S	MS	
1.	Paddy (n=40)	92.68	76.26	16.39	8.60	7.36	1.24	4110.33	3376.00	734.33	19	21	2	22	18	4				
2.	Ragi (n=5)	43.00	32.60	10.4	8.00	7.20	0.80	2710.00	2180.00	530.00	2	3	1	3	2	1				
3.	Sugarcane (n=38)	160.87	148.97	11.90	8.42	7.62	0.80	7203.84	5801.60	1396.24	18	20	2	18	20	2				
4.	Cotton (n=10)	141.50	129.20	12.30	8.40	7.70	0.70	6338.50	5750.00	608.50	4	6	2	6	4	2				
5.	Tapioca (n=20)	157.40	146.25	16.15	9.52	7.85	1.67	7185.00	5835.00	1350.00	7	10	3	10	7	3				
6.	Groundnut (n=26)	94.57	83.08	11.49	8.17	7.42	0.75	4480.76	3750.00	730.76	12	14	2	15	11	4				

Note: B - Before mechanization

A - After mechanization

D - Decrease of labour, time, cost and satisfaction of work

I - Increase of satisfaction

S - Satisfied

MS - Not satisfied

operational efficiency and average yield/ha for farm productivity. For any impact study there should be a specific time period to be considered as a base period to measure. So for this study the farmers who were continuously using implements, tools for three years were selected as the respondents and mechanisation index also used for analysis purpose.

#### **4.4.1. Impact of farm mechanisation on operational efficiency**

Operational efficiency is the efficiency obtained for doing different agricultural operations as a result of using improved farm equipments - machinery, implements and tools for minimum period of three years. It was studied in terms of change in, average number of labours used, average working time in hours, average cost involved in rupees and change in quality of work. The data collected on this from the respondents were analysed and presented in Table 22.

##### **4.4.1.1. Decrease in average number of labours used**

It could be visualised from the Table 22 that an average decrease in number of labourers used due to the impact of farm mechanisation which was registered in paddy crop 16.39 whereas the average minimal decrease in the average number of labourers used was noticed in ragi 10.4 labours. The decrease of labourers used other crops was in between 16.39 and 10.4.

It was noticed 11.90 for sugarcane, 12.30 for cotton, 16.15 for tapioca and 11.49 for groundnut.

It could be inferred that since for the paddy crop more number of implements and tools are used there is more decrease in the average number of labours. The change was noticed less for ragi as the use of improved implements and tools is less.

#### 4.4.1.2. Decrease in average working time (in hours)

It could be observed from the Table 22 that the average decrease in the working time was more registered for tapioca crop (1.67) whereas the minimum decrease was registered for cotton (0.70). The other crops registered a decrease in average working time viz., 1.24 for paddy, 0.80 for ragi, 0.80 for sugarcane and 0.75 for groundnut.

It could be concluded that decrease on time taken for tapioca crop is more than any other crop because of more mechanisation, whereas the time taken for cotton crop is comparatively less due to less mechanisation for various farm operation.

#### 4.4.1.3. Decrease in average cost involved (in Rs/ha)

It could be inferred from the Table 22 that the average decrease in the cost involved was registered more for

sugarcane crop (1396.24 Rs/ha) whereas it was registered less for ragi (530 Rs/ha). The decrease in cost for other crops were, 734.33 Rs/ha for paddy, 708.50 Rs/ha for cotton, 1350.00 Rs/ha for tapioca and 730.76 Rs/ha for groundnut.

It could be concluded that even though the average cost of cultivation is more in sugarcane at the average decrease in cost involved more as an impact of use of improved machinery and implements. cost involved was more as an impact of use of improved machinery and implements. Comparatively the decrease of cost involvement is seen less in ragi may be due to more use of indigenous/traditional farm implements and tools for ploughing, weeding and harvesting operations.

#### 4.4.1.4. Decrease in the quality of work

The decrease in the quality of work was measured in terms of farmers' rating as satisfied/not satisfied as an impact of farm mechanisation.

It could be seen from the Table 22 that for all the crops there was considerable increase in farmers' satisfaction about the quality of work and decrease in farmers' dissatisfaction about the quality of work after farm mechanisation.

It could be seen that the increase in the farmers' satisfaction was more for sugarcane and satisfaction was less for ragi.

#### 4.4.2. Impact of farm mechanisation on farm productivity

Impact of farm mechanisation in terms of farm productivity was measured based on the change in the average yield/ha. The data about the change in average yield/ha were collected in quintals, analysed and presented in Table 23.

Table 23. Distribution of respondents according to their impact of mechanisation - Farm productivity

Sl. No.	Crop	Average yield in quintal/ha		
		B	A	D
1.	Paddy (n=40)	49.325	53.475	4.150
2.	Ragi (n=5)	2.150	2.300	0.150
3.	Sugarcane (n=38)	815.000	995.000	180.000}
4.	Cotton (n=10)	2.125	2.375	0.250
5.	Tapioca (n=20)	476.900	504.025	27.125
6.	Groundnut (n=26)	32.400	35.950	3.550

Note: B - Before mechanisation    A - After mechanisation  
D - Difference in yield between after and before mechanisation

It could be evident from the Table 23 that the average increase in yield per unit area registered more for sugarcane (180 quintals/ha) as an impact of farm mechanisation whereas it registered negligible difference for ragi (0.150 quintals/ha). For paddy the average increase in yield was 4.150 quintals/ha. The increase in yields of other crops varied and they were 0.250 quintals/ha in the case of cotton, 27.125 quintals/ha for tapioca and 3.550 quintals/ha for

groundnut crop which may be considered as impressive increase as a result of farm mechanisation as of now.

It can be concluded that there is considerable increase in the yields of five out of six major crops studied due to farm mechanisation. The impact was more prominent in the case of sugarcane followed by tapioca, paddy, groundnut and cotton. There observed to be negative growth in the case of ragi, but to a negligible degree. There exists considerable impact as a result of farm mechanisation.

#### 4.5. Constraints faced by the farmers while using and in availability of farm equipments - machinery, implements and tools

Table 24. Constraints in use and availability of farm equipments - machinery, implements and tools

Sl. No.	Constraints	HIID (n=80)		LIID (n=80)		Total (n=160)	
		No.	%	No.	%	No.	%
<b>I. Use</b>							
1.	Inadequacy of hiring agency	63	78.75	55	68.75	118	73.75
2.	Non-availability of farm machinery at required time	52	65.00	48	60.00	100	62.50
3.	Lack of training related to farm machinery, implements and tools	48	60.00	50	62.50	98	61.25
4.	High hire charge	41	51.25	56	70.00	97	60.62
5.	Unsuitable farm machinery, implements and tools used in the field	44	55.00	40	50.00	84	52.50
6.	Frequent power cut	46	57.50	27	33.75	73	45.63

Table 24 (Contd.)

Sl. No.	Constraints	HIID (n=80)		LIID (n=80)		Total (n=160)	
		No.	%	No.	%	No.	%
7.	Small and fragmented land holdings	31	38.75	29	36.25	60	37.50
8.	High fuel cost	22	27.50	32	40.00	54	33.75
<b>II. Availability</b>							
1.	High initial and maintenance cost	59	73.75	55	68.75	114	71.25
2.	Lack of credit facilities	42	52.50	40	50.00	82	51.25
3.	Frequent repairing	30	37.50	39	48.75	69	43.12
4.	Lack of skilled labour to operate farm machinery and implements	38	47.50	29	36.25	67	41.87
5.	Non-availability of service centre and spare parts shops	42	52.50	24	30.00	66	41.25
6.	High tax rate	37	46.25	29	36.25	66	41.25
7.	Non-availability of petrol/diesel bunk locally	25	31.25	38	47.50	63	39.37
8.	Low resale value of farm implements and machinery	28	35.00	19	23.75	47	29.37

#### 4.5.1. Constraints while using farm equipments - machinery, implements and tools

The above Table 24 reveals the various constraints encountered by the farmers while using the farm equipments - machinery, implements and tools.

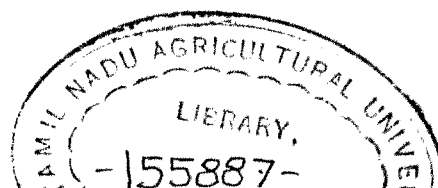
Of all the constraints 'inadequacy of hiring agency' was the major constraint expressed by nearly three-fourth (73.75%) of the total respondents. This was reported by about three-fourth (78.75%) and more than two-third (68.75%) of HIID and LIID respondents respectively.

'Non-availability of farm machinery at required time' was the constraint faced by nearly two-third (62.50%) of the respondents. This was accounted by 65.00 and 60.00 per cent of HIID and LIID respondents respectively.

'Lack of training on farm equipments - machinery, implements and tools' was a constraint expressed by more than three-fifth (61.25%) of HIID farmers and 62.50 per cent of LIID farmers. In total 61.25 per cent of farmers expressed this as a constraint. This may be due to the reason that majority of the respondents in this study area have not participated in any training programme on these aspects.

About three-fifth (60.62%) of the total respondents reported that 'high hire charge' as a constraint while using the farm equipments - machinery, implements and tools. This was opined by slightly more than half (51.25%) and 70.00 per cent of the respondents in the HIID and LIID respectively.

A little more than half (52.50%) of the total respondents expressed 'unsuitable farm equipments - machinery,



implements and tools' as a constraint while using them in the field. The same percentage was observed from both HIID and LIID farmers.

'Frequent power cut' was the constraint expressed by the total respondents (45.63%) while using the farm equipments - machinery, implements and tools. A more percentage of (57.50%) HIID farmers felt this as a major constraint than the LIID farmers (33.75%).

Relatively one-third of the total respondents expressed the following constraint of 'small and fragmented land holdings' and 'high fuel costs' while using the implements in the fields. The HIID and LIID farmers expressed the above constraint in an equal manner.

#### 4.5.2. Constraints in availability of farm equipments - machinery, implements and tools

The Table 24 reveals that the constraints faced by the farmers for the availability of the farm equipments - machinery, implements and tools in the HIID and LIID.

Majority of the total respondents (71.28%) reported that 'high initial and maintenance cost' as a major constraint while accessing the farm equipments - machinery, implements and tools. Nearly three-fourth (73.75%) of the HIID farmers expressed the above constraints whereas 68.75 per cent of the LIID farmers expressed the same.

'Lack of awareness of credit facilities' is a constraint faced by little more than half (51.25%) of the farmers in total as well as in particular in HIID and LIID farmers.

Constraints like 'frequent repairing', 'higher tax rate', 'non-availability of service centre' and 'spare parts shop', 'lack of skilled labour for operating machinery, implements and tools' and 'non-availability of petrol/diesel bulks locally' expressed by an equal number of farmers (more or less 40.00%) while accessing the farm equipments - machinery, implements and tools.

A little more than one-fourth (29.37%) of the total respondents expressed the 'low resale value of farm equipments - machinery, implements and tools' as constraints while accessing the above things in the field.

Almost all the HIID and LIID farmers expressed similar constraints in a same manner. Because, the farm equipments - machinery, implements and tools play a vital role in terms of saving the time, effective and efficient operation of important works, ultimately leading on to increase in the production and productivity of agriculture produce in both the situations. Hence, the HIID and LIID farmers expressed all the constraints relatively in a similar number and in a same manner.

4.6. Suggestion to overcome the constraints in use and availability of farm equipments - machinery, implements and tools

The suggestions rendered by the respondents of the study area, to overcome the constraints are presented below.

Table 25. Suggestions to overcome the constraints

Sl. No.	Suggestions	HIID (n=80)		LIID (n=80)		Total (n=160)	
		No.	%	No.	%	No.	%
1.	There should be government and private agencies to hire the farm machinery, implements and tools in the village itself at reasonable charges	46	57.50	41	51.25	87	53.38
2.	The government should arrange the continuous power supply at the peak hours	53	66.25	31	38.75	84	52.50
3.	Introduction of new farm machinery, implements and tools should be coupled with attractive subsidy scheme	32	40.00	39	48.75	71	44.38
4.	Long term loan facilities from nationalised banks should be coupled with introduction of new farm machinery and implements	36	45.00	33	41.25	69	43.12
5.	There should be encouragement from both Government and private side for the manufacture of indigenous farm implements and tools also	24	30.00	41	51.25	65	40.62

Table 25 (Contd.)

Sl. No.	Suggestions	HIID (n=80)		LIID (n=80)		Total (n=160)	
		No.	%	No.	%	No.	%
6.	The government should encourage the joint ownership pattern of farm machinery, implements and tools	27	33.75	33	41.25	60	37.50
7.	Research system should introduce feasible, cost effective farm machinery, implements and tools	38	47.50	19	23.75	57	35.63
8.	There should be subsidy for diesel/petrol when used exclusively for agricultural purpose of farm machinery	23	28.75	34	42.50	57	35.63
9.	There should be adequate training for the farmers about all aspects of farm machineries, implements and tools	17	21.25	21	26.25	38	23.75
10.	The government should utilise the mass media support to popularise the farm implement, machinery and tools	18	22.50	13	16.25	31	19.37
11.	Introduction of farm machinery, implements and tools should be based on the felt needs of farmers	13	16.25	17	21.25	30	18.75
12.	The officials should be trained periodically on the maintenance and repairing aspects, so that they can clear the doubts of farmers when they need	12	15.00	17	21.25	29	18.12

Table 25 (Contd.)

Sl. No.	Suggestions	HIID (n=80)		LIID (n=80)		Total (n=160)	
		No.	%	No.	%	No.	%
13.	There should be separate scheme for the population, lending, distribution of farm machinery, implements and tools	16	20.00	11	13.75	27	16.87
14.	The government should waive or relax the various taxes collected for owning of farm machinery, implements and tools	9	11.25	12	15.00	21	13.12
15.	There should be distance education course on agricultural engineering for the educated farmers to gain knowledge in these aspects	12	15.00	7	8.75	21	13.12

It could be observed from the Table 25 that, in total, majority of the farmers (53.38%) suggested that there should be government and private agencies to hire the farm equipments - machinery, implements and tools in the village itself at reasonable cost. More than half (57.50%) and 51.25 per cent of HIID and LIID farmers opined that due to the lack of hiring agencies, farm equipments - machinery and implements were not available at the peak season.

The results from the Table 25 shows that about half (52.50%) of the total farmers expressed that the government should arrange for a continuous power supply in the working hours. Two-third (66.25%) of the HIID respondents and nearly two-fifth (38.75%) of the LIID farmers expressed the same suggestion for the reason resorted was the frequent power cuts in the working hours.

Nearly less than half of the total respondents (44.38%) suggested the introduction of new farm equipments - machinery, implements and tools should be coupled with attractive subsidy scheme. There were 48.75 per cent and exactly two-fifth (40%) of the LIID and HIID farmers who supported the given suggestion. This suggestion might be expressed by the farmers because of the higher initial cost, lack of purchasing power, inadequate information about the new machinery, implements and tools.

Encouragement from both Government and private sectors to the local artisans for manufacturing of indigenous farm implements and tools are suggested by 40.62 per cent of the total farmers. About half (51.25%) and three-tenth (30%) of the LIID and HIID farmers expressed the encouragement from both Government and private sectors for the production of indigenous farm implements and tools which might be due to the

reason of non-availability of needed implements and non-availability of service and reporting centre at the study area.

The nationalised banks should provide more long term credit for purchase of farm equipments - machinery, implements and tools as 43.12 per cent of the total farmers expressed this suggestion, whereas 45 and 42.25 per cent of the HIID and LIID farmers suggested this suggestion. It could be discussed that the reason explicated for this result might be due to improper and ineffective functionary of the nationalised banks towards credit provided for the farm machinery and implements. Another important reason for this suggestion expressed by the respondents was due to the presence of less number of nationalised banks in the study area.

The Table 25 shows that about one-third (37.50%) of the total respondents suggested that the Government should encourage the joint ownership pattern of farm equipments - machinery, implements and tools. More than two-fifth (41.25%) and one-third (33.75%) of the respondents in the LIID and HIID expressed the same suggestion respectively. Major reasons for this suggestion given by the respondents may be due to higher initial cost of machinery and implements as well as lower resale value and non-availability of machinery at the needed time.

More than one-third (35.65%) of the total respondents opined that the research system should introduce feasible, cost effective farm equipments - machinery, implements and tools. Less than half (47.50%) and nearly one-fourth (23.75%) of the respondents from the HIID and LIID exhibited the same suggestions respectively. It would be discussed that the farmers of the marginal, small and medium land holders suggested this because of the reason that they were not having appropriate machinery to suit their farm conditions.

It is evident from the Table 25 that 35.63 per cent of the total farmers suggested that subsidies for diesel/petrol when used exclusively for agricultural purposes for farm machinery should be implemented. Less than half of the (42.50%) LIID farmers and 28.75 per cent of the HIID farmers opined the same suggestion. This had been expressed by the farmers due to the higher fuel rate.

A little less than one-fourth of the total respondents (23.75%) suggested that there should be adequate training for the farmers about all aspects of farm equipments - machinery, implements and tools. About one-fourth (26.25%) and 21.25 per cent of the LIID and HIID farmers suggested the same. It could be discussed that majority of the respondents did not have a chance to participate in any of the training relevant to farm equipments - machinery, implements and tools given by the various institutes.

It could be seen from the Table 25 that one-fifth (19.35%) of the total respondents suggested that the government should utilise the media to popularise the farm implements, machinery and tools. More than one-fifth (22.50%) and 16.25 per cent of the HIID and LIID farmers suggested the above said statement. From the farmers point of view, T.V., radio and newspaper in which much importance is not given to the introduced and existing farm equipments - machinery, implements and tools.

It is evident from the Table 25 that nearly one-fifth (18.75%) of the total farmers suggested the introduction of farm equipments - machinery, implements and tools should be based on the felt needs of the farmers. A little more than one-fifth of the respondents (21.25%) in the LIID and 16.25 per cent respondents in the HIID suggested the similar statement. This might be due to the small holdings and fragmented lands and also the non-suitability of the farm equipments - machinery, implements and tools to the fields of the study area.

The results in the Table 25 showed that 18.12 per cent of the total respondents suggested that the officials should be trained periodically on the maintenance and repairing aspects, so that they can clear the doubts of the farmers when they are approached. A meagre proportion (21.25%) and (15.00%) of the LIID and HIID farmers suggested the same.

It could be observed from the Table 25 that 16.87 per cent of the total respondents suggested that there should be a separate scheme for popularising, lending, distribution of farm equipments - machinery, implements and tools. One-fifth (20.00%) of the HIID farmers and 13.75 per cent of the LIID farmers suggested the same. It could be discussed that majority of the respondents would have less awareness about the improved farm equipments - machinery, implements and tools.

The Table 25 showed that about one-tenth (13.12%) of the total respondents, a meagre proportion (15.00% and 11.25%) of LIID and HIID farmers suggested that the Government should waive or relax the various taxes collected for owners of farm equipments - machinery, implements and tools. This was suggested by the big land holders because of the collection of taxes at higher rate.

It is evident from the Table 25 that 13.12 per cent of the total respondents suggested that there should be distance education course on agricultural engineering for the educated farmers to gain knowledge in these aspects. Nearly one-tenth (8.75%) of the LIID respondents and 15.00 per cent of the HIID farmers suggested the similar statement. This might be due to the reason that the farmers would have joined for the correspondence or short education courses offered by TNAU on the other aspects of agriculture rather than agricultural engineering.

#### 4.7. Extent of farm mechanisation in different districts of Tamil Nadu and a strategy for selective farm mechanisation

Labour has become scarce to do agricultural operations in the pre-harvest, harvest and post-harvest phases. This has created farm mechanisation as a substitute in the recent past. Though the Research and Development centres has produced modern implements, equipments and tools in the agricultural sector, the farmers are disguised to use it due to varied reasons. The most probable reason may be the high initial cost supplemented with its non-location specific. So, it is urgent at this stage that the extensionists have to give a strategy for selective mechanisation in Tamil Nadu.

##### 4.7.1. Extent of farm mechanisation in different districts of Tamil Nadu

To propose a selective farm mechanisation strategy for Tamil Nadu, first we should know the present level of farm mechanisation for entire state. For that total farm power (HP) of all districts, net area sown, gross cropped area and irrigated area were collected and presented in Table 26.

It could be observed from the Table that Vellore, Coimbatore, Villupuram, Erode and Salem districts of Tamil Nadu had high farm power when compared to the other districts. In contrast Virudhunagar, Nilgiris, Sivaganga, Ramnad and Kanyakumari had a low farm power i.e., less than 57321 HP.

Table 26. District-wise total farm power availability, net area sown, gross cropped area and irrigated area

Sl. No.	District	Hand operated Agri. tools- (in HP)	Animal operated Agri. imple- ments (in HP)	Power operated Agri. equip- ments (in HP)	Tractor operated Agri. equip- ments (in HP)	Total farm power (in HP)	Net area sown (in ha)	Gross cropped area (in ha)	Area irri- gated by all sources (in ha)	Farm mecha- nisation rank
1.	Chennai	0	0	0	0	0	0	0	0	XIII
2.	Coimbatore	11919.6	43344	670174.6	512640	1238078.2	348512	382578	147285	II
3.	Cuddalore	273953	21313	219998.2	120760	636024.2	307385	371906	137837	VIII
4.	Dharmapuri	36974.4	42633	469188.2	78480	627276.6	416884	565848	117272	IX
5.	Dindigul	6368.7	18460	273884.2	245080	543792.9	294255	288145	86842	XII
6.	Erode	32518.2	56815	712433	148640	950406.2	327667	368433	14100	IV
7.	Kanchee- puram (Thiruval- lore)	113911	59115	328279.2	91960	593205.2	319679	449016	249130	X
8.	Kanyakumari	2728.9	3041	6991	182360	195120.9	86552	108725	29519	XVIII
9.	Madurai (Theni)	18995.9	40573	318731	198120	576419.9	294255	328169	137098	XI
10.	Nagapattinam	22946.7	48054	191409.8	172200	434610.5	286514	411127	255994	XIV
11.	The Nilgiris	3548.1	293	1924.2	56200	61965.3	72163	73277	602	XXI
12.	Pudukottai	21442.7	36524	145615	117480	321061.7	184302	194278	59681	XV
13.	Thanjavur (Mayavaram)	15817.4	46520	143243.8	71480	277061.2	219902	311222	178686	XVI
14.	Tirunelveli	28772.9	23762	242662.2	185240	480437.1	172261	218118	99331	XIII
15.	Thiruvanna- malai	117091.6	55694	562793.8	16840	752419.4	272334	352787	125572	VI
16.	Tuticorin	5184.6	16117	88944.8	137760	248006.4	209104	219213	41039	XVII
17.	Trichirapalli (Perambalur and Karur)	41680.1	56636	645057	7360	750733.1	566744	625606	184636	VII
18.	Salem (Namakkal)	50761.3	38426	648390	136280	873857.3	456916	652528	184652	V
19.	Ramathapuram	6143.5	14625	41517.4	52440	114725.9	217889	218887	59596	XIX
20.	Sivaganga	12497.5	26274	25139.8	920	64831.3	139593	140247	86824	XX
21.	Vellore	29844	30848	96784980	686000	1714541.8	234343	280587	108584	I
22.	Villupuram	38527.6	76091	826593	127680	1068891.6	301763	397432	169415	III
23.	Virudhunagar	3754.6	11289	41678.2	600	57321.8	192820	199907	43945	XXII

The probable reasons for the district's having low and high farm power existing are discussed below.

The districts having a high farm power may be due to the reason that the farmer would be aware of the mechanisation complimented with location-specific farm equipments - machinery, implements and tools. One of the major reason for the high farm power is also due to the acute labour problem because of the industrial development. All the high farm power districts are observed to be nearer in surroundings all falling in the North of Tamil Nadu. It becomes evident that the research system and the extension system have a better linkage complimented with the reason that all the important commercial crops of Tamil Nadu are grown in this area. It is an accepted fact that mechanisation is essential for commercial crop cultivation.

The districts having a low farm power is observed to be in the drought prone and in the hilly areas of Tamil Nadu. All the districts having a low farm power have the major plantation crops. There is an absence of proper irrigation source in these districts because they do not have a perennial river system except Kanyakumari district.

#### 4.7.1.1. Relationship of total farm power availability with net area sown, gross cropped area and irrigated area

From the Table 27, the relationship between the total farm power and the net area sown, gross cropped area and area irrigated by all sources and the results are furnished. The correlation coefficient between the total farm power and the net sown area shows that Ramanathapuram and Virudhunagar were the two districts which were negatively significant while all other districts were positively significant. This may be due to the reason that the districts are drought prone with less opportunity to increase the farm mechanisation.

Similarly the correlation coefficient between the total farm power and the gross cropped area showed that Ramanathapuram, Sivaganga and Virudhunagar districts were negatively significant, while all other districts were positively significant. This may be due to the reason that the land conditions may not be suitable for intensive crop cultivation and due to the drought proneness.

It could be observed from the Table 27 that the correlation coefficient between the total farm power and the area irrigated by all sources showed that Kancheepuram, Thanjavur, Trichy, Vellore and Villupuram districts were significant. The probable reason might be due to the presence of a perennial river system while all other districts were negatively correlated.

Table 27. Zero order correlation showing relationship of total farm power availability with net area sown, gross cropped area and irrigated area

Sl. No.	District	Total farm power (in HP)	Correlation co-efficient		
			Net area sown	Gross cropped area	Irrigated area
1.	Chennai	0	0	0	0
2.	Coimbatore	123078.2	0.7317 **	0.7317 **	-0.3287 NS
3.	Cuddalore	636064.2	0.8936 **	0.9883 **	-0.3464 NS
4.	Dharmapuri	627276.6	0.8863 **	0.8476 **	-0.0636 NS
5.	Dindigul	543792.9	0.9905 **	0.9299 **	0.3697 NS
6.	Erode	950406.2	0.9503 **	0.9932 **	-0.0101 NS
7.	Kancheepuram (Thiruvallore)	593205.2	0.9747 **	0.8789 **	0.6327 **
8.	Kanyakumari	195120.9	0.9982 **	0.6145 **	-0.0679 NS
9.	Madurai (Theni)	576419.9	0.8491 **	0.8409 **	-0.0548 NS
10.	Nagapattinam	434610.5	0.6162 **	0.7557 **	-0.0777 NS
11.	The Nilgiris	61965.3	0.7190 **	0.9429 **	0.0954 NS
12.	Pudukottai	321061.7	0.7026 **	0.6270 **	0.0601 NS
13.	Thanjavur (Mayavaram)	277061.2	0.5882 **	0.7092 **	0.7359 **
14.	Tirunelveli	480437.1	0.9981 **	0.8335 **	-0.2639 NS
15.	Thiruvannamalai	752419.4	0.7495 **	0.6873 **	-0.2055 NS
16.	Tuticorin	248006.4	0.9896.00	0.9003 **	-0.0770 NS
17.	Trichirappalli (Perambalur and Karur)	750733.1	0.9525 **	0.5618 **	0.4879 *
18.	Salem (Namakkal)	873857.3	0.9530 **	0.9050 NS	0.3680 NS
19.	Ramanathapuram	114725.9	0.3231 NS	-0.2315 **	0.1216 NS
20.	Sivaganga	64831.3	0.8151 **	0.0336 NS	0.0746 NS
21.	Vellore	1714541.8	0.9889 **	0.8407 **	0.9960 **
22.	Villupuram	1068891.6	0.6472 **	0.8942 **	0.4407 *
23.	Virudhunagar	57321.8	0.3246 NS	-0.0246 NS	-0.0346 NS

\*\* Significant at 1 per cent level

\* Significant at 5 per cent level

NS - Non-significant

#### 4.7.1.2. Districts wise labour availability and macro level farm mechanisation score

The secondary data collected from the statistical department is presented in Table 28. The table reveals that some of the districts such as Trichirapalli, Madurai, Salem, Kancheepuram and Villupuram have more population of agricultural labourers when compared to other districts. This might be due to the fact that the labourers have limited or no chance of diverting to non-agricultural sectors. Further, these districts are found to have more agricultural lands with irrigation facilities. There may be ample opportunity for continuous cropping and so much so continuous employment opportunities in agricultural fields. Such assured employment opportunities round the year might have motivated them to depend fully or mostly on agricultural sector.

In contrast, the districts such as The Nilgiris, Ramanathapuram, Sivaganga, Pudukottai and Kanyakumari are found to have lesser population of agricultural labourers. This might be due to the limited scope for agricultural operations in these districts. Further, such agricultural operations may be confined to seasonal conditions which is mostly dependent on rainy seasons. In addition to this, there might be diversified opportunities in non-farm sector such as match or cottage industries, fishery activities and the like.

Table 28. District-wise agricultural labour availability and macro level farm mechanisation score

Sl. No.	District	Macro level farm mechanisation (Total farm power - net area sown)	Rank	Agricultural labourers	Rank
1.	Chennai	0	XXIII	199	XXIII
2.	Coimbatore	3.55	II	455700	VII
3.	Cuddalore	2.06	VIII	364973	XI
4.	Dharmapuri	1.50	XIV	349836	XIII
5.	Dindigul	1.84	XII	366338	X
6.	Erode	2.90	IV	450036	VIII
7.	Kancheepuram (Thiruvallore)	1.85	XI	569341	IV
8.	Kanyakumari	2.25	VII	177410	XVIII
9.	Madurai (Theni)	1.96	IX	636323	II
10.	Nagapattinam	1.51	XIII	487676	VI
11.	The Nilgiris	0.85	XIX	24992	XXII
12.	Pudukottai	0.94	XVIII	133588	XIX
13.	Thanjavur (Mayavaram)	1.25	XVI	346310	XV
14.	Tirunelveli	2.78	V	349069	XIV
15.	Thiruvannamalai	2.76	VI	357117	XII
16.	Tuticorin	1.18	XVII	192836	XVII
17.	Trichirappalli (Perambalur and Karur)	1.32	XV	648518	I
18.	Salem (Namakkal)	1.91	X	618515	III
19.	Ramanathapuram	0.52	XX	97308	XXI
20.	Sivaganga	0.46	XXI	122894	XX
21.	Vellore	7.31	I	378770	IX
22.	Villupuram	2.95	III	513413	V
23.	Virudhunagar	0.29	XXII	245133	XVI

Source: The Economic Appraisal 1996-97, Tamil Nadu.

The remaining 13 districts are found to have a moderate population of agricultural labourers. The above trend of farm labourers implies that the government may take into account the population of agricultural labourers, the opportunities for employment in non-farm sector or agro-based industries or any other industries, while planning for farm mechanisation in the state as well as in the country. Further, the availability of labourers at farm level may also be hampered due to migration of agricultural labourers to other areas or to non-farm sector, season vagaries, monetary advantage and assured employment in the non-farm sector. These factors may also affect the availability of agricultural labourers and hence farm mechanisation has to be promoted in a phased manner without affecting agriculturists (cultivators) as well as the agricultural labourers. Any hasty implementation may throw the agricultural labourers out of job and so it is like a 'tight-rope walking' and this has to be dealt with very carefully and with lot of social responsibility.

The macro level farm mechanisation score was worked out for all the districts ie., the total farm power is divided by net area sown of each district. The results are furnished in Table 28.

The result showed that Vellore, Coimbatore, Erode, Tirunelveli and Thanjavur districts are found to have more

mechanisation score when compared to other districts of Tamil Nadu. This indicates that the above mentioned districts are having more mechanisation than other districts. So there is an urgent need to mechanise the other districts too.

Though there are many farm equipments - machinery, implements and tools developed by the research and development centres, there are a lot of ifs and buts in utilisation of all these, by the farming community. From this study as well as from the secondary data collected viz., to area irrigated by all sources, net area sown, gross cropped area, the farm power availability and the agricultural labour availability for all districts of Tamil Nadu, a strategy is being derived for some of the major field practices. The strategy may be applicable for the whole state of Tamil Nadu.

#### 4.7.2. Selective farm mechanisation for major field operations

##### 4.7.2.1. Land preparation and sowing

Country plough is the main source of land preparation, it takes 3-4 tillage operation and the coverage is 0.5 - 0.75 ha/day. In contrast, tractor drawn cultivator, disc harrow, improved iron plough are the better machinery. It is suggested because of its high efficiency and timely economical nature.

For sowing, bamboo made potti and koodai are the tools used by majority of the farmers. This will not give an uniform

distribution of seeds so, it is impossible to maintain the optimum plant population. Broadcasting machine is recommended for all grain seed crops because of its uniform distribution of seeds and subsequently maintaining the seed rate.

For paddy crop, power tiller, puddler, tractor operated cage wheel and engine operated rice planter are the needed machinery to the farmers. For sugarcane, sugarcane planter is recommended.

#### 4.7.2.2. Intercultural and plant protection

In the intercultural operations, weeding is a major activity, for this most of the farmers had used 'hand hoe' as weeding device. It consumes more manual labourers. Alternate one is long handed weeder and power operated weeder as the recommended.

For earthing up operation spade and country plough are being used. For this bund former, ridger are the two most effective implements which would cover more area as well as better quality of work in unit time.

For spraying, power sprayer, power duster, tree sprayer are suggested because of their uniform distribution of spray fluid which control the pest and disease in a proper manner.

#### 4.7.2.3. Harvesting and threshing

The sickle, koddari and katthi are the major tools used for harvesting the matured produce. This will take more time for doing operations and frequent sharpening.

Reapers operated by engine, power tiller and tractor have been suggested for harvesting paddy, pulses, ragi and other millets.

Combined harvesting of paddy and soyabean are accepted by the farmers in the regions having labour shortage during the peak period.

Threshing of paddy and millets is done by bullock trampling which is arduous and time consuming with poor quality of grains. This has been gradually replaced by engine/power thresher that is paddy thresher, multiple crop thresher for major cereals, oilseeds, pulses and maize thresher.

For groundnut, podding is tedious and time consuming process. Alternate one is the decorticator. This will give better quality of outputs quickly.

#### 4.7.3. Suggested strategy for various organisations

The research system, extension system and the government are one or the other way interrelated in producing

and distributing a technology. So, proper measures have to be taken by each system which is discussed below.

#### 4.7.3.1. Research System

1. As majority of the farmers belonged to small and medium category, suitable farm equipments should be introduced considering the cost as the main parameter for adoption of farm machines by the farmers. Regional Research Stations of TNAU have to take special steps in developing such machinery which are cost effective and efficient taking into account the available data with the present use and future needs of farm machines.
2. Considering the different types of soil, topography, indigenous tools and implements etc., the research system has to modify the developed farm equipments to suit the agro-ecological conditions and the cropping pattern. Proper soil testing measures should be made to identify soil properties for developing suitable machinery which can compete with soil conditions. It is an accepted fact that all the indigenous tools and implements are location-specific but need<sup>s</sup>ing some refinements. Proper measures have to be taken for modifying them to suit to other areas.
3. Proper linkage should be established between the extension and research systems to develop appropriate packages in

local languages to inform extensionist about the modified farm equipments for dissemination.

#### 4.7.3.2. Extension System

1. To create awareness and adoption of appropriate farm equipments, extension programmes should be conducted frequently with various extension approaches. Awareness and field demonstration programmes may be collaborated with various agro-industries. The State Department of Agriculture should become familiar about the farm equipments that are cost effective as well as location-specific. Mass media such as radio, TV and newspapers are the appropriate tools for popularisation in which TV is considered as one of untapped effective and reachable media. Utilization of these media should be done effectively along with mass awareness campaigns in villages.
2. Of all the extension approaches training is one of the most important to impart knowledge, skill and action. Separate training programmes with appropriate modules should be targeted for farmers, agricultural labourers and local artisans. For agricultural labour, gender issues should be considered. Women in agriculture is an important issue in which their role in the post harvest is immense. So separate training programmes should be concentrated in this area.

3. Merely informing the farmers about the farm equipments becomes obsolete as cost is one of the major factor. In this context the extension system has to identify the various institutions in the local area supplementing various farm equipments at subsidised rates in a nearby place.
4. The Government of India has taken a decision in principle to establish one KVK in each district in our country. In such a condition, KVKs to be funded by ICAR or any other agency should take care in having a separate consideration for conducting training programmes in agricultural engineering. Private KVK's with NGO as a base can also take this activity in a better way to impart skill oriented training programmes to farmers, agricultural labourers, local artisans, women and youth.

#### 4.7.3.3. Government

1. Considering the high cost of agricultural implements and machines, there is need for the government to provide more credit and subsidy facilities to the needed farmers through various agencies such as rural/agricultural banks, co-operatives etc.
2. Spares of agricultural implements and machinery should be made easily available in villages and provide service facilities for the same.

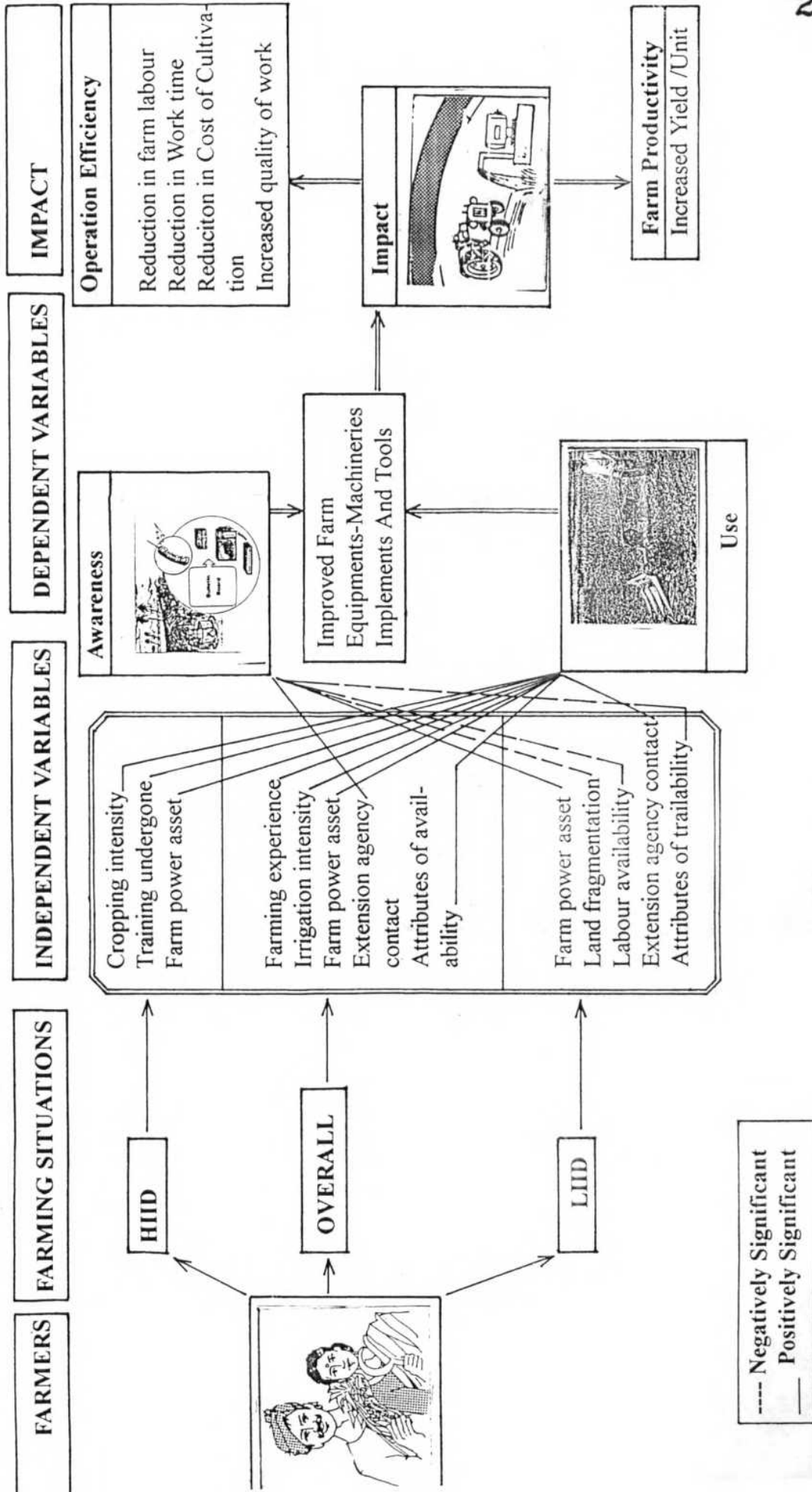
3. The Government should establish the farm machinery workshop/custom service centre in every block headquarters/cluster of villages. This may facilitate farmer to make use of the farm equipments - machinery, implements and tools at reasonable hire charges, besides getting these required farm equipments for timely farm operations.
4. The linkage among State Department of Agriculture, Agricultural Engineering, Agrofed and other development departments has to be strengthened to promote the dissemination of technologies.
5. The government should take steps to co-ordinate the efforts of research and extension system in the light of the government policy by conducting regular and time-based co-ordination meeting with all concerned.
6. Government should ensure no interruption in the power supply during agricultural seasons so as to encourage farmers to go for intensive farming.
7. There is urgent need for establishing fuel/petrol bunk at every panchayat union level or cluster of villages to ensure the availability of fuel for lifting water and processing operations. level or cluster of villages.
8. To increase the life span of the farm equipments, proper measures should be taken by the government machinery

periodically by checking the quality of the raw materials that are used for manufacturing the farm equipments by the manufacturers. Strict measures should be enforced to avoid the distribution of poor farm equipments that cannot be used for a long time.

9. Repairing cost of machineries were said to be very high. Therefore, the establishment of service centres in rural areas, particularly by the unemployed young agricultural/agricultural engineering graduates may be encouraged by the Government. In this regard, the financial institutions can come forward with suitable schemes and incentives. Such financing should be provided in a liberal manner without insisting immovable security.

The findings of this study are summarised and presented in the next chapter.

Fig. 6. Empirical Model Showing the Contribution of Characteristics of Farmers with Awareness and use of Improved Farm Equipments- Machineries, Implements and Tools.



## CHAPTER V

### SUMMARY AND CONCLUSION

Agriculture is the most important sector of the Indian economy. Most of the farming in India is carried out on small holdings (54% of farms are under one hectare). Due to the level of agricultural mechanisation in India is relatively low with only 10 per cent of Indian farms are tractor powered. Draught animals and farm labourers are the important sources of farm power. Mechanisation possibilities in the future will be strongly influenced by the farm size, cost of farm, labour, machines and energy. Agricultural machinery and implements are not only capable of doing field operation of better quality complementing with a lesser time but would also lead to rapid adoption of other technological innovations. A shift from traditional agriculture can be achieved by improving the existing farming practices, improving the hand tools and animal drawn implements, development and adoption of equipment for different locations and introduction of a selective mechanisation.

This study is attempted to identify the indigenous/traditional farm implements and tools used by the farmers in different farming situation viz., High Irrigation Intensity District (HIID) and Low Irrigation Intensity District (LIID).

It includes the analysis of farmers awareness and use (both own and hired) of improved farm equipments - machinery, implements and tools and their impact of farm mechanisation on operational efficiency and farm productivity. In addition, the socio-economic profile and their relationship with use and awareness, constraints in the use and availability of improved farm equipments - machinery, implements and tools. Keeping the above factors in mind the following objectives were set forth.

The specific objectives of the study were as follows:

1. To identify the indigenous/traditional farm implements and tools used by farmers in different farming situations.
2. To study the level of awareness and use (both own and hired) of improved equipments - machinery, implements and tools in different farm size categories under different farming situations.
3. To analyse the socio-economic profile of respondents and to find out their relationship with awareness and use of farm equipments.
4. To study the impact of farm mechanisation on operational efficiency and farm productivity.

5. To find out the constraints in availability and use of improved farm equipments - machinery, implements and tools.
6. To assess the extent of farm mechanisation in different districts of Tamil Nadu and its relationship with the net area sown, gross cropped area and area irrigated at macro-level with secondary data and to suggest an appropriate strategy for promotion of selective farm mechanisation in Tamil Nadu.

The study was conducted in two blocks of Kancheepuram (HIID) and two blocks of Dharmapuri (LIID) districts of Tamilnadu. Among the four blocks 16 villages were selected. From each village 10 respondents were selected based on simple random sampling. Based on an extensive review of literature, discussion with experts and a pilot study, 24 independent variables were selected for a detailed investigation. The dependent variables selected for the study were awareness and use of farm equipments.

The statistical tools used in the study were percentage analysis, cumulative frequency, omega test, chi-square, zero order correlation, multiple regression and path analysis. The salient findings of the study are as follows:

### 5.1. Identification of indigenous/traditional farm implements and tools used by the farmers

A total of 62 indigenous/traditional farm implements and tools were identified in HIID and LIID under 17 different farming operations namely, preparation of land, levelling, bund forming, puddling, sowing, irrigation, desilting, weeding and intercultural operation, fertiliser application, pest control, rat control, scaring birds, harvesting, threshing, transport, storage, post harvest and the value of the product.

The omega test revealed there was no significant difference in the use pattern of 14 indigenous/traditional farm implements and tools in HIID and LIID. However there were, significant difference (positive or negative) between the two farming situations.

### 5.2. Awareness and use of improved farm equipments - machinery, implements and tools

#### 5.2.1. Awareness level of respondents

Majority of the respondents in both the farming situations (HIID and LIID) had a medium level of awareness about the improved farm equipments - machinery, implements and tools.

In both the farming situations, cent per cent of the respondents in all the categories were aware of tractor drawn cultivator and electric motor pump. Majority of the

respondents in all categories under the HIID and LIID were aware of the tractor drawn disc plough, puddler, case wheel, power sprayer, knapsack sprayer, power thresher and tractor-trailer.

#### 5.2.2. Use level of respondents

Majority of the respondents in case of the HIID and LIID had a low level of use of the improved farm equipments - machinery, implements and tools.

Most of the respondents in all the categories used tractor drawn cultivator, puddler, cage wheel, electric motor pump, power sprayer and knapsack sprayer for the different farm operations under both the farming situations.

### 5.3. Socio-economic profile of respondents in relation to their awareness and use of improved farm equipments - machinery, implements and tools

#### 5.3.1. Profile of farmers

Majority of the respondents in the two farming situations were old aged, had an education upto secondary school level, agriculture alone as a major occupation with nuclear type family and less than five members family. Further, they had medium farm size, farming experience, land fragmentation, cropping intensity, high irrigation intensity, labour availability, low training undergone, farm

power asset, medium material possession, extension agency contact, low social participation, medium level of exposure to media and high attributes of farm machinery on cost and trialability, medium efficiency, feasibility, availability and profitability. The chi-square analysis showed that the farmers are HIID and LIID differ gratefully with referenceto the family type, family size, land fragmentation, cropping intensity, labour availability, extension agency contact, the attributes such as efficiency, trailability and profitability. Thus they didn't differ in terms of other 14 variables.

### 5.3.2. Independent variables Vs awareness of improved farm equipments - machinery, implements and tools

#### 5.3.2.1. Zero order correlation coefficient

There was positive relationship between 11 variables such as family type, farming experience, farm power asset, material possession, extension agency contact, social participation, level of exposure to media, attributes of trialability, feasibility, availability and profitability of HIID farmers with their awareness level of improved farm equipments - machinery, implements and tools, whereas the variables, educational status, family type, family size, farming experience, irrigation intensity, farm power asset, material possession, extension agency contact, social

participation, level of exposure to media, attributes of cost, feasibility and availability of LIID respondents showed a positive relationship. In pooled analysis, except six variables viz., occupational status, family size, land fragmentation, labour availability, training undergone and hiring agency, other variables were non-significant when the awareness level of farmers were correlated. Others showed a positive relation with awareness.

#### 5.3.2.2. Multiple regression analysis

The multiple regression analysis showed that in pooled data one out of 24 variables namely extension agency contact contributed 46.58 per cent variation in the awareness of improved equipments - machinery, implements and tools.

All the selected 24 independent variables of HIID and LIID respondents together explained a significant variation in their awareness level to a tune of 40.26 per cent and 75.85 per cent respectively. The beta quotient of extension agency contact of LIID respondents was found to be positively significant. The land fragmentation, labour availability and attributes of trialability were found to be negatively contribute towards awareness of farm equipments. d

#### 5.3.2.3. Path analysis

The path analysis revealed that the extension agency contact, social participation, labour availability, farm power

asset and exposure to media in association with other variables acted as crucial variables in explaining the variation in the awareness of improved farm equipments - machinery, implements and tools.

### 5.3.3. Independent variables Vs use of improved farm equipments - machinery and tools

#### 5.3.3.1. Zero order correlation coefficient

The correlation analysis in pooled data except six variables viz., occupational status, family size, land fragmentation, labour availability, hiring agency and attributes of cost, others showed a non-significant relation, others were positively significant. In the HIID, the variables age, educational status, family type, family size, farming experience, cropping intensity, irrigation intensity, training undergone, farm power asset, material possession, extension agency contact, social participation, exposure to media, attributes of trialability, feasibility, availability and profitability were found to be positively significant, whereas, in LIID, the variables age, occupational status, family type, family size, cropping intensity, labour availability, training undergone and hiring agency were found to be non-significant. Others had a positive association with the use of improved farm equipments - machinery, implements and tools.

### 5.3.3.2. Multiple regression analysis

Four independent variables viz., farming experience, irrigation intensity, farm power asset and attributes of availability contributed in pooled data to the variation in use to a tune of 68.61 per cent.

In the HIID, four variables namely cropping intensity, training undergone, farm power asset and attributes of availability contribute to the variation in use to a tune of 77.04 per cent, whereas, in LIID, farm power asset only contributed to the variation in use of improved farm equipments - machinery, implements and tools to a tune of 74.66 per cent.

### 5.3.3.3. Path analysis

From the path analysis of the pooled data, HIID and LIID, it would be concluded that farm power asset, material possession, farm size, attributes of availability acted as crucial variables in explaining the variation in the use of improved farm equipments - machinery, implements and tools.

## 5.4. Impact of farm mechanisation on operational efficiency and farm productivity

The impact of farm mechanisation were measured with the farmers who continuously used machinery, implements, tools for three years. They were selected as the respondents and mechanisation index was used for the analysis.

#### 5.4.1. Operational efficiency

An average decrease in number of labour used was due to the impact of mechanisation which was higher in paddy crops than in ragi.

An average decrease in the work time was registered more for tapioca crops whereas a minimum decrease was observed in cotton.

An average decrease in the cost involved was registered more for sugarcane crops and less in ragi.

All the crop growers expressed satisfaction about the quality of work with the use of farm equipments - machinery, implements and tools.

#### 5.4.2. Farm productivity

The impact of farm mechanisation on farm productivity was, by and large, encouraging which was observed by considerable increase in yields of five out of six major crops studied. The increase was maximum in the case of sugarcane to the tune of 180 quintals/ha and it was maximum in the case of cotton which was 0.250 quintals/ha. There observed negative trend but negligible degree in the case of ragi which was grown under rainfed conditions.

## 5.5. Constraints in use and availability of improved farm equipments - machinery, implements and tools

### 5.5.1. Constraints in use

Inadequacy of hiring agency was pronounced by most of the respondents as a major farming constraint in both the farming situations.

Non-availability of farm machinery at required time and lack of training related to farm equipments - machinery, implements and tools were reported as the second major constraint.

More than half of the respondents expressed more hire charge with unsuitable farm machinery, implements and tools in the field.

About 45 per cent of respondents expressed frequent power cut as a major constraint while using the farm equipments - machinery, implements and tools.

About one-third of the respondents expressed small and fragmented land holding and high fuel cost as the other constraints.

### 5.5.2. Constraints in availability

Majority of the respondents viewed high initial cost and maintenance cost as the prime constraints in availing the

farm equipments - machinery, implements and tools under both the farming situations.

About half of the respondents pronounced lack of credit facilities followed by frequent repairing, lack of skilled labour to operate farm machinery and implements, high tax rate, non-availability of service centre and spare parts shops, and non-availability of sufficient quantity of petrol/diesel locally as the constraints.

Low resale value of farm implements and machinery were the other constraints expressed by a low percentage of respondents of the two farming situations.

#### **5.6. Suggestions to overcome the constraints**

The suggestions offered by the respondents in HIID and LIID respondents to overcome the constraints are multifaceted. Set up of private hiring agency, providing continuous power supply at peak hours of farm operation, supply of machinery at subsidised rate and extension of credit for purchasing new farm machinery, encouraging the manufacturers of indigenous farm implements and tools, research need for developing location specific farm implement tools, cost effective, feasible machinery and popularisation of existing ones were advocated by majority of the respondents.

## 5.7. Extent of farm mechanisation in different districts of Tamil Nadu and a strategy for selective farm mechanisation

### 5.7.1. Extent of farm mechanisation in different districts of Tamil Nadu

The districts of Vellore, Coimbatore, Villupuram, Erode, Thanjavur, Trichirapalli and Salem having more macro level mechanisation score as well as total farm power when compared to other districts. The agricultural labour availability also more in Trichirapalli, Madurai, Kancheepuram, Salem and Coimbatore districts when compared to other districts. This shows that, these districts are already having better mechanisation. At this movement we want to promote selective farm mechanisation to other districts.

Correlation coefficient between the total farm power and the net area sown and gross area sown showed that majority of the districts were positively significant. The correlation coefficient between the total farm power and the area irrigated by all sources showed that only six districts, Kancheepuram, Thiruvannamalai, Thanjavur, Trichy, Vellore and Villupuram were highly significant while others were non-significant.

### 5.7.2. Strategy for selective farm mechanisation

A strategy for selective farm mechanisation has been proposed in this study based on the salient findings with the secondary data collected, analysed and processed. The strategy recommends farm equipments - machinery, implements and tools for major farm operation viz., land preparation and sowing, intercultural and plant protection, harvesting and threshing. Based on the strategy, policy measures for the research system, extension and Government has been recommended.

### 5.8. Implications of the study

On the basis of the salient findings of the study certain broad implications are furnished below. These could be used by planners and administrators of governmental and non-governmental agencies for planning and strengthening the agricultural extension system and research system who devote for the development of mechanisation in Indian agriculture.

1. It was seen that better the education more was the awareness level. So more importance should be given to the education of farmers as well as creation of awareness of improved farm equipments.
2. Attributes of farm machinery had a role to play in the use of improved farm equipments - machinery, implements and

tools in both the farming situations. So feasible, effective and constant effort should be taken by the researchers and the extension personnel to disseminate the new technologies effectively through different mass media and other communication methods.

3. As the level of use of the machinery, implements and tools is very low, efforts should be taken to make the devices simple, the results more observable and physically compatible and they should receive importance in the fabrication and the transfer of technology.
4. Periodical training programmes and demonstrations may be conducted for the farmers on various aspects of existing and introduced farm equipments - machinery, implements and tools.
5. Adequate technical guidance may be provided to the farmers while using the improved farm equipments - machinery, implements and tools.
6. Provision of financial assistance and subsidy for purchasing the introduced farm equipments - machinery, implements and tools should be made available liberally.
7. Local artisans and manufacturers of indigenous/traditional farm implements and tools should be encouraged to produce more by government and private agencies.

8. Hiring agency licence may be provided to private sector and the government has to fix reasonable hiring charges based on the value of machinery.
9. Field level workers should be technically competent. and the government has to take care during the recruitment of staff.
10. Small and fragmented land holding is a major constraint in farm mechanisation. For this, government and non-government agencies should encourage self-help groups through a co-operative approach or farmers own organisations.
11. Each village or a cluster of villages such as growth centre should have a spare parts shop, workshop and servicing centre to meet the farmers needs.
12. For the study area, the respondents expressed fuel cost to be very high. The government has to set up fuel stations at an easier reach and should provide them fuel at subsidized rate during farming seasons.

#### 5.9. Suggestion for future research

1. An action research may be carried out involving various extension agency so as to analyse the impact of farm mechanisation with various crops.

2. As the study has brought out a number of findings on the identification of indigenous/traditional farm implements and tools, awareness, use, impact of farm mechanisation on operational efficiency and farm productivity, constraints in use and availability, similar studies are to be contemplated in different agro-climatic zones of India as well as Tamil Nadu.
3. Knowledge level, perception and attitude towards farm mechanisation can be done for further studies in farm mechanisation.
4. A comparative study on the use of traditional and modern farm equipments - machinery, implements and tools can be used for analysing the sustainable issues.
5. Case studies on farm mechanisation if studied and published through the traditional and modern media, it can motivate other farmers to follow quickly.

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APPENDIX II

Mechanization index (Bose, 1961)

Mechanization index was based on the number of farm machinery used and the number of years for which each farm machinery is used by the respondents concerned. For example, if two farm machinery  $x_1$  and  $x_2$  are used by a farmer for the past  $n_1$  and  $n_2$  years respectively, then the mechanization index of the farmer will be  $(x_1n_1 + x_2n_2)$ .

The method of Purdue University was used in this study to determine the significance of the difference between the HIID and LIID respondents with regard to use of indigenous/traditional farm implements and tools.

The formula used for this was as follows.

$$t = (\sigma_1 - \sigma_2) \sqrt{\frac{2 N_1 + N_2}{N_1 + N_2}}$$

Where

$\sigma_1$  = Omega value for the proportion of the first sample

$\sigma_2$  = Omega value for the proportion of the second sample

$N_1$  = Total number of respondents in the first sample

$N_2$  = Total number of respondents in the second sample

Omega was positive when proportion value was greater than 0.50 and negative when proportion value was less than 0.50. If the proportion value was 0.50, the omega value becomes zero. Then tabular 't' value was referred at  $(N_1+N_2-2)$  degrees of freedom to find out the significance of the calculated 't' value. The omega values are given in the following table.

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Omega values\*

P	Omega values	P	P	Omega values	P
1.00	1.1106	0.00	0.75	0.3702	0.25
0.99	0.9690	0.01	0.74	0.3541	0.26
0.98	0.9099	0.02	0.73	0.3379	0.27
0.97	0.8648	0.03	0.72	0.3221	0.28
0.96	0.8259	0.04	0.71	0.3064	0.29
0.95	0.7917	0.05	0.70	0.2910	0.30
0.94	0.7602	0.06	0.69	0.2756	0.31
0.93	0.7320	0.07	0.68	0.2612	0.32
0.92	0.7052	0.08	0.67	0.2453	0.33
0.91	0.6797	0.09	0.66	0.2303	0.34
0.90	0.6565	0.10	0.65	0.2155	0.35
0.89	0.6326	0.11	0.64	0.2006	0.36
0.88	0.6104	0.12	0.63	0.1861	0.37
0.87	0.5891	0.13	0.62	0.1714	0.38
0.86	0.5697	0.14	0.61	0.1568	0.39
0.85	0.5472	0.15	0.60	0.1424	0.40
0.84	0.5287	0.16	0.59	0.1280	0.41
0.83	0.5096	0.17	0.58	0.1137	0.42
0.82	0.4911	0.18	0.57	0.0994	0.43
0.81	0.4728	0.19	0.56	0.0851	0.44
0.80	0.4550	0.20	0.55	0.0708	0.45
0.79	0.4375	0.21	0.54	0.0567	0.46
0.78	0.4202	0.22	0.53	0.0424	0.47
0.77	0.4033	0.23	0.52	0.0283	0.48
0.76	0.3867	0.24	0.51	0.0141	0.49
0.75	0.3702	0.25	0.50	0.0000	0.50

\* Source: Nandini, N. 1995. Impact of Soil and Water Conservation Programme implemented by an NGO and Government organisation - A Comparative Study, M.Sc.(Ag.) Thesis, TNAU, Coimbatore.

## APPENDIX IV

## HAND OPERATED AGRICULTURAL IMPLEMENTS

Sl. No.	District	Seed cum fer-tiliser	Seed drill	Chaff cutter	Wheel hoes	Sprayer	Duster	Thresher	Rice planter	Wooden plough	Soil stirring	Soil turning
1.	Chennai	0	0	0	0	0	0	0	0	0	0	0
2.	Kancheepuram	495	1666	101270	7339	2933	187	423	139	91147	49203	19151
3.	Cuddalore	523	761	26084	5439	5768	2691	70	95	48069	17575	6836
4.	Vellore	71	34	124663	64074	3043	362	170	1	73229	25191	7602
5.	Tiruvannamalai	0	103	61695	16597	3013	213	178	33	1044206	37836	7042
6.	Salem (Composite)	3108	23	295656	1342	1025	766	76	584	202060	2519	454
7.	Dharmapuri	797	1153	136718	12840	5651	656	649	75	146947	44603	19655
8.	Coimbatore	175	594	29190	1078	7255	1589	265	544	87493	5074	724
9.	Erode	16	6	22682	1109	2572	491	84	793	70456	6724	1326
10.	Trichirapalli (Composite)	951	1269	187529	18428	11063	2564	231	300	165205	19957	9304
11.	Pudukottai	33	379	56428	8658	6481	87	21	3	56123	26541	59673
12.	Thanjavur (Composite)	13	129	27471	18872	13037	188	84	82	44607	24893	28798
13.	Madurai (Composite)	2650	342	90432	7819	4602	669	237	674	34876	9253	7447
14.	Dindugal	2	0	26352	15322	2420	225	811	334	61863	13496	8175
15.	Ramanathapuram	1429	10	7757	4	1279	4	30	190	46609	1559	2564
16.	Virudhunagar	2	39	6922	1354	3230	203	48	313	22571	2347	517
17.	Sivaganga	10	0	20858	1342	2073	1314	16	1349	78244	13466	7303
18.	Tirunelveli	943	352	63575	46730	7956	100	8	30	30911	9029	3120
19.	Tuticorin	0	22	21537	1645	3092	256	70	33	20021	4243	927
20.	Kanyakumari	1	92	7831	4085	1160	632	73	70	12503	782	60
21.	Villupuram	4493	34	85384	28097	4773	632	216	534	215910	34699	10504
22.	The Nilgiris	4823	1075	19407	12	3382	1152	0	4384	771	344	131
23.	Nagapattinam	37	225	101513	15495	15976	1164	133	362	57739	26383	10440
	State	24580	8313	1521004	280682	120887	15516	3943	17522	2661553	375719	211753

Source: Report on Fifteenth Quinquennial Livestock Census - 1994, Directorate of Economics and Statistics, Govt. of Tamilnadu, Chennai-600 006.

## ANIMAL OPERATED AGRICULTURAL IMPLEMENTS

Sl. No.	District	Triphali cultivator	Disc harrow	Seed cum fertili-ser drill	Seed drill	Leveller	Wetland puddler	Old pad thresher	Animal cart	Sugarcane crusher	Ghainy wheel	Persian wheel	Maize sheller
1.	Chennai	0	0	0	0	0	0	0	0	0	0	0	0
2.	Kancheepuram	2173	1342	785	2315	22666	7642	300	21552	259	62	19	0
3.	Cuddalore	2600	520	64	96	2590	2903	258	14976	172	34	3	0
4.	Vellore	1245	875	93	14	14193	986	1	12840	523	67	12	1
5.	Tiruvannamalai	1161	213	15	29	26331	6273	92	20984	499	86	9	2
6.	Salem (Composite)	4	227	0	0	2590	2903	1717	30005	722	215	14	29
7.	Dharmapuri	3696	684	900	2591	12390	3542	6166	15642	548	76	66	28
8.	Coimbatore	405	415	9	47	9782	2074	172	38239	140	31	12	49
9.	Erode	436	136	51	12	3593	475	44	43753	226	48	0	12
10.	Trichirapalli (Composite)	901	175	48	0	9976	3682	198	41094	377	185	0	0
11.	Pudukkottai	2880	53	2	2	4145	4097	38	25229	26	21	28	3
12.	Thanjavur (Composite)	641	942	31	0	9008	5371	134	30132	73	12	176	0
13.	Madurai	754	289	18	64	13943	5313	1137	19831	61	193	49	38
14.	Dindugal	582	82	27	639	4953	1367	231	10418	110	134	17	130
15.	Ramanathapuram (Composite)	191	21	0	81	4621	89	284	9563	9	38	13	0
16.	Virudhunagar	233	287	16	22	1983	357	45	8263	9	15	52	5
17.	Sivaganga	1234	38	3	117	8559	1399	538	14007	299	74	6	0
18.	Tirunelveli	432	1560	33	46	5685	2159	3	13831	5	7	1	0
19.	Tuticorin	123	13	62	44	2956	770	1405	10501	206	6	31	0
20.	Kanyakumari	24	0	0	0	2319	51	1	645	0	1	0	0
21.	Villupuram	7918	1479	7	40	25656	8163	407	29804	2373	222	22	0
22.	The Nilgiris	915	2955	30	2	7477	6316	142	29854	115	189	15	44
23.	Nagapattinam	3	0	0	0	0	265	17	0	8	0	0	0
	State	28608	12335	2194	6199	218073	69279	13330	441162	6759	1713	550	341

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## POWER OPERATED

Sl. No.	District	Leveller	Planter	Sprayer & duster	Sugarcane crusher	Oil engine		Electrical pumpset		
						0-5 HP	6-10 HP	0-5 HP	6-10 HP	> 10 HP
1.	Chennai	0	0	0	0	0	0	0	0	0
2.	Kancheepuram	353	58	1005	258	12775	6175	33082	7374	1833
3.	Cuddalore	8	15	313	61	4271	3707	6812	7516	3436
4.	Vellore	92	17	421	3363	7514	2257	9814	63171	3673
5.	Tiruvannamalai	213	17	519	823	10656	9712	70738	4878	53
6.	Salem (Composite)	0	0	2275	38	21412	429	85462	10008	436
7.	Dharmapuri	83	40	713	394	23384	13742	32570	3903	535
8.	Coimbatore	71	0	2744	630	11359	13823	53174	17115	1714
9.	Erode	48	18	7542	329	3682	4150	42083	21786	3257
10.	Trichirapalli (Composite)	99	15	2446	260	20011	9329	66286	10696	510
11.	Pudukottai	25	0	350	5	7721	448	16269	1192	571
12.	Thanjavur (Composite)	1	0	198	294	13952	98	9559	1793	240
13.	Madurai	157	134	425	47	7326	2738	41345	3879	470
14.	Dindugal	116	3	561	134	5951	1198	34592	4499	858
15.	Ramanathapuram (Composite)	7	4	16	2	1664	277	1558	483	57
16.	Virudhunagar	3	0	276	24	2696	152	8869	275	6
17.	Sivaganga	34	6	71	8	3603	56	4328	116	6
18.	Tirunelveli	9	1	1521	29	11018	789	31333	1549	360
19.	Tuticorin	115	25	739	18	2303	139	13235	680	122
20.	Kanyakumari	0	0	5	0	232	59	691	106	48
21.	Villupuram	33	4	753	530	28332	15937	51497	23876	1538
22.	The Nilgiris	3	23	753	78	15831	1564	14165	2172	157
23.	Nagapattinam	0	0	116	7	306	2	5	14	0
	State	1473	374	24072	7830	216959	94392	127590	16322	832732

TRACTOR OPERATED

Sl. No.	District	Power tiller	Mould board plough	Disc harrow	Seed-cum fertili-ser drill	Seed planter	Level-ler	Trailer	Combined harvester	Thresher's							
										Tractor operated	Self propeller	Paddy	Wheat	Multi crop	Maize	Chaff cutter	S.scane crusher
1.	Chennai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.	Kancheepuram	10941	374	549	11	14	687	154	29	1	5	0	0	0	0	0	0
3.	Cuddalore	426	795	596	31	7	119	9201	19	2	43	0	2	15	36	8	8
4.	Vellore	403	316	249	0	3	334	428	3	5	66	0	0	0	0	155	0
5.	Tiruvannamalai	200	118	222	4440	0	258	463	42	4	133	0	2	0	3	245	388
6.	Salem (Composite)	1795	245	290	43	15	102	2138	0	3	42	0	0	0	28	76	0
7.	Dharmapuri	465	162	325	24	10	481	631	16	3	18	1	2	1	47	236	0
8.	Coimbatore	624	345	455	1	2	367	1905	8	3	395	0	9	3	197	817	0
9.	Erode	632	717	629	15	7	582	880	9	13	40	4	198	60	350	60	0
10.	Trichirapalli (Composite)	743	808	446	9	5	595	1236	119	6	76	4	12	50	136	60	0
11.	Pudukottai	165	140	138	2	1	147	332	39	17	13	69	34	63	238	7	0
12.	Thanjavur (Composite)	434	573	386	8	0	88	1120	3	0	177	0	1	0	3	144	0
13.	Madurai	255	389	313	0	4	169	396	20	3	68	0	61	25	8	76	0
14.	Dindugal	628	1033	795	56	15	359	1175	81	2	349	2	17	17	83	19	0
15.	Ramanathapuram (Composite)	123	81	53	2	2	13	134	1	1	2	1	1	1	1	3	0
16.	Virudhunagar	300	823	491	19	7	143	1020	0	0	1	0	0	1	587	52	0
17.	Sivaganga	52	22	36	0	0	3	61	2	0	6	0	0	0	0	2	0
18.	Tirunelveli	886	523	736	2	0	191	1055	0	4	9	0	0	0	0	1	0
19.	Tuticorin	296	430	140	22	7	26	380	5	0	0	3	2	0	0	0	0
20.	Kanyakumari	4	1	1	0	0	1	9	0	0	7	0	0	0	0	0	0
21.	Villupuram	923	735	638	19	34	497	14067	26	3	47	0	1	0	29	131	0
22.	The Nilgiris	268	402	490	12	4	37	1912	29	7	8	8	3	0	0	12	0
23.	Magapattinam	0	0	0	0	0	10	-	5	0	0	0	0	0	0	0	0
State		10712	8994	8128	4716	137	6014	27403	458	77	1506	92	345	236	1750	2513	0

## APPENDIX V

## DISTRICTS WISE TOTAL WORKERS, MAIN WORKERS, MARGINAL WORKERS AND INDUSTRIAL CATEGORY OF MAIN WORKERS

District	Total workers	Main workers	Marginal workers	Culti-vators	Agricul-tural	Allied activi-labour-ers	Mining & quarry-ties	Indust-ries ing
1. Chennai	1173062	1171739	1323	883	199	9982	1245	7683
2. Kancheepuram (Composite)	1771326	1691977	79349	273563	569341	23419	4160	64943
3. Vellore	1223243	1148042	75201	268734	378770	9742	2269	80071
4. Dharmapuri	1156040	1070306	85734	497172	359836	7325	4504	10236
5. Thiruvannamalai	932432	882434	49998	343981	357117	7329	1098	34054
6. Cuddalore	880713	81697	62016	225618	364973	11236	22561	14623
7. Villupuram	1250009	1142429	107580	449926	513413	6845	3022	14256
8. Salem (Composite)	1918826	1803139	115689	465041	618515	17010	9708	105482
9. Erode	1213560	1152410	61150	274235	450036	7102	1528	46944
10. The Nilgiris	288869	281048	7821	10922	24992	150631	466	547
11. Coimbatore	1583452	1552076	31376	185562	455700	49339	2189	46151
12. Dindigul	864770	832493	32277	216559	366338	25045	1072	18655
13. Tiruchirapalli (Composite)	1919755	1801141	118614	600983	648518	5535	2822	52682
14. Thanjavur (Composite)	855966	796022	59944	196709	346310	5826	157	22121
15. Nagapattinam	982801	909057	73744	180844	487676	16122	262	10206
16. Pudukkottai	587254	516835	70419	251181	133588	4775	2131	7346
17. Sivaganga	497104	423735	73369	185828	122894	2349	208	4140
18. Madurai (Composite)	1517583	1454729	62854	249751	636323	13170	3905	19693
19. Virudhunagar	783741	749912	33829	145118	245133	5062	1151	28154
20. Ramanathapuram	519753	453837	65916	219832	97308	19634	39	12522
21. Tuticorin	605584	576878	28706	108824	192836	17351	1310	21321
22. Tirunelveli	1180369	1106043	74326	251257	349069	17291	2450	167749
23. Kanyakumari	488131	464087	24044	61567	177410	33996	928	13377
Tamil Nadu	24194343	22799066	1395277	5664090	7896295	463116	69185	802956

Source: The Economic appraisal 1996-97, Tamil Nadu.

*Plates*

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1. KILANGU NARUKKI

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2. MUD KUDHIR

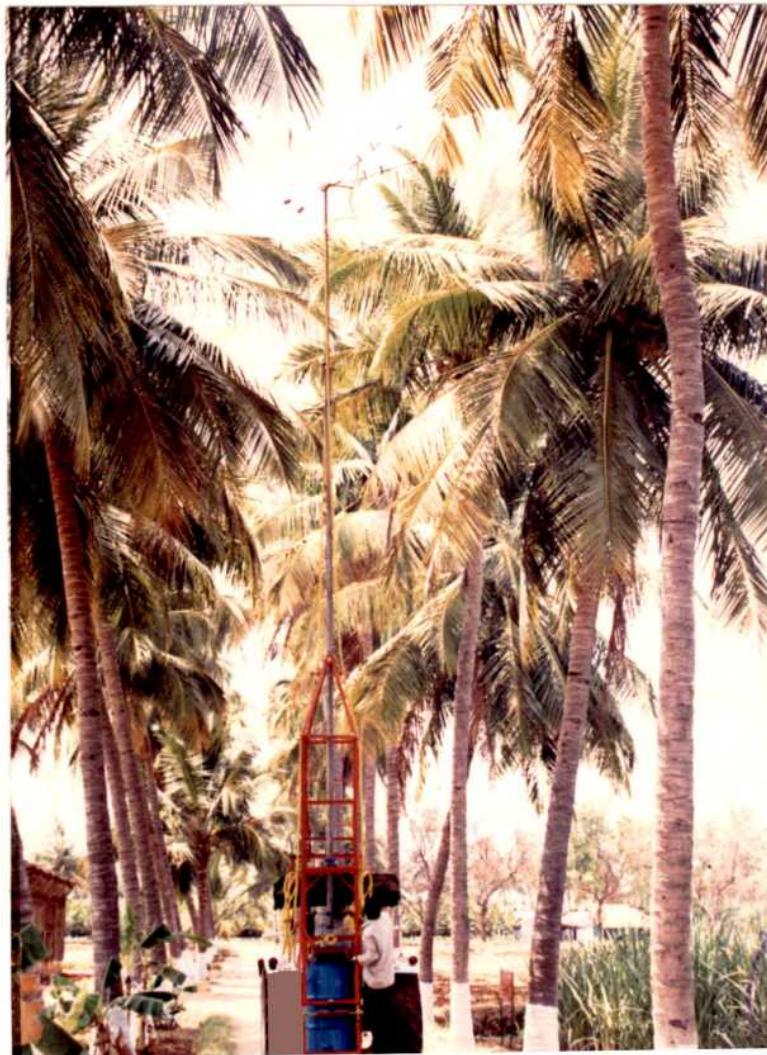


1. TRACTOR DRAWN CULTIVATOR WITH RIDGER CUM SEEDER

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2. TALL TREE SPRAYER



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