AN ANALYSIS OF FARMER'S PREFERENCE IN THE SELECTION OF FARM MACHINERY

By

DUDEKULA KHADARBASHA

B.Sc. (Ag.)

THESIS SUBMITTED TO THE
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(AGRICULTURAL STATISTICS)

CHAIRPERSON: Dr. SHAIK NAFEEZ UMAR

DEPARTMENT OF STATISTICS AND MATHEMATICS
AGRICULTURAL COLLEGE, BAPATLA- 522101
ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY
GUNTUR, ANDHRA PRADESH

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DECLARATION

I, D. KHADARBASHA, hereby declare that the thesis entitled "**AN ANALYSIS OF FARMER'S PREFERENCE IN THE SELECTION OF FARM MACHINERY"** submitted to the **Acharya N.G. Ranga Agricultural University** for the degree of **Master of Science in Agriculture** in the major field of **Agricultural Statistics** is the result of original research work done by me. I also declare that no material contained in the thesis has been published earlier in any manner.

Place: (**D. KHADARBASHA**)
BAM-15-059

Date:

CERTIFICATE

Mr. D. KHADARBASHA has satisfactorily prosecuted the course of research and that thesis entitled "**AN ANALYSIS OF FARMER'S PREFERENCE IN THE SELECTION OF FARM MACHINERY**" submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that neither the thesis nor its part thereof has been previously submitted by him for a degree of any University.

Date:
Place:

(Dr. SHAIK NAFEEZ UMAR)
Assistant Professor
Department of Statistics and Mathematics
Agricultural College
Bapatla

CERTIFICATE

This is to certify that the thesis entitled "**AN ANALYSIS OF FARMER'S PREFERENCE IN THE SELECTION OF FARM MACHINERY**" submitted in partial fulfilment of the requirements for the degree of **'Master of Science in Agriculture'** of the Acharya N.G. Ranga Agricultural University, Guntur is a record of the bonafide original research work carried out by **Mr. D. KHADARBASHA** under our guidance and supervision.

No part of the thesis has been submitted by the student for any other degree or diploma. The published part and all the assistance received during the course of the investigations have been duly acknowledged by the author of the thesis.

Thesis approved by the Student Advisory Committee:

Chairperson : **Dr. SHAIK NAFEEZ UMAR** _____
Assistant Professor
Department of Statistics and Mathematics
Agricultural College
Bapatla

Member : **Dr. V. SRINIVASA RAO** _____
Professor and University Head
Department of Statistics and Mathematics
Agricultural College, Bapatla

Member : **Dr. G. RAGHUNADHA REDDY** _____
Senior Scientist, Ag. Economics
RARS, LAM
Guntur

Date of final viva-voce:

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LIST OF ABBREVIATIONS

Symbol/Abbreviation	Meaning/Expansion
%	Per Cent
et al.	And Other People
etc.	And So On; And Other People/Things
Fig.	Figure
S. No	Serial Number
i.e.,	That Is
e.g.	For Example
NGO	Non-Governmental Organization
R^2	Coefficient Of Determination
TPS	Total Point Score
PPS	Percent Point Score
LGA	Local Government Areas
SRI	System Of Rice Intensification
PT	Power Tillers
&	And
UK	United Kingdom
IPM	Integrated Pest Management
<	Less Than
>	Greater Than
PC	Principal Components
MPEO	Multi-Purpose Extension Officer
AEO	Agricultural Extension Officer
MAO	Mandal Agricultural Officer
ADA	Assistant Director Of Agriculture
ATMA	Agricultural Technology Management Appraisal
DF	Degrees Of Freedom
Sig.	Significance

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Date :

Place : **(D. Khadar Basha)**

ABSTRACT

Author	:	**DUDEKULA KHADARBASHA**
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An attempt was made to study about the factors that influence the farmer in selection of farm machinery in Guntur, Krishna and Prakasam districts of Andhra Pradesh by collecting data from six villages, i.e., in each district one wet land and one dry land village covering 15 farmers in each village making a sample size of 90 farmers. The data was analysed using statistical tools like Spearman's Rank correlation, factor analysis, Ward's Minimum Variance Cluster analysis and non-parametric tests like Chi-Square test, Garret Ranking Techniques and Z-test.

This study showed that the variables mechanics reputation, engine, loan availability to the farmer and media influence were showing significant difference in between dry land and wet land farmers whereas the variables brand reputation, easy reparability, cost of the machine, appearance, performance, resale value and subsidy does not show any significant difference in between dry land and wet land farmers.

Factor analysis is a data reduction technique, which was used to identify a small set of variables, which accounts for a large proportion of the total variance in the original variables. The first five factors constitute about 63.60% of the total variance in the total 13 variables included in the analysis. The results indicated that multivariate approaches based on cluster analysis and factor analysis effectively summarized the source of variability in farmer's preference in the selection of farm machinery and precisely identifies different clusters of farmers based on their similarities existing among them.

Correlation studies showed that farmers prefer branded machinery which can have best engine capacity and its performance to agricultural operations was very good. It was also revealed that the farmers were buying the farm machinery based on the media influence. Hence, when the farmer was looking for a branded farm machinery, he was not considering spare parts availability, cost of machine, appearance of the machine, offers from the dealers, resale value and subsidy from the Government because the branded machinery generally have all these characteristics automatically.

Chi-square test showed that there was significant difference between the independent variables like age, education, farm size, family size, farming experience and crops grown with the preference in the selection of farm machinery.

Cluster analysis revealed that there were 4 different clusters of farmers existing among the selected villages based on the similarities existing in between them among the various variables that influence a farmer in selecting farm machinery. Among them, cluster IV was the largest with 30 farmers contributing about 33.33% of the total farmers. The cluster I was the second largest cluster with 28 farmers contributing about 31.11% followed by cluster II with 21 farmers with 23% of the total farmers. The smallest cluster was cluster III with 11 farmers contributing about 12% of the total farmers.

The various constraints that the farmers were facing during usage of farm machinery were analysed using Henry Garret Ranking technique and concluded that lack of credit facilities majorly influence the farmer's for buying farm machinery. The other constraints were small land holding, scattered farm holdings, high cost of farm machinery and maintenance of farm machinery. Farmers were least influenced by constraints like negative attitude of farmers towards improved machinery and belief of few farmers that the machinery was not suitable for varied types of lands and crops.

This study helps to identify the factors that were positively and negatively affecting the farmers in selecting the farm machinery. This helps to analyze the various constraints involved in selecting the farm machinery and suitable measures can to be taken to overcome these constraints. This will lead to increase the usage of farm machinery in the modern mechanized era to a greater extent.

Chapter I

INTRODUCTION

The term “mechanization” is used to describe tools, implements and machinery applied to improving the productivity of farm labour and of land; it may use either human, animal or motorized power, or combination of these. In practice, therefore, it involves the provision and use of all forms of power sources and mechanical assistance to agriculture, from simple hand tools, through draught animal power to mechanical power technologies**.**

Mechanization is a key factor for agricultural development and farmers’ well-being. Not only it helped improving labour productivity up to 500 times in comparison to agriculture without motorization and without chemical application (Mazoyer, 2001), mechanization provides also the power to ensure that agricultural operations for the soil, the plants and the animals are done precisely in time and with the highest efficiency. Thereby the quality of agricultural products specified by their ingredients, freshness, maturity and shelf life are improved, leading to higher prices at the market. Furthermore, with the recent development in terms of precision farming technologies, side effects for the environment due to fertilizers and chemicals can be reduced substantially. This also means that smaller amounts of fertilizers and chemicals are applied and production costs can be reduced.

Farm machinery helps in increasing production, productivity and profitability in agriculture by achieving timeliness in farm operations, bringing precision in metering and placement of inputs, reducing available input losses, increasing utilization efficiency of costly inputs (seed, chemical fertilizer, irrigation water etc.), reducing unit cost of produce, enhancing profitability and competitiveness in the cost of operations. It also helps in conservation of the produce and bi-products from quantitative and qualitative damages; enables value addition and establishment of agro processing enterprises for additional income and employment generation from farm produce. It is also one of the important inputs to user in all-round development in the rural India.

Food experts have argued that the farmers are unable to produce enough food for the growing population and raw materials for agro-industries due to the use of local or crude implements that are manually operated (Dauda, Agidi and Shotunde, 2010).

Farm machinery enables the farmer to raise a second crop or multi crop making the Indian agriculture attractive and a way of life by becoming commercial instead of subsistence. There is a need to double the food production by 2020. This will call for raising more crops in a year thus limiting the turnaround time. Increases production will require more use of agricultural inputs and protection of crops from biotic and abiotic stresses. This will call for greater engineering inputs which will require development and introduction of high capacity, precision, reliable and energy efficient equipment. Farmers, policy makers and developmental agencies now realize that for increasing production and productivity at reduced unit cost of production, free of arduous labour, agricultural mechanization is essential (Gitau *et al.*, 2010).

The selection of machinery that is suitable and profitable for their particular farm business is a recurrent, complex, and important decision confronting farm business managers. Multivariate analysis procedures are used to test whether certain characteristics of the farm have an effect on the importance attributed to factors affecting farm machinery purchase decisions.

There are number of factors that influence the extent of adoption of technology such as size of land holding, irrigation, labour, credit and risk orientation and socio-economic profile of farmer, characteristics or attributes of technology; the adopters or clientele, which is the object of change (Edwards, 2001). Farmers have been seen as major constraints in development process.They are innovators or laggards. Socio-psychological trait of farmers is important. The age, education attainment, income, family size, tenure status, credit use, value system, and beliefs were positively related to adoption. The biophysical environment influences the adoption. The conditions of the farm include its location, availability of resources and other facilities such as roads, markets, transportation, pests, rainfall distribution, soil type, water, services, and electricity. Thus the study is planned with following objectives.

Objectives:

1. To analyse the structure of inter-relationships (correlations) between various factors that are contributing in preference of farm machinery.
2. To group farmers into different clusters having similarities in their preference to farm machinery.
3. To analyse the factors that relate specifically in determining the type of machinery.
4. To analyse whether there is any significant difference between various characteristics of farmer and type of farm machinery preferred.

1.1 SCOPE AND IMPORTANCE OF STUDY

The findings of the study on preference of the farmers in the selection of farm machinery will largely helpful in the transfer of suitable technologies helpful for the farmers. The findings of the study on preferences of the farmers would help to know the favourable and unfavourable preferences towards agricultural machinery utilized by the farmers. The results of the study will be helpful to the researchers in knowing the important factors that are involved in the selection of farm machinery.

The constraints faced by the farmers in utilization of the farm machinery and their suggestions will also help the government to launch or modify the programmes. The study also will help the Department of Agriculture to develop strategies to overcome the constraints faced by the farmers and to facilitate them to adopt the latest technologies and improved practices for better utilization of farm machinery to increase the production and productivity of their crops.

Limitations of the study:

Like any other social research, this research also has the following inherent limitations:

1. The present study being a post graduate research, the investigator had the limitation of time, money, conveyance and other resources.
2. The study was designed on ex-post-facto research design, the memory bias on the part of the farmers cannot be ruled out.
3. The area of investigation was restricted to 6 villages in three districts of Andhra Pradesh and a sample size of 90 farmers as it was carried out.

PRESENTATION OF THE STUDY

The report of the thesis was presented in five chapters. The first chapter opens with the brief introduction including the objectives, scope and limitations of the study. Review of literature was the second chapter. The third chapter dealt with material and methods in the process of investigation. It includes locale of the study, selection of respondents, sampling procedure followed, choices of variables with their empirical measurement, devices and methods used for collection of data and statistical tools used etc.

The results of the work were presented in the fourth chapter. The fifth chapter brought the summary of the investigation with implications of the study and suggestions for future strategies. Literature cited also presented, Finally Appendices were provided at the end.

Chapter II

REVIEW OF LITERATURE

In this chapter, the thorough review of literature was of paramount importance to a research endeavour. It gives an idea for better understanding of the study and helps to find out the available information in relation to the objectives of the proposed research and assists in delineation of problem area and provides basis for theoretical frame work, testing and interpretation of findings. The investigation was carried out to study the various factors that influence the farmers in selection of farm machinery. Hence the present study was concerned with "An Analysis of Farmers Preference in the Selection of Farm Machinery".

"Mechanization of agriculture means the use of machines like tractors, water pumps, threshers, chaff cutters operated by oil, battery or electricity in the place of similar implements operated manually or by bullock power"- Singh *et al.*

Subedi (2016) analyzed the prevailing confusions, issues and challenges regarding using Likert data in social science research. The study concluded that in calculating reliability of Likert type data, ordinal alpha is used for ordinal data. He mentioned various statistical methods can be done in Likert data. For association between various variables, tools like Kendal tau B or C, Speraman's Rho or polychoric correlations can be done. For finding associations, chi-square test can be done.

Mottaleb *et al.* (2016) analyzed the factors associated with agricultural machinery ownership in Bangladesh and concluded that wealth status and land size holding of the sampled households was significantly and positively related to the ownership of agricultural machinery at the household level. They also suggested when farmers had improved access to credit and loans, either through formal banks or NGOs, machinery ownership was significantly more common.

Elum *et al.* (2016) analyzed the major constraints to the adaptive capacity of the potato and cabbage farmers using Garret Ranking technique and indicated that the groups of farmers are facing challenges related to gender issues and followed by inadequate rainfall as the second challenging issue.

Balamurugan *et al.* (2016) analysed the problems encountered by the farmers in cultivation of coconut in Theni District of Tamilnadu by using Garrett's Ranking Technique and revealed that 'incidence of pests and diseases' is the major problem in coconut cultivation faced by the village farmers with a mean score of 56.36, followed by the second vital problem 'high cost of input' faced by the coconut cultivators with a mean score of 54.67.

They also analysed the problems faced by the coconut farmers in marketing it could be understood that price fluctuation is the major problem with a mean score of 55.09, followed by 'Lack of Market Information' is the second important factor with a mean score of 44.37.

Ahmed *et al.* (2015) analyzed the relationship between influencing factors (affecting consumer behavior) and switching intentions of consumers regarding their mobile phones. The findings of this research study are confirming the impact of need based and opportunity based behavior, the impact of technology, innovations, changing demographics, brand image, perception, behaviors, attitudes, loyalty, advertising and other factors which have the significant effect towards stimulating and de-motivating the behaviouir of mobile users regarding keeping loyal with existing brand or switch towards another brand.

Zalkuwi *et al.* (2015) analyzed about the constraints influencing sorghum farmers using Garret Ranking Technique and the study revealed that major challenges experienced by farmers cultivating sorghum in India are low price of sorghum (75.34), variability in amount of rainfall (74.48), inadequate agricultural credit (74.48), extension support lacuna (72.32), shortage/high cost of inputs (71.81) and bird infestation (69.78).

Patel and Sanwal (2015) reported that age had significant relationship with preference of farmers towards selection of farm machinery.

Ayandiji *et al.* (2015) studied about the socio economic factors that affecting adoption of farm mechanization by Cassava farmers in Ondostate, Nigeria and defined that the effect of all independent variables i.e., age (number of years of farmers), level of education of respondent, farming experience, farm size, sex of respondent, access to extension agent, membership of cooperative, access to farm machines on the dependent variable (adoption of farm mechanization) tested were significant at 5% level of probability with the Cox & Snell R^2=0.307, Nagelkerke R^2=0.4.

The major determinants of adoption of farm mechanization were access to extension workers which had a positive relationship with adoption and access to farm machines which also had a positive relationship with adoption. Problems faced include access to spare parts, access to skilled man power, maintenance of farm machines, availability of machines in time required.

Ajah Julius (2014) studied about the factors limiting small scale farmers access and use of tractors for agricultural mechanization in Abuja, Nigeria. He analyzed data using descriptive statistics. He indicated that the major factors limiting the farmers from using tractors to work on their farms were high cost of tractor hiring services (64.09%) and inadequate sources of hiring points (19.29%) resulting in poor access to tractors and its implements. The cost of hiring tractor should be regulated by government to make them more accessible to farmers.

Aiyasha and Shivamurthy (2014) stated from their study on Knowledge of Farmers regarding use of *Trichoderma* that majority (47.77%) of the respondents belonged to middle age followed by old age (42.33%) and young age (10.00%).

Navadeep *et al.* (2014) reported majority of the respondents (50.83%) were middle age, followed by old age (35.84%) and young age (13.33%) from his study conducted on Satisfaction of Farmers regarding Subsidies Provided under National Food Security Mission.

Parmer *et al.* (2014) observed that age was negatively and non-significantly related to preference on farm machinery among the farmers.

Bagheri and Bordbar (2014) developed a descriptive survey research in order to assess challenges facing agricultural mechanization development in Iran. The results of factor analysis indicated that 69% of the variances of the challenges could be classified in seven groups, namely: programming, technical, infrastructural, managerial, economical, research and extension and content area. From each group the most important challenges facing agricultural mechanization development in Iran include: inefficiency of subside payment methods for buying agricultural machinery, large number of time-worn agricultural machinery, incomplete collection of agricultural equipment's for power generator machinery (tractor), slow trend of beneficiaries in accepting new technologies, financial weakness of agricultural beneficiaries, inefficiency of agricultural extension and education methods, and weakness of agricultural machinery producers and operators in protecting their guild benefits.

Divya *et al.* (2014) analyzed the constraints faced by farmers in adopting good agricultural practices by using Garret's ranking technique and concluded that inadequate knowledge about good agricultural practices was the most important reason for non- adoption. The other reasons ranked by non- adopters were increase in production costs and less land holding.

Su-mei *et al.* (2014) studied on consumer based brand research on agricultural machinery in China. A questionnaire survey on Chinese farmers' perception towards brands of agricultural machinery is prepared. The empirical study with tractor brands indicated that farmers showed different awareness to domestic and foreign agricultural machinery brands. National tractor brands got more attention from consumers and Dong fang hong (YTO) brand gained the most familiarity. Foreign brands, New Holland and John Deere had higher perceptive price, but Chinese brands, Dong fang hong (YTO) and Foton acquired higher perceptive value, and domestic brands, Dong fang hong (YTO) and Shi feng got more preference and purchase intention from consumers.

Sivakumar (2014) reported that consumers make purchase decisions in each and every aspect of their life. Thus studying consumer behaviour becomes more vital. All marketing decisions & activities are based on assumptions about consumer behavior. To study the factors influencing the purchase of agricultural tractors and to evaluate the most important factors like brand name, subsidy, horsepower, maintenance etc. considered for the purchase of agricultural tractors. The study was carried out in Sivaganga district of Tamil Nadu state. The researcher has used both primary and secondary data for his research. The researcher has collected primary data from the tractor owners who had bought their tractor for service to the dealer point during the study period in Sivaganga district. It is found as per the ranking given by the respondents subsidy is ranked first and followed by sources consulted, horse power, after sales service, price and brand name respectively are considered for purchase of tractors.

Singh *et al.* (2014) conducted customer satisfaction survey for various brands of tractors in Kotkapura region. The statistical Z test, total point score (TPS) and percent point score (PST) was used. From the Z-test, TPS and PPS tests fifteen technical parameters were analyzed and according to these technical parameters the Swaraj tractor brand was found to be the most efficient with (24.14) overall satisfaction score followed by HMT (21.56), Mahindra (16.97), Johndeere (15.39) and Sonalika (10.22).

Bhati *et al.* (2014) reported that extension contact was positively and significantly related with knowledge of farmers on different agricultural operations.

Rani (2014) studied the consumer buying behaviour, which refers to the buying behaviour of the ultimate consumer. Many factors, specificities and characteristics influence the individual in what he is and the consumer in his decision making process, shopping habits, purchasing behaviour, the brands he buys or the retailers he goes. A purchase decision is the result of each and every one of these factors. An individual and a consumer is led by his culture, his subculture, his social class, his membership groups, his family, his personality, his psychological factors, etc. For a successful consumer oriented market service provider should work as psychologist to procure consumers. By keeping in mind affecting factors things can be made favourable and goal of consumer satisfaction can be achieved. Study of consumer buying behaviour is gate way to success in market.

Sivakumar and Kaliyamoorthy (2014) revealed that consumers make purchase decisions in each and every aspect of their life. Thus studying consumer behaviour becomes more vital. All marketing decisions & activities are based on assumptions about consumer behaviour. Consumer behaviour deals with the behaviour that consumer displays in the consumption of goods right from purchasing, using, evaluating & disposing them. In other way, it deals with what they buy, how often they use it when they buy it, why they buy it where they buy and how they evaluate it after purchase. Understanding the consumer purchase process is critical to a marketer so as to design the marketing activities effectively. It is found as per the ranking given by the respondents subsidy is ranked first and followed by sources consulted, horse power, after sales service, price and brand name respectively are considered for purchase of tractors.

Singh *et al.* (2014) conducted customer satisfaction survey for various brands of tractors in Kotkapura region. Chi-square test was applied to calculate overall satisfaction score. From the Chi-square test income, age of respondents and Horse Power of tractors were related with brands, but education and land of respondents were not related with brands when consumers intend to purchase new or second hand tractors

Kiranmaye (2013) reported that more than half of the chilli farmers belonged to middle age (66.67%), followed by the rest belonging to young age (21.67%) and old age (11.66%) categories..

Abdul and Velayutham (2013) studied that Consumer Behavior had an essential criteria in Present Marketing Scenario. Consumers are the kings of markets. Without consumers no business organization can run. All the activities of the business concerns end with consumers and consumer satisfaction. They analyse that Customer behavior study is based on consumer buying behavior, with the customer playing the three distinct roles of user, payer and buyer. Consumer buying behaviour has become an integral part of strategic market planning.

Abdullah and Samah (2013) studied about the factors impinging farmers use of agricultural technology. Based on the findings, it can be concluded that farmers' perceptions and levels of education, as well as extension-workers' knowledge, the management of the extension program and the physical conditions of the area are all factors that affect technology adoption among farmers.

Kiranmaye (2013) revealed that more than half of the chilli farmers were semi-medium farmers (56.67%), followed by the remaining as medium farmers (23.33%) and small farmers (20.00%).

Kiranmaye (2013) indicated that a little more than half of the chilli farmers belonged to medium (56.67%) extension contact category, followed by the rest having high (25.00%) and low (18.33%) extension contact categories.

Dharmraj (2013) studied to identify the factors that affect consumers purchasing behaviour towards agriculture inputs like fertilizer, seeds, agrochemicals, oils and lubricants etc. Buying behaviour refers to the act of consumers obtaining and using goods and services and the decision process that determines these acts. Buying decision is a set of many decisions which may involve a product, brand, style, quality, dealer, time, price and mode of payment. Price is the most important consideration at the time of purchasing agriculture inputs followed by packaging and branding, fair billing and home delivery are considered relatively less important. It can be concluded from the result that the respondents were mainly purchasing the agri-inputs from the cooperative societies of their area. Major reasons for purchasing from cooperative societies

included fairness in billing and credit facilities given to the farmers. From the above results, it can be stated that agri-inputs remain a price-sensitive market as factors like quality, brand and packaging.

Kumar *et al.* (2013) revealed that majority of the vegetable growers had medium farming experience (71.66%), followed by the remaining having high (15.00%) and low (13.33%) farming experience.

Nagraj *et al.* (2013) conducted a study to know the knowledge and Adoption level of paddy growers of Raichur district about farm mechanization practices. The study was conducted in Sindhanur and Manvitaluks of Raichur district comprising 120 respondents from six villages. The result showed that nearly half of the respondents (45.00%) belonged to medium level of overall knowledge category about farm mechanization practices. Majority of the respondents had complete knowledge i.e., mode of operation, frequency of use and specification of the implements such as mouldboard plough, harrow, cultivator, power tiller, cage wheel, puddler, sprayer, combine harvester and thresher. Further, less than half of the respondents (42.50%) belonged to medium level of adoption category.

Uma *et al.* (2013) analyzed the causes of Regional Migration using Garret Ranking scale. According to Garrets ranking technique table, unemployment/ Seasonal employment is one of the important reasons to migrate; second foremost reason is low wage. Compared to agriculture, construction wages are high hence they are migrate to higher waged construction area. Accessibility to loans is also pulling them to migrate to higher waged construction area which was ranked third in Garret ranking table.

Bisen and Sharma (2013) stated that age had negative and significant relationship with knowledge regarding selection of farm machinery.

Lamidi and Akhande (2013) reviewed status, challenges and prospects of agricultural mechanization in Osun State of Nigeria. Personal observation, oral interview, past records and questionnaire were used to collect data from various establishments visited in the nine selected Local Government Areas (LGAs) in Osun State. Results identified shortage of capital, land tenure, small farm holding and fragmented land, poor infrastructural facilities, poor attitudes toward adoption of new innovation and non- availability of storage means as problems.

Archana (2012) reported that majority of the respondents had low farm machinery status (39.17%), followed by those who had medium (36.67%) and high (24.16%) farm machinery status.

Tidke *et al.* (2012) reported that socio-economic status was significantly related with knowledge of chickpea farmers.

Aikins and Haruna (2012) conducted a survey to identify their personal profile, perception about the causes of tractor breakdown, and the major constraints affecting tractor maintenance and repair. Data was collected through questionnaire administration. Tractor owners and operators perceived the causes of tractor breakdown to be careless tractor operation, inadequate maintenance, aged tractors, poor roads to farms, use of fake spare parts for tractor maintenance and repair, and problems to tractor operation in the farms including stumps, roots and buried stones. It was concluded that the major constraints affecting tractor maintenance and repair were found to be high cost of genuine spare parts, poor educational background of owners and operators, and lack of financial credit and there was need for the provision of professional training in tractor operation, financial credit and after-sales-service to tractor owners and operators.

Manickam *et al.* (2012) studied on vulnerability of agricultural productivity to climate change in Mahabubnagar district, Andhra Pradesh carried out average linkage method of cluster analysis for identifying the clusters of rainfall as well as crop yields. They suggested that the cluster analysis provides useful information about the yield response range corresponding to the different rainfall patterns that are likely to occur during the crop growth season.

Nirmala (2012) observed that more than half of the SRI paddy growers had medium farming experience (52.50%), followed by the remaining with low (30.00%) and high (17.50%) farming experience.

Quayum and Ali (2012) analyzed about the variation in adoption across selected areas to investigate the justification for wider use of power tillers. They indicated that there is a significant relationship between number of PT and credit availability. Area, number of small farm holdings and credit availability are found to have significant and positive association with intensity of power tiller use in different regions of

Bangladesh. Analysis of Logit Model applied to farm level data indicates that the educational level and income surplus of farmers have significant positive relationship with ownership of power tillers. Thus credit should be provided to the farmers and owners of all regions of the country to buy power tillers to adopt evenly to increase crop production profitably. They also found that credit availability can significantly and positively affect the adoption of power tillers.

Shrivastava and Kumar (2011) studied that consumer behaviour in the rural market is even more perplexing because of a singular lack of consistency in groups which are homogeneous in parameters of demographics- Age, occupation, education and income. Most marketers realize that India is on the cusp of momentous change. The economy is vibrant, incomes are rising & the habits, preferences & attitude are changing rapidly. But nowhere is it more evident than in rural India. There is, thus an emerging need to build expertise in rural marketing. The study of consumer behaviour implies how & why a particular consumer reacts to the decisions of producers. The study of consumer behaviouur is the study of how individual make decision to spend their available resources (time, money, effort) on consumption related items. It includes the study of why they buy it, when they buy it, where they buy it, how often they buy it & how often they use it.

Cavane (2011) reported that more than half of the maize growers belonged to small family size (65.8%), followed by the remaining belonged to medium (25.0%) and large (9.2%) family size.

Jalal-Ud-Din (2011) examined how the small farmers are facing with socio economic problems in adopting new farm technology. This study revealed that majority of the respondents was illiterates. Moreover, most of them had meager facilities of purchasing agricultural inputs, fertilizers, sprays and storage facilities. Most of the households belonged to low monthly income group and large families. This study further revealed that lack of proper extension services of the agriculture department was another obstacle in improving the productivity of small farmers in the study areas. These studies showed that majority of the respondents were tenants and owner-cum-tenants and therefore were not prone to take any risk. This study also revealed that lack of latest information as well as non-availability of credit facilities was main problems of the small farmers of the study area.

Thiyagarajan (2011) revealed that the knowledge and adoption of the SRI farmers and their extension contact were positively and significantly related with each other,

Prashanth (2011) revealed that little more than half of the organic cotton farmers (51.67%) had medium level of extension contact, followed by the remaining having high (30.83%) and low (17.50%) extension contacts.

Tiwari and Mishra (2011) reviewed that effective technique such as hierarchical agglomerative clustering approach, fizzy clustering, hierarchical divisive clustering can be carved out for solving different agricultural problems of various complexities by intelligent use of data mining and its tools. The cluster heuristic allows data to be combined into useful patterns that may lead to better decisions in agriculture and allied sciences.

Loganathan (2011) reported that group pressure to conform is referred to in the consumer and social psychology literature as social influence or interpersonal influence, which has an impact on consumer product and brand preferences, on evaluations of product quality and also on buying decisions.

Mamta and Bharat (2011) strongly believed that data mining and cluster analysis should be a part of agriculture because they can improve the accuracy of decision systems. The cluster heuristic allows data to be combined into useful patterns that may lead to better decisions.

Farida *et al.* (2011) reported that majority of paddy farmers (45%) belonged to more than 45 years category followed by (40%) in between 35 to 45 years category, (9.7%) in between 25 to 35 years and (5.3%) in between 20 to 25 years category.

Kale *et al.* (2011) reported that education had significant and positive relationship with knowledge of women farmers towards vermicompost production.

Truogh Thi Ngoc (2010) studied about the factors affecting mechanization in rice harvesting and drying in the Mekong Delta, South Vietnam. He demonstrated that the important factors affecting the mechanization of harvest and post harvest were farmers' education and perception on machines, capital, rice area, technical training, knowledge of extension workers, methods of extension organization and information

system. Attending training and farmers' knowledge were two important factors positively and significantly affected the use of machines in rice harvesting and drying by farmers. High education and female managed-farmers also increased the use of harvesters. The information from the intermediate agents also contributed to the use of harvesters by farmers

Manjunath (2010) found that a little less than three fifth of the paddy respondents belonged to small family size (57.14%), followed by the rest belonged to medium family (31.46%) and large family (11.40%) size.

Cankurt and Miran (2010) studied on farmers decision making tractor brand choices. The purpose of study is farmers in choosing of the tractor brand to determine what criteria they are given more priority. Low price, durability, fuel economy, dealers reliability and brand value are taken into account. Results indicate that durability (0.35) took first place among the purchase criteria, fuel economy (0.28), brand value (0.20), low price (0.09) and the dealers reliability (0.08) have been followed respectively.

The important factors affecting farmers' use rice harvester and dryer included farmer education, perception on machinery, and capital. The farmers with younger age, larger land, attending training, knowledge of extension staff, methods of organization and extension, number of extension personnel and information system, infrastructures.and rice ecosystem affected the use of machinery in harvest. Market price and advertisement affected farmers' use machinery(Truong Thi Ngoc Chi,2010).

Hartwich and Scheidegger, (2010) confirmed in their findings that education, social networks, farm size, income level, and age are especially important in the rate in which farmers are willing to adopt new techniques, regardless of where they are from or their specific culture.

Feng *et al*. (2010) aimed at farmers' purchase behavior for agricultural machinery in China, proposed a model of farmers' purchase intention based on the theory of planned behavior (TPB), gained data from 12 provinces by questionnaire, adopted logistic regression to estimate the model. Research results reveal that significant factors influencing farmers' purchase intention for agricultural machinery are educational level, income, governmental policy, attitude (cognitive component and affective component) and perceived behavior control (convenience), the effect extent and direction of these factors are discrepant.

Ayinde *et al.*(2010) examined the determinants of adoption of Downy mildew resistant maize by small-scale farmers in Kwara state. They found that Farm size and extension contact were found to be significant at 5% level of significance. The study recommends that farm expansion and intensification of extension visit would be an incentive to adoption decisions by small-scale farmers in the study area.

Ghosh (2010) studied about the factors such as irrigation, access to institutional credit, government support extension services and experience of farmers on the level of mechanization. Using logit regression model, the study reveals that the factors such as irrigation, access to institutional credit, size of farm holding are found to have positive significant bearing on the level of farm mechanization. The study also reveals that younger generation are more apt for farm mechanization than the old ones, i.e., age-old customs act as hindrance to mechanize the farming practices.

Madhushekar (2009) reported that a little more than two fifth of the chilli growers had medium farming experience (41.25%), followed by the rest having low (37.50%) and high (21.25%) farming experience.

Nepal and Thapa (2009) analyzed effective factors on agricultural mechanization in Nepal. Information was collected through a questionnaire survey covering 120 farm households, group discussion and key informant interviews. In all the instances of farm mechanization, the degree of commercialization is the most influential factor, indicating significant role of mechanization in agricultural commercialization.

Vijaya Chithra *et al.* (2009) studied about the factors influencing towards start up a small scale industry using Garret ranking technique and concluded that majority of the respondents are opined that the external factors ‘consumers’ and ‘suppliers’ are the major role plays to start a Small scale industry unit.

Hussain and Lee (2009) studied a classification of rainfall regions in Pakistan. The classification was obtained by applying factor analysis and Ward’s method of hierarchical clustering technique by 10 days rainfall data from 32 specific weather stations for the period of January 1980 to December 2006. The factor analysis provides three factors account for 94.6 percent of the total variance and the study area are divided into six rainfall regions by hierarchical clustering method which have specific similar rainfall patterns.

Aybek and Senel (2009) conducted a study to determine mechanization properties of widely used tractors in Eastern Mediterranean turkey and to evaluate farmers opinion to use tractors. The pearson correlation coefficient between the farm size and tractor power, farm size and number of tractors, farm size and operation time of tractor and tractor power and operation time of tractor were found to be 0.43(moderate), 0.82(strong correlation coefficient), 0.34(moderate correlation), 0.22 (low correlation) respectively.

Singh *et al.* (2009) conducted a study in Jaunpur District of Uttar Pradesh state to find out the relationship of socio- economic status with economic motivation of the farmers. The study exposed that majority of farmers belonged to medium socioeconomic status followed by 18.0 percent belonged to low socioeconomic status, while 16.0 percent farmers possessed high score category of socioeconomic status. It was observed that except education, age, land holding and socio- economic status have been found to have significant association with economic motivation.

Nepal and Thapa (2009) analyzed effective factors on agricultural mechanization in Nepal. Information was collected through a questionnaire survey covering 120 farm households, group discussion and key informant interviews. In all the instances of farm mechanization, the degree of commercialization is the most influential factor, indicating significant role of mechanization in agricultural commercialization.

Rasouli *et al.* (2009) studied about the major factors affecting the implementation of national agricultural mechanization programs in Iran. A Delphi technique was used to gather experts points of view on variables affecting agricultural mechanization program. The Delphi investigation showed that the main constraints on farm mechanization were small farms and scattered agricultural land holdings, lack of common understanding of mechanization, lack of national strategy for agricultural mechanization, high price of agricultural machinery, problem of topography in technology transfer and inefficient mechanization implementation programmes.

Based on a study conducted by Truong (2008), there are many characteristics for running a successful technology strategy. The main reasons for non-adoption of technology are weak perceptions of technology and low education of farmers, low teaching capacities, limited knowledge among extension workers, disorganization,

geographical conditions, and inadequate resources and funds. Furthermore, farmers should must have a certain level of education and be very familiar with rice farming in order to be motivated to learn new technology.

Truong (2008) which accentuated on factors such as education, negative perceptions, lack of capital, small land areas, ineffective infrastructure facilities and limited capacity of extension workers as the main drivers that led to low technology adoption. Additionally, factors such as the knowledge level of extension workers, methods of organization and management of extension programs, and local conditions are also highlighted as the drivers for technology adoption.

Sharma *et al*. (2008) reported that socio-economic status was positively and significantly related with knowledge of rice farmers.

Akpoko (2007) used probit analysis to study about the level of adoption and factors influencing the adoption of intermediate farm tools and implements and concluded that availability of after sale services facilities, compatability, cost, energy/skill requirement, preference for imported ones are some technology specific factors that play important role in farmers adoption decision. Factors such as extension contact and energy/skill requirement did not have significant effect on the intensity of adoption of farm implements in Kaduna State.

Lagat *et al.*(2007) used chi- square analysis to test the significance of main types of tools/equipment by jua kali mechanics to repair and service agricultural machinery. The results indicated that some tools/equipment have insignificant use, which means that specific repair and servicing work requiring their use is not done, which indicates that the quality of work done by mechanics is poor. Therefore the hypothesis that there is no significant difference between the tools/equipments used by jua kali mechanics to repair and service agricultural mechines and those recommended by manufacturers is rejected.

Akpoko (2007) suggested that family size had a negative influence on the use intensity of intermediate farm tools equipment. This suggests that farmers with small family size use IFTE more intensively. Farming experience has also been shown to have negative impact on purchase of farm machinery. Farmers experience with the use of traditional tools may limit land cultivation.

Kulkarni and Narendranath (2007) applied a multivariate approach for studying rainfall pattern. They found that multivariate approaches like clustr analysis efficiently summarized the source of variabilities in the rainfall which can be used to study the most likely rainfall pattern of the districts which would help in planning suitable crop strategies on the basis of the availability of the rainfall during the crop period.

Prasad Reddy *et al.* (2007) reported that land holding had positive and significant relationship with knowledge of rice farmers on eco-friendly technologies. He also reported that farming experience had positive and significant relationship with the farmers.

Hingley (2007) reported that the brands being an important source of competitive advantage, knowledge of branding is needed to inform their management. After reviewing the literature, the article aims to report the findings of a case study that investigated the role of branding in the industrial purchase of agricultural tractors in the UK. The study's overall conclusion is that branding can play an important role in industrial purchase decisions, brand name, price, dealer proximity, quality of dealer's service, and buyer's experience of the dealer. The conjoint analysis revealed that brand accounts for 38.95 per cent of the purchase decision, ahead of price (25.98 per cent) and service (14.90 per cent). The importance of brand varies according to the tractor brand. Also, the overall utility varies, with John Deere and New Holland brand names appearing as marketing assets and Valtra, Massey Ferguson, and Case IH as marketing liabilities. Among the studies other findings are that UK tractor buyers are brand loyal. The study focuses on tractors in the UK, so while it provides an insight into the role of branding in an industrial purchase situation, further research is required in other product categories before the findings can be generalized.

Sami Ayramo (2006) presented Cluster analysis for organize a collection of data items into clusters, in which items inside a cluster are more “similar” to each other than they are to items in the other clusters. Those similarity characteristic can be expressed in different ways, along with the reason of the study, to domain-specific assumptions and to previous knowledge of the problem.

Gopinath (2005) reported that more than half of the bengalgram growers (62.00%) had low level of socio-politico participation followed by the remaining with medium (23.33%) and high (14.67%) levels of socio-politico participation.

Ramesh and Santha (2005) concluded that less than half of the organic farmers were illiterate (45.00%), while a little less than one third of them had primary education (31.00%), followed by middle school (10.00%), high school (8.00%) and intermediate (6.00%) education.

Serafin *et al*. (2005) applied cluster analysis techniques to the verification of quantitative precipitation forecasts to create group of rain gauges displaying interrelated measurements and a well-defined spatial structure, related to the interaction of air masses with Orographic obstacles. Verification scores computed in each cluster help in detecting the spatial variation of a weather prediction model's performance.

Gopinath (2005) revealed that less than half of the Bengal gram farmers had small land holding (49.34%), followed by the rest with medium land holding (31.33%) and big land holding (19.33%).

Nagaraja (2004) identified the important factors influencing the purchasing of the goods among the rural consumers. They are quality, price, easy availability, advertising, use by the neighbour consumers and experience of the own family members. In the rural areas, cinema dialogues, pictures and names of famous heroes and heroines, flowers, symbols, entertainments, quickies, short theatre commercials, TV spots, cricket themes, road shows, vow programmes are used extensively to influence the consumer behaviour. He also found that the rural consumer is very much attached to and influenced by touch and feel aspect of any promotional activity.

Natarajan (2004) stated from his study on impact of Farmers Field School on Rice in Pondichery that majority (55.56%) of the respondents belonged to middle age followed by old age (32.22%) and young age (12.22%).

Obaiah (2004) stated that farming experience had positive and significant relationship with knowledge of farm machinery in rice growing areas of Krishna-Godavari Zone of Andhra Pradesh.

Dixit *et al.* and Sujatha *et al.* (2004) used Garret ranking technique and identified low price of milk as one of the serious constraint pointed out by the farmers. Lack of marketing facilities due to distant location of milk societies for selling milk was also significant marketing constraints for dairy enterprise. Other important problems expressed by the farmers were irregular payment from milk society and lack of credit availability showing that the farmers could not rely on milk cooperative societies for selling the milk and getting the credit to get optimum production from their dairy animals.

Subash Chander and Singh (2004) observed that land holding had significant relationship with knowledge of farmers on cotton IPM practices in Haryana.

Ani *et al*. (2004) studied about the correlation between socio economic characteristics of rural farmers and their adoption of farm technologies in Southern Eboyni State, Nigeria and concluded that the educational level of the farmers is having significant association with the adoption of farm machinery. They also concluded that there is negative relationship between farming experience and adoption of those other technologies implies that new entrants into the farming business adopted more than older farmers.

Gadge and Shailendra (2003) conducted a study on changes in the farmers' Socio-economic status in Karanja blocks of Wardha district. The study reported that age, education, economic status, farm size, annual income, economic motivation and extension contact were significantly correlated with the change in cropping pattern. However age was negatively correlated in the study.

Kumari and George (2003) reported that less than three fourth of coconut farmers had high school education (71.30%), followed by rest having education up to intermediate (21.50%), graduation (7.00%) and post-graduation (0.20%).

Hansen and Christensen (2007) mentioned that the brands would involve a symbolic value which assists the people for choosing the best product based on their satisfaction and need. People do not purchase specific brand just for need and design, but also in a trail for enhancing their self-esteem and self-respect in the society. Brand relies on the quality of its goods in the market and content of satisfaction of the consumer in its services and products.Such offers the trust of consumers in the brand. Apart from this, it was noted that if consumers trust a quality of brand it makes a positive connection or link to the brand and consumers would have a reason for becoming loyal to the brand.

Sagwal and Malik (2001) reported that education had a positive and significant relationship with the knowledge of rice farmers. He reported that land holding had positive and significant relationship with knowledge of rice farmers.

Olmstead and Rhode (2001) concluded after studying the benefits from adoption of farm tractors. They conclude that economic historians have largely underestimated the impact of mechanization on growth coming through the channels of reduction in input costs and land augmentation.

Senthil Kumar (2000) revealed that most of the respondents (69.01%) were not members of any organization and 21.66 per cent were members in one organization, 8.33 per cent of respondents were office bearers in one organization and only less than 1.00 per cent of them were office bearers in more than one organization.

Alene *et al.*(2000) in their study in Ethiopia reported that farmers with higher level of education had a higher probability of adopting improved technology.

Gowda *et al.* (2000) reported that education had significant and positive relationship with regarding to knowledge of groundnut farmers.

Khan *et al.* (1999) reported that farming experience had negative and non-significant relationship with knowledge on eco-friendly technologies in rice cultivators.

SankaraRao (1995) reported that 80.00 per cent of the tribal farmers had medium farm power and 20.00 per cent farmers had low farm power.

Adesina and Forson (1995) tested the hypothesis that farmer's perception of technology characteristics significantly affects their adoption decisions. They suggested that extension workers do not influence the technology transfer in all cases. Farmers are also important as sources of technology information and agents of technology transfer. When farmers assess the characteristics of new technology and find them to match their preference, they often give the technologies to other farmers to test and evaluate their by setting into motion an endogenous process of technology transfer.

Bisschoff *et al.* (1994) studied on identification of factors that influence farmers buying behavior of new agricultural tractors. Eight factors were identified by means of principle VARIMAX factor analysis. These factors are product and service facilities, operational qualities, pre-purchase planning, after sales service, ergonomics, ease of operation, cost of credit and potential savings. These factors declare a cumulative variance of 55.65 percent.

Mohandas (1994) identified the non-availability of labour and increased costs, weed infestation and incidence of pests and diseases as serious constraints as perceived by paddy farmers and that the less important problems perceived by the farmers were destruction of crops by wild animals and high transportation cost.

Rao (1993) reported that majority (62.50%) of the tribal farmers had medium farm power followed by the rest with high (20.10%) and low (17.40%) farm power.

Prasad (1990) observed that majority (78.00 %) of tribal farmers had average level of farm implements and machinery followed by those with high (15.00%) and low (7.00%) level of farm implements and machinery.

El.Hossary (1988) confirmed that land fragmentation with numerous canals and drainage ditches, narrow access roads to individual farm plots seriously restrict the use of mechanized equipment.

Johnson G. Thomas *et al.* (1985) conducted a multivariate analysis of factors influencing farm machinery purchase decisions. They tested the relative importance of various socioeconomic characteristics on the decision to purchase machinery. They concluded that the type of soil, value of machinery, operator's age and operator's education are the important factors that influence the purchase of farm machinery.

Feder *et al*. (1985) found a negative relationship between age and technology adoption. They found that the older the farmer the less likely they adopt because they have confidence in their long adopted practices.

Chapter III

MATERIALS AND METHODS

This chapter deals with the research methodology adopted for the present study with respect to the selection of study area, selection of respondents, collection of data and analytical techniques. This chapter consists of various statistics on different aspects in order to have the knowledge of the study area, geographical location, size and number of land holding including farm machineries and different socio-economic indicators of the study area. The details of the method and techniques adopted for the present study are describes as below:

3.1 RESEARCH DESIGN

An ex-post-facto research design was used to achieve the objectives of the study. The ex-post-facto research design was a systematic empirical inquiry in which the scientist does not have any direct control of variables because they are inherently not manipulable. Inferences about relations among variables were made without direct interventions, from concomitant of variables.

3.2 SAMPLING PROCEDURE

3.2.1 Selection of Study Area:

Andhra Pradesh state was purposively selected as the researcher hails from the state and was familiar with the local language i.e., Telugu which would build up a good rapport to obtain relevant information. The India map showing Andhra Pradesh was presented in Fig. 3.1

3.2.2 Selection of District

The study was conducted in Guntur, Krishna and Prakasam districts of Andhra Pradesh during the year 2016-17. These districts were selected purposively for the study. Andhra Pradesh map showing Guntur, Krishna and Prakasam districts was presented in Fig.3.2.

3.2.3 Selection of Mandals

After listing out the total number of mandals in each district in descending order of the magnitude based on mechanization,in each district, 2 mandals were selected purposively one in dry land area and other in wetland area thus selecting a total of six mandals.

3.2.4 Selection of villages

After listing out the total number of villages in each mandal, one village was selected randomly.

3.2.5 Selection of Respondents

In each village, 15 farmers were selected by random sampling procedure, thus making a total of 90 farmers.

3.3 VARIABLES AND THEIR EMPIRICAL MEASUREMENT

For the research study, six independent variables were selected based on the available literature, discussion with experts, members of advisory committee and progressive farmers.

3.3.1 Methods Used For Measurement of Selected Independent Variables

Selected variables were classified in accordance with mean and standard deviation as low, medium and high, except the age, education, land holding.

S.No.	Category	Confidence interval
1	Low	< (Mean-S.D)
2	Medium	Mean ± S.D
3	High	> (Mean+ S.D)

3.3.1.1 Age

It was operationalized as the number of years completed by an individual at the time of investigation for categorization of the farmers on age, the norms of maximum admissible age of the members into youth club or middle age club i.e., 35 years and old age club i.e., 51 years were taken as yard stick.

S. No.	Category	Age
1	Young Age	Up to 35 years
2	Middle Age	36 - 50 years
3	Old Age	Above 51 years

3.3.1.2 Education

Education refers to the formal educational level of the farmers. Education qualification of a respondent was operationalized as the extent of formal education an individual possessed. The minimum and maximum score was 1 and 3 respectively.

S. No.	Educational qualification	Score
1.	Illiterate to 5^{th} class	1
2.	6^{th} to 10^{th} class	2
3.	Intermediate and above	3

3.3.1.3 Family size

Number of persons who were living along with the respondent was considered for measuring this variable. The minimum and maximum scores were 1 and 3 respectively. The following scoring pattern was followed for quantifying this variable.

S. No.	Family members	Score
1	Up to 4 members	1
2	5-7 members	2
3	>8members	3

Based on the scores obtained, the farmers were classified into three groups by using mean and standard deviation.

3.3.1.4 Land holding

The land holding has been operationalized as the number of acres of land possessed by the respondent at the time of enquiry. The information about land holding was obtained in terms of acres. The minimum and maximum score was 1 and 3 respectively. To calculate the individual farmers land holding, the scoring pattern adopted was as given below.

S. No.	Land Holding Category	Score
1	Marginal (1 to 5 acres)	1
2	Small (6 to 10 acres)	2
3	Large (above 10 acres)	3

3.3.1.5 Farming experience

Number of years of experience a farmer is having in agriculture was considered for measuring this variable. The minimum and maximum scores were 1 and 3 respectively. The following scoring pattern was followed for quantifying this variable.

S. No.	Farming experience	Category	Score
1	Up to 10 years	Low farming experience	1
2	11-20 years	Medium farming experience	2
3	> 20 years	High farming experience	3

3.3.1.6 Number of crops grown

Number of crops a farmer is growing for a particular year was considered for measuring this variable. The minimum and maximum scores were 1 and 3 respectively. The following scoring pattern was followed for quantifying this variable.

S. No.	Number of crops grown	Score
1	Single crop	1
2	Two crops	2
3	More than 2 crops	3

3.3.1.7 Usage of Machinery

This is measured on the basis of scores given by the farmers for the thirteen variables on a five point scale giving 5 points to highly agree and one point to highly disagree. After the summing the scores of all these variables, we consider this score as total score of farmer in using the farm machinery. Based on the total score, we categorise the farmers into 3 groups according to mean and standard deviation. Thus the minimum and maximum scores were obtained between 1 and 3 respectively. The following scoring pattern was followed for quantifying this variable.

S. No.	Machinery usage	Category	Score
1	Score less than 52	Machinery usage low	1
2	Score between 53-62	Machinery usage medium	2
3	Score above 63	Machinery usage high	3

3.4 INSTRUMENTS USED FOR COLLECTION OF DATA

A well-structured interview schedule was the instrument used for data collection. Keeping in view the specific objectives, based on relevant literature, discussion with researchers, extension specialists and field extension personal, a well-structured interview schedule was developed.

An interview schedule was designed with three parts. Part I included all general information of the farmer. Part II included factors which were influencing the farmer in the purchase of farm machinery and Part III included the constraints that are faced by farmers in selection of farm machinery.

3.5 STATISTICAL TOOLS USED

Statistical method is the scientific method of judging collective natural or social phenomena from the results obtained by the analysis or enumerated or collected statements.

For the purpose of statistical analysis to fulfil the set objectives, the following statistical tools were used:

1. Frequencies and percentages
2. Z- test
3. Chi-square test (Modified)
4. Spearman's Rank Correlation coefficient
5. Factor analysis
6. Cluster analysis
7. Garret Ranking Technique

3.5.1 Frequencies and Percentages

Frequencies and percentages were used to know the distribution pattern of the farmers according to the objectives under study. Percentages were used for standardization of the sample size by calculating the number of individuals that would be under the given category if the total number of individuals were 90.

3.5.2 Z- test

A z-test is a statistical test used to determine whether two population means are different when the variances are known and the sample size is large. The test statistic is assumed to have a normal distribution, and nuisance parameters such as standard deviation should be known for an accurate z-test to be performed.

Null Hypothesis: $\boldsymbol{H_o: \mu_1 = \mu_2}$

Alternative Hypothesis: $\boldsymbol{H_1: \mu_1 \neq \mu_2}$

To calculate the standardized statistic

$$z = \frac{|\overline{x_1} - \overline{x_2}|}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Where $\overline{x_1}, \overline{x_2}$ = means of 2 samples

s_1, s_2= standard deviations of two samples

n_1, n_2=sizes of two samples

If p value is less than 0.05, then null hypothesis is rejected and conclude that there is significant difference between the two samples, otherwise we do not reject null hypothesis

3.5.3 Chi-Square Test

The Chi Square statistic is commonly used for testing relationships between categorical variables. The null hypothesis of the Chi-Square test is that no relationship exists on the categorical variables in the population; they are independent.

The Chi-Square statistic is most commonly used to evaluate Tests of Independence when using a cross-tabulation (also known as a bivariate table). Cross-tabulation presents the distributions of two categorical variables simultaneously, with the intersections of the categories of the variables appearing in the cells of the table. The Test of Independence assesses whether an association exists between the two variables by comparing the observed pattern of responses in the cells to the pattern that would be expected if the variables were truly independent of each other. Calculating the Chi-Square statistic and comparing it against a critical value from the Chi-Square distribution allows the researcher to assess whether the observed cell counts are significantly different from the expected cell counts.

The calculation of the Chi-Square statistic is quite straight-forward and intuitive:

$$\chi^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$$

Where O_i = the observed frequency (the observed counts in the cells) and E_i= the expected frequency.

If many of the frequencies are less than 5, then Modified Chi-Square test was used for drawing accurate conclusions.

$$\chi^2_{Yates} = \sum_{i=1}^{n} \frac{(O_i - E_i - 0.5)^2}{E_i}$$

As depicted in the formula, the Chi-Square statistic is based on the difference between what is actually observed in the data and what would be expected if there was truly no relationship between the variables.

3.5.4 Spearman's Rank Correlation Co-efficient (ρ)

In statistics, Spearman's Rank correlation coefficient or Spearman's Rho, named after Charles Spearman and often denoted by Greek letter ρ, is a non-parametric measure of rank correlation (statistical dependence between the rankings of two variables). It assesses how well the relationship between variables can be described by using a monotonic function.

The Spearman's correlation between variables is equal to the Pearson correlation between the rank values of those variables; while Pearson correlation assesses linear relationships. Spearman's correlation assesses monotonic relationships (whether linear or not). If there are no repeated data values, a perfect Spearman's correlation of -1 to +1 occurs when each of the variables is a perfect monotonic function of the other.

The Spearman's rank correlation is high when observations are having a similar rank between the variables and low when observations have dissimilar rank between the variables. Spearman's rank correlation is appropriate for both continuous and discrete data, including ordinal variables.

For a sample size *n*, the *n* raw scores X_i. Y_i are converted to ranks r_{x_i} and $r_{y_i}$and ρ is computed from formula:

$$\rho = 1 - \frac{6\sum_{i=1}^{n} d_i^2}{n(n^2 - 1)}$$

Where d_i=difference between the ranks

n= number of observations

The Spearman correlation coefficient is often described as being "nonparametric". This can have two meanings: First, a perfect Spearman correlation results when *X* and *Y* are related by any monotonic function. Contrast this with the Pearson correlation, which only gives a perfect value when *X* and *Y* are related by a linear function.

3.5.5 Factor Analysis

Factor analysis seeks to resolve a large set of measured variables in terms of relatively few categories, known as factors. This technique allows the researcher to group variables into factors (based on correlation between variable), and the factors so derived may be treated as new variables and their values derived by summing the values of the original variables which have been grouped into the factor.

The main applications of factor analytic techniques are:

a) To reduce the number of variables and

b) To detect the structure in the relationships between variables, that is to classify variables.

The basic principle of expressing two or more variables by a single factor illustrates principal components analysis. Extraction of principal components amounts to a variance maximising (VARIMAX) rotation of the original variable space. For example, in a scatter plot one can think of the regression line as the original 'x' axis, rotated so that it approximates the regression line. This type of rotation is called variance maximising because the criterion for (goal of) the rotation is to maximise the variance (variability) of the "new" variable (factor), while minimising the variance around the new variable.

In principal component analysis, we assume that all variability in an item should be used in the analysis. This method usually starts with the correlation matrix, where the variances of all variables are equal to 1.0, therefore, the total variance in that matrix is equal to the number of variables.

Eigen Values

The variances extracted by the factors are called the eigen values. This name derives from the computational issues involved. The sum of the eigenvalues is equal to the number of variables.

Reliability test

Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. It is considered to be a measure of scale reliability. Technically speaking, Cronbach's alpha is not a statistical test – it is a coefficient of reliability (or consistency).

Cronbach's alpha can be written as a function of the number of test items and the average inter-correlation among the items. Below, for conceptual purposes, the formula for the standardized Cronbach's alpha is given as

$$\alpha = \frac{N.\bar{c}}{\bar{v} + (N-1).\bar{c}}$$

Here N is equal to the number of items,

$\bar{c}$ is the average inter-item covariance among the items and

$\bar{v}$ Equals the average variance.

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy is a statistic which indicates the proportion of variance in our variables which is common variance, i.e., which might be caused by underlying factors. High values (close to 1.0) generally indicate that a factor analysis maybe useful for the data. If the value is less than 0.50, the results of the factor analysis probably won't be useful. Values between 0.5-0.7 are satisfactory, values between 0.7-0.8 are good and values between 0.8 and 0.9 are great and above 0.9 are best.

Bartlett's Test of Sphericity

The Bartlett's Test of Sphericity relates to the significance of the study and thereby shows the validity and suitability of the data being collected through the study. For Factor Analysis to be recommended suitable, the Bartlett's Test of Sphericity must be less than 0.05.

Communalities

The proportion of variance of a particular item that is due to commonfactors (shared with other items) is called communality.

The whole sample data were subjected to factor analysis using SPSS 16.0 software. The purpose of using factor analysis was to group the variablesused in the schedule into meaningful factors. Principal component factoranalysis with VARIMAX rotation was used to extract the factors.

3.5.6 Cluster Analysis

Researches frequently come across situations requiring the ability to define homogenous group of objects such as varieties, locations etc. Cluster analysis is one of the primitive techniques in multivariate analysis, in which no assumptions are made concerning the number of groups or the group structure suggested (Johnson and Wichern, 2003). It is a class of techniques used to classify objects or cases into relatively homogenous groups called clusters. Grouping is done on the basis of similarities or distances (dissimilarities). The basic objective of cluster analysis is to discover natural grouping of the items (or variables)

3.5.3.1 Similarity measures

Most efforts to produce a rather simple group structure from a complex data set necessarily require a measure of closeness or similarity. Important considerations include the nature of the variable (discrete, continuous and binary) or scores of measurement (nominal, ordinal, interval and ratio) and subject matter knowledge.

3.5.3.2 Ward's Minimum Variance Method

The variance methods attempt to generate clusters to minimize the within cluster variance. The distance between two clusters is the sum of squares between the two clusters summed overall variables. It is the most commonly used variance method.

Ward's distance between clusters C_i and C_j is the difference between the total within cluster sum of squares for the two clusters separately and within cluster sum of squares resulting from merging the two clusters in cluster $C_{ij.}$

$$D_w(c_i, c_j) = \sum_{x \in c_i} (x - r_i)^2 + \sum_{x \in c_j} (x - r_j)^2 + \sum_{x \in cij} (x - r_{ij})^2$$

Where r_i, r_j and r_{ij} are the centroids of the clusters c_i, c_j and c_{ij} respectively

3.5.3.3 Dengrogram

A dendrogram (tree graph) is a two dimensional diagram for displaying clustering results. Vertical lines represent clusters that are joined together. The position of the line on the score indicates the distances at which clusters were joined. The dendrogram is to be read from left to right.

The procedure for these clustering methods is same; these methods differ in computation of the distance matrix at every step, i.e., the distance of the clusters those are already formed with the other (remaining) objects.

3.5.7 Garret Ranking Technique

Garret ranking technique was used to rank the constraints faced by the farmers while purchasing the farm machinery. As per this method, respondents have been asked to assign the rank for all the factors and the outcomes of such ranking have been converted into score value with the help of following formula.

$$\textbf{Percent position} = \frac{100(R_{ij} - 0.5)}{N_j}$$

Where R_{ij} = Rank given for the *i*th variable by *j*th respondents

N_j= Number of variable ranked by *j*th respondents

With the help of Garrett's Table, the percent position estimated is converted into scores. Then for each factor, the scores of each individual are added and then total value of scores and mean values of score is calculated. The factors having highest mean value is considered to be the most important constraint.

Chapter IV

RESULTS AND DISCUSSION

The chapter highlights the results of the study. The data collected from the farmers were analyzed by using relevant statistical tools and the results obtained were presented under the following heads.

1. To study the profile characteristics of the farmers
2. To analyse whether there is significant difference between dry land and wet land farmers in usage of farm machinery.
3. To analyse whether there is any significant difference between various characteristics of farmer and type of farm machinery preferred.
4. To analyse the structure of inter-relationships (correlations) between various factors those were contributing in usage of farm machinery.
5. To analyse the factors that relate specifically in determining the type of machinery
6. To group the farmers into different clusters having similarities in their preference to farm machinery.
7. To analyse the major constraints faced by the farmer during the purchase of farm machinery.

4.1 TO STUDY THE PROFILE CHARACTERISTICS OF THE FARMERS

In social science, it is essential to know about respondent's profile characteristics which would serve as a base for clear and thorough understanding about the subjects. The information about the profile characteristics would help in deriving exact results from the data. In this study, distribution of the respondents according to their characteristics and the relevant discussion has been presented.

4.1.1 Age

Table 4.1 Distribution of the farmers according to their age

S. No	Category	Farmers	
		Frequency	Percentage
1	Young Age(<35 years)	21	23.33
2	Middle Age(36 to 50 years)	47	52.23
3	Old Age (> 50 years)	22	24.44
Total		90	100.00

Source: Field Survey.

It could be seen from the Table 4.1 and Fig 4.1 that majority (52.23%) of the farmers belonged to middle age category, followed by 24.44 per cent in the old age and 23.33 per cent under young age category.

The probable reason for the above trend might be, the middle age farmers were more enthusiastic to know the existing schemes and make use of them for their farming. Further the middle age farmers had high work efficiency than younger and older farmers. These findings were in agreement with the findings of Obaiah (2004).

4.1.2 Education

Table 4.2 Distribution of the farmers according to their education

S. No	Category	Farmers	
		Frequency	Percentage
1	Upto 5th Class	36	40.00
2	6th To 10th Class	37	41.11
3	Intermediate And Above	17	18.89
Total		90	100.00

Source: Field Survey.

From the Table 4.2 and Fig 4.2 it could be seen that majority of the farmers were educated up to high school (41.11%), followed by primary school (40.00%), then followed by Intermediate and above education (18.89%).

Thus, the findings revealed that majority of the farmers found to be educated. This is because of the availability of the higher secondary schools in the study area. The

other possible reasons for the various education levels may be due to their medium annual income, poor economic status, lack of awareness among elders in the village about education and lack of encouragement from their family members. This finding was in conformity with the finding of Aiyasha and Shivamurthy(2014).

4.1.3 Farm Size

Table 4.3 Distribution of the farmers according to their farm size

S. No.	Category	Farmers	
		Frequency	Percentage
1	Marginal Farmers(>5acres)	30	33.33
2	Small Farmers(5 to 10 acres)	44	48.89
3	Large Farmers(10acres<)	16	17.78
Total		90	100.00

Source: Field Survey

From Table 4.3 and Fig 4.3 it was evident that majority of the farmers were small (48.89%), followed by marginal (33.33%) and large (17.78%).

The possible reason might be that in the recent times most of the families were of nuclear system and joint family system was gradually fading away. This resulted in fragmentation of land among the family members. This result was in agreement with findings of Sajith Kumar (2004).

4.1.4 Family Size

Table 4.4 Distribution of the farmers according to their family size

S. No.	Category	Farmers	
		Frequency	Percentage
1	Small Family(1 to 4 members)	49	54.44
2	Medium Family(5 to 7 members)	39	43.33
3	Large Family(above 8 members)	2	2.23
Total		90	100.00

Source: Field Survey

Table 4.4 and Fig 4.4 revealed that majority (54.44%) of the farmers belongs to small family size bearing one to four members followed by medium family size farmers (43.33%) bearing five to seven members and large family size farmers with more than eight people (2.23%).

This might be due to the fact that majority of the farmers belonged to small family size category and after selecting agriculture as main source of livelihood, they tend to lead their separate life with their wives and children.

4.1.5 Farming Experience

Table 4.5 Distribution of the farmers according to their farming experience

(n=90)

S. No.	Category	Farmers	
		Frequency	Percentage
1	Low Experienced(up to 10 years)	19	21.11
2	Medium Experienced(10 to 20 years)	44	48.89
3	High Experienced(above 20 years)	27	30.00
Total		90	100.00

Source: Field Survey

Table 4.5 and Fig 4.5 revealed that majority (48.89%) of the farmers had medium farming experience of about ten to twenty years followed by high farming experience (30.00%), more than 20 years and a meagre portion of the farmers belong to low experience category with up to 10 years (21.11%) of farming experience.

This might be due to the fact that majority of the farmers belonged to middle and old age categories and involvement of farmers in agriculture as occupation since ages and as their livelihood. The finding of the study was in agreement with the findings of Natarajan (2004).

4.1.6 Number of Crops Grown

4.6 Distribution of farmers based on the number of crops grown

S. No.	Category	Farmers	
		Frequency	Percentage
1	One crop	25	27.78
2	Two crops	52	57.78
3	More than 2 crops	13	14.44
Total		90	100.00

Source: Field Survey

Table 4.6 and Fig. 4.6 shows that majority of farmers are growing two crops in an year (57.78%) followed by farmers who are growing one crop in an year (27.78%) and more than two crops in an year (14.44%).

This might be due to the fact that majority of the farmers belonged to area where there is plenty of water source for raising two crops in a year.

4.1.7 Machinery Preference

Table 4.7 Distribution of the farmers according to their machinery preference (n=90)

Usage		Farmers	
		Frequency	Per cent
Valid	Machinery usage low	14	15.56
	Machinery usage medium	70	77.77
	Machinery usage high	6	6.67
Total		90	100.00

Source: Field Survey

Table 4.7 and Fig. 4.7 shows that majority of the farmers are having medium usage of farm machinery (77.77%) followed by low usage of farm machinery (15.58%) and only 6.67% of the farmers are using machinery high.

This might be due to fact that farmer's interest in using farm machinery is based on several factors that may be or may not be accessible to the farmer.

4.2 TO ANALYSE WHETHER THERE IS SIGNIFICANT DIFFERENCE BETWEEN WET LAND AND DRY LAND FARMERS IN THE USAGE OF FARM MACHINERY

To study whether there is significant difference between wet land and dry land farmers in usage of farm machinery, Z- test was computed and the values were presented in Table 4.8.The significant difference between wet land and dry land farmers was tested by null hypothesis and empirical hypothesis.

Null hypothesis

There is no significant difference between wetland and dry land farmers in the usage of farm machinery.

Empirical hypothesis

There is a significant difference between wetland and dry land farmers in the usage of farm machinery.

Table 4.8 Z-test between dry land and wet land farmers in usage of farm machinery

S. No	Variable	Area	Mean	SD	t-value	P-value
1	Brand reputation	Wet land	4.95	0.29	0.44	0.65
		Dry land	4.97	0.14		
2	Availability of spare parts	Wet land	3.82	0.44	1.89	0.04
		Dry land	3.95	0.21		
3	Easy reparability	Wet land	3.02	0.54	0.85	0.39
		Dry land	3.11	0.43		
4	Mechanics reputation	Wet land	4.02	0.33	2.03	0.04*
		Dry land	4.17	0.38		
5	Engine	Wet land	3.88	0.43	1.34	0.07
		Dry land	4.15	0.36		
6	Cost	Wet land	2.62	0.68	1.06	0.28
		Dry land	2.75	0.48		
7	Appearance of the machine	Wet land	3.88	0.64	0.36	0.71
		Dry land	3.93	0.49		
8	Performance with regards to agricultural operations	Wet land	4.95	0.20	1.43	0.15
		Dry land	5.00	0.00		
9	Offers from the dealer	Wet land	2.35	0.57	1.89	0.04
		Dry land	2.57	0.54		
10	Resale value	Wet land	4.20	0.45	1.13	0.25
		Dry land	4.31	0.46		
11	Loan availability	Wet land	2.84	0.56	1.98	0.05*
		Dry land	3.02	0.26		
12	Subsidy	Wet land	4.97	0.14	0.58	0.56
		Dry land	4.95	0.20		
13	Media influence	Wet land	2.93	0.39	2.04	0.09*
		dry land	3.04	0.20		

* and ** indicates significance at 5% and 1% level of significance

From the table 4.8, it is evident that the wet land and dry land farmers differ from each other in variables loan availability because the farmers of wet land areas are able to get higher amount of loans compared to dry land farmers because they are having sufficient water for raising the number of crops and the crops are expected to come for harvest at correct time without delay as the resources are good. Thus there is a significant difference between wet land and dry land farmers with regard to loan availability. With addition to loan availability, media influence and mechanics reputation are showing significant difference between wet land and dry land farmers whereas the rest of variables like brand reputation, cost of machines, engine, performance with regard to agricultural operations etc., are variables with regarding to the machine which does not show significant difference between wet land and dry land farmers.

4.3 TO ANALYSE WHETHER THERE IS ANY SIGNIFICANT RELATIONSHIP BETWEEN VARIOUS CHARACTERISTICS OF FARMER AND USAGE OF FARM MACHINERY

To analyse whether there is any significant difference between various characteristics of farmer and type of farm machinery preferred, Modified Chi-Square test was used. The relationship between the profile and the farmer's usage towards machinery were tested by null hypothesis and empirical hypothesis.

Null hypothesis

There is no association between the profile of the farmers and usage of machinery.

Empirical hypothesis

There is a significant association between the profile of the farmers and usage of farm machinery.

4.3.1 Age vs. Usage of farm machinery

Table 4.9 Contingency table for Age and Usage of farm Machinery

Count		Machinery usage (wetland)			Machinery usage (dry land)			Total
		Low	Medium	High	Low	Medium	High	
Age	Young Farmers	5 (11.11%)	7 (15.56%)	0 (0.00%)	4 (8.89%)	5 (11.11%)	0 (0.00%)	21 (23.33%)
	Middle Aged Farmers	1 (2.22%)	18 (40.00%)	2 (4.44%)	6 (13.33%)	20 (44.44%)	0 (0.00%)	47 (52.22%)
	Old Aged Farmers	0 (0.00%)	8 (17.78%)	4 (8.89%)	1 (2.22%)	7 (15.62%)	2 (4.44%)	22 (24.44%)
Total		6 (13.33%)	33 (73.33%)	6 (13.33%)	11 (24.44%)	32 (71.11%)	2 (4.44%)	90 (100.00%)
Modified Chi-Square Value				16.59			10.04	
P-Value				0.00**			0.03*	

Here * and ** indicates significance at 5% and 1% level of significance respectively.

From table 4.9, the chi-square value in case of wet land areas is 16.59 and P-value is 0.00 which is significant at 1% level of significance where as in case of dry land areas, the chi-square value is 10.04 and the P-value is 0.03 which is significant at 5% level of significance. Thus age is showing significant association with farmer's usage of farm machinery. Thus different age grouped farmers are having different opinions and usage of farm machinery

It was revealed that in case of wet land areas, the highest percentage (40.00%) is obtained between middle aged group farmers and medium farm machinery usage category and lowest per cent (0.00%) is obtained between old aged group farmers with low machinery usage category and young aged farmers with high machinery usage category.

In case of dry land areas, the highest percentage (44.44%) is obtained between middle aged farmers and the farmers whose machinery usage is medium and the lowest percentage (0.00%) is obtained between young and medium aged farmers who are having high machinery usage. Overall one can say that medium aged farmers with medium machinery usage are high in both wetland and dry land areas.

4.3.2 Education vs. Machinery Usage

Table 4.10 Contingency table for Education and Machinery Usage

Count		Machinery usage			Machinery usage			Total
		Wet land area			Dry land area			
		Low	Medium	High	Low	Medium	High	
Education	Primary Schooling	6 (13.33%)	11 (24.44%)	0 (0.00%)	9 (20.00%)	9 (20.00%)	1 (2.22%)	36 (40.00%)
	Secondary Schooling	0 (0.00%)	17 (37.80%)	2 (4.44%)	2 (4.44%)	16 (35.60%)	0 (0.00%)	37 (41.10%)
	Intermediate and above	0 (0.00%)	5 (11.11%)	4 (8.89%)	0 (0.00%)	7 (16.56%)	1 (2.22%)	17 (18.90%)
	Total	6 (13.33%)	33 (73.33%)	6 (13.33%)	11 (24.40%)	32 (71.11%)	2 (4.44%)	90
Modified Chi-Square value				20.33			13.06	
P-Value				0.00**			0.01*	

* and ** indicates significance at 5% and 1% level of significance respectively.

From table 4.10, the chi-square value in case of wet land areas is 20.33 and P-value is 0.00 which is significant at 1% level of significance where as in case of dry land areas, the chi-square value is 13.06 and the P-value is 0.01 which is significant at 5% level of significance. Thus educational qualification shows a significant association with farmer's usage of farm machinery. Thus different educational farmers are having different opinions on usage of farm machinery.

It is revealed that in case of wet land areas, the highest percentage (37.80%) is obtained between farmers with secondary schooling and medium farm machinery usage category and lowest per cent (0.00%) is obtained between farmers with educational qualification of secondary schooling and intermediate and above category with low machinery usage group.

In case of dry land areas, the highest percentage (35.60%) is obtained between farmers with educational qualification of secondary schooling and the farmers whose machinery usage is medium and the lowest percentage (0.00%) is obtained between farmers with secondary educational schooling and has high machinery usage and farmers with intermediate and above qualification and were under low machinery usage category. Overall majority of the farmers are having primary and secondary schooling educational qualification.

4.3.3 Farm Size vs. Machinery usage

Table 4.11 Contingency table for Farm size and Machinery usage

Count		Machinery usage (wet land)			Machinery usage (dry land)			
		Low	**Medium**	**High**	**Low**	**Medium**	**High**	**Total**
Farm Size	Marginal	5 (11.11%)	9 (20.00%)	2 (4.44%)	7 (15.60%)	7 (15.60%)	1 (2.22%)	31 (34.40%)
	Small	1 (2.22%)	17 (37.80%)	1 (2.22%)	4 (8.90%)	19 (42.20%)	0 (0.00%)	42 (46.70%)
	Large	0 (0.00%)	7 (15.60%)	3 (6.70%)	0 (0.00%)	6 (13.33%)	1 (2.22%)	17 (18.90%)
Total		6 (13.33%)	33 (73.33%)	6 (13.33%)	11 (24.50%)	32 (71.11%)	2 (4.44%)	90 (100%)
Modified Chi-Square value				11.08			10.23	
P-Value				0.02*			0.02*	

* and ** indicates significance at 5% and 1% level of significance respectively.

From table 4.11, the chi-square value in case of wet land areas is 11.08 and P-value is 0.02 which is significant at 5% level of significance where as in case of dry land areas, the chi-square value is 10.23 and the P-value is 0.02 which is significant at 5% level of significance. Thus farm size shows a significant association with farmer's usage of farm machinery. Thus different levels of farmers are having different opinions and usage of farm machinery.

In case of wet land areas, the highest percentage (37.80%) is obtained between small farmers and medium farm machinery usage category and lowest per cent (0.00%) is obtained between farmers with large area under agriculture with low machinery usage group.

In case of dry land areas, the highest percentage (42.22%) is obtained between small farmers with less land holding and the farmers whose machinery usage is medium and the lowest percentage (0.00%) is obtained between farmers with large areas under agriculture and was categorized under low machinery usage group and small farmers who were categorized under high machinery usage category. Overall majority of the farmers are small farmers and were under medium machinery usage category.

4.3.4 Farming Experience vs. Machinery usage

Table 4.12 Contingency table of Farming experience and machinery usage

Count		Machinery usage (wet land)			Machinery usage in (dry land)			Total
		Low	Medium	High	Low	Medium	High	
Experience	Low	4 (8.89%)	4 (8.89%)	0 (0.00%)	5 (11.11%)	6 (13.33%)	0 (0.00%)	19 (21.11%)
	Medium	1 (2.22%)	17 (37.78%)	2 (4.44%)	5 (11.11%)	19 (42.22%)	0 (0.00%)	44 (48.90%)
	High	1 (2.22%)	12 (26.67%)	4 (8.89%)	1 (2.22%)	7 (15.56%)	2 (4.44%)	27 (30.00%)
Total		6 (13.33%)	33 (73.33%)	6 (13.33%)	11 (24.44%)	32 (71.11%)	2 (4.44%)	90 (100%)
Modified Chi-Square value		13.44			10.80			
p-value		0.00*			0.02*			

* and ** indicates significance at 5% and 1% level of significance respectively.

From table 4.12, the Modified Chi square value in case of wet land areas is 13.44 and P-value is 0.00 which is significant at 1% level of significance where as in case of dry land areas, the Modified Chi square value is 10.80 and the P-value is 0.02 which is significant at 5% level of significance. Thus farming experience shows a significant association with farmer's usage of farm machinery. Thus different levels of farming experience are having different opinions and usage of farm machinery.

In case of wet land areas, the highest percentage (37.80%) is obtained between medium experienced farmers and medium farm machinery usage category and lowest per cent (0.00%) is obtained between low experienced farmers with high machinery usage.

In case of dry land areas, the highest percentage (42.22%) is obtained between medium farming experienced farmers where the machinery usage is medium and the lowest percentage (0.00%) is obtained between low and medium farming experienced farmers under high machinery usage group. Overall majority of the farmers are medium farming experienced farmers and were under medium machinery usage category.

4.3.5 Number of crops grown vs. Machinery usage

Table 4.13 Contingency table for number of crops grown and machinery usage

Count		Machinery usage (wetland)			Machinery usage (dryland)			Total
		Low	Medium	High	Low	Medium	High	
Crops	One Crop	4 (8.89%)	6 (13.33%)	0 (0.00%)	8 (17.78%)	7 (15.56%)	0 (0.00%)	25 (27.78%)
	2 Crops	2 (4.44%)	22 (48.90%)	4 (8.89%)	2 (4.44%)	21 (46.67)	1 (2.22%)	52 (57.78%)
	Above 2 Crops	0 (0.00%)	5 (11.11%)	2 (4.44%)	1 (2.22%)	4 (8.89%)	1 (2.22%)	13 (14.44%)
Total		6 (13.33%)	33 (73.33%)	6 (13.33%)	11 (24.44%)	32 (71.11%)	2 (4.44%)	90 (100%)
Modified Chi-Square value				10.53			12.89	
P-value				0.03*			0.01*	

* and ** indicates significance at 5% and 1% level of significance respectively.

From table 4.13, the Modified Chi square value in case of wet land areas is 10.53 and P-value is 0.03 which is significant at 5% level of significance where as in case of dry land areas, the Modified Chi square value is 12.89 and the P-value is 0.01 which is significant at 5% level of significance. Thus the number of crops grown per year shows a significant association with farmer's usage of farm machinery. Thus different crops raising farmers are having different opinions and usage levels in the selection of farm machinery.

In case of wet land areas, the highest percentage (48.90%) is obtained between farmers who raise 2 crops per year and were in medium farm machinery usage category and lowest per cent (0.00%) is obtained between farmers who raise single crop and were in high machinery usage category and the farmers who grow more than 2 crops but were categorized under low machinery usage category.

In case of dry land areas, the highest percentage (46.67%) is obtained farmers who raise 2 crops per year and were in medium farm machinery usage category and the lowest percentage (0.00%) is obtained between farmers who raise single crop and were in high machinery usage category Overall majority of the farmers grow 2 crops per year and were under medium machinery usage category.

4.3.6 Family Size vs. Machinery Usage

Table 4.14 Contingency table for Family size and Machinery usage

Count		Machinery Usage (wet land)			Machinery Usage (dry land)			
		Low	**Medium**	**High**	**Low**	**Medium**	**High**	**Total**
Family Size	Small	6 (13.33%)	20 (44.44%)	2 (4.44%)	6 (13.30%)	14 (31.11%)	1 (2.22%)	49 (54.44%)
	Medium	0 (0.00%)	13 (28.90%)	3 (6.76%)	5 (11.11%)	18 (40.00%)	0 (0.00%)	39 (43.33%)
	Large	0 (0.00%)	0 (0.00%)	1 (2.22%)	0 (0.00%)	0 (0.00%)	1 (2.22%)	2 (4.44%)
Total		6 (13.3%)	33 (73.33%)	6 (13.33%)	11 (24.44%)	32 (71.11%)	2 (4.44%)	90 (100.00%)
Modified Chi-Square value				11.76			12.56	
P-value				0.01*			0.00**	

* and ** indicates significance at 5% and 1% level of significance respectively.

From table 4.14, the Modified Chi square value in case of wet land areas is 11.76 and P-value is 0.01 which is significant at 5% level of significance where as in case of dry land areas, the Modified Chi square value is 12.56 and the P-value is 0.00 which is significant at 1% level of significance. Thus family size shows a significant association with farmer's usage of farm machinery. Thus different levels of family sizes are having different usage levels of farm machinery.

In case of wet land areas, the highest percentage (44.44%) is obtained between farmers with small families and medium farm machinery usage category and lowest per cent (0.00%) is obtained between medium and large sized families with their machinery usage is low and large family farmers who are categorized under medium machinery usage category.

In case of dry land areas, the highest percentage (40.00%) is obtained between farmers with medium families and medium farm machinery usage category and lowest per cent (0.00%) is obtained between medium and large sized families with their machinery usage is low and large family farmers who are categorized in medium machinery used category. Overall majority of the farmers are medium farming experienced farmers and were under medium machinery used category.

Reliability Test

The questionnaire prepared for the collection of data from the farmers is initially tested for the reliability of the data. Cronbach's alpha is used for testing the reliability. From the data of the present study, we obtained Cronbach's alpha value of 0.58 indicating that our data is reliable.

4.4 TO ANALYSE THE STRUCTURE OF INTER-RELATIONSHIPS (CORRELATIONS) AMONG FACTORS THOSE ARE CONTRIBUTING IN USAGE OF FARM MACHINERY

The study of the nature of relationship among various factors that influence a farmer's usage in selection of farm machinery was studied by using Spearman's Rank correlation coefficients (r) were computed and the values were presented in Table 4.17.The relationships between various factors that influence a farmer's usage of farm machinery were tested by null hypothesis and empirical hypothesis.

Null hypothesis

There is no significant relationship among various factors that influence a farmer's usage in selection of farm machinery

Empirical hypothesis

There is a significant relationship among various factors that influence a farmer's usage in selection of farm machinery

Table 4.15 revealed that farmers prefer branded machinery which can have best engine capacity and its performance to agricultural operations are very good. It is also revealed that the farmers are buying the farm machinery based on the media influence. Hence, when the farmer is looking for a branded farm machinery, he is not considering spare parts availability, cost of machine, appearance of the machine, offers from the dealers, resale value and subsidy from the Government because the branded machinery will have all these characteristics automatically.

It is also clear that farmers are purchasing farm machinery according to the cost of machine as well as spare parts cost and their availability in their own locality because unavailability of spare parts makes the delay in repairability and also incur

high cost in procurement of those unavailable spare parts. It is also revealed that the farmers are purchasing farm machinery based on the loan available for them. Thus the farmer is looking for money terms like cost and loan availability in purchasing farm machinery.

It was also revealed that farmers are buying the farm machinery on the basis of resale value at the current season. They believe that the machinery that performs well in agricultural operations will fetch higher resale value. Thus they prefer resale value as one of the important components in the purchase of farm machinery.

Subsidy is one of the factors that influence a farmer in the purchase of farm machinery. But this subsidy is not significant with any of the other variables because all the farmers are eligible for the subsidy. The subsidy rates differ according to the community to which that farmer belongs to. Thus subsidy from the Government is also one of the major factors that help a farmer in purchasing the farm machinery. The analysis was conducted in accordance with Basu Prasad Subedi (2016)

4.5 TO ANALYSE THE FACTORS THAT RELATE SPECIFICALLY IN DETERMINING THE TYPE OF MACHINERY

Farm machinery is the tools and implements that are being used in agriculture so as to reduce the human efforts and make the agricultural operations to be done in time without delay. As the labour availability is also getting reduced day by day and labour if available, huge wages are to be given, thus farmers are using these agricultural machinery for cultivating the crops.

A questionnaire with these characteristic variables is prepared and data was collected from a sample size of 90. Farmers were asked to rate based on their usage of farm machinery.

The several variables like brand reputation, availability of spare parts, easy repairability, mechanics reputation, engine, cost of machinery, performance with regard to agricultural operations, offers from the dealer, resale value, loan availability, subsidy from the government and media influence the farmer in purchasing the farm machinery

4.4.1 Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett test of Sphericity

This table 4.16 shows two tests which indicate the suitability of our data for factor analysis.

Table 4.16 KMO and Bartlett Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.65
Bartlett's Test of Sphericity	Approx. Chi-Square	262.43
	Df	78
	P-value	0.00*

In the present study, there are 13 variables measured on 90 farmers. The Kaiser-Meyer Olkin (KMO) and Bartlett's Test measure of sampling adequacy was used to examine the appropriateness of Factor Analysis. The approximate of Chi-square is 262.43 with 78 degrees of freedom, which is significant at 0.01 Level of significance. The KMO statistic of 0.658 is also large (greater than 0.50). Hence Factor Analysis is considered as an appropriate technique for further analysis *of the data.*

Eigen values

To study the factors that are influencing a farmer in the purchase of farm machinery, thirteen major components were taken into consideration. In this section, PCA and factor analysis (with VARIMAX rotation) were used to group the components into factors based on the communalities observed.

Principal component analysis was carried out with all the components and the results were furnished in Table 4.17.

Table 4.17 Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative
1	2.49	19.17	19.17	2.49	19.17	19.17	2.40	18.50	18.50
2	1.84	14.19	33.36	1.84	14.19	33.36	1.63	12.53	31.03
3	1.54	11.84	45.21	1.54	11.84	45.21	1.50	11.53	42.55
4	1.31	10.10	55.30	1.31	10.10	55.30	1.50	11.53	54.08
5	1.08	8.30	63.60	1.08	8.30	63.60	1.24	9.52	63.60
6	0.98	7.52	71.12						
7	0.91	7.02	78.15						
8	0.86	6.58	84.73						
9	0.65	5.03	89.76						
10	0.43	3.31	93.07						
11	0.40	3.04	96.12						
12	0.36	2.80	98.92						
13	0.14	1.08	100.00						

Extraction Method: Principal Component Analysis.

The initial components are the numbers of the variables used in the Factor Analysis. However, not all the 13 variables will be retained. In the present research only the 5 factors will be extracted by combining the relevant variables. The first factor will always account for the most variance and hence have the highest Eigen values. The next factor will account for as much of the left over variance as it can and the same will continue till the last factor. In the present research the first 5 factors explain 63.60% of variance.

The rotation sums of the squared loading represent the distribution of the variance after the VARIMAX rotation with Kaiser Normalisation. The VARIMAX rotation tries to maximize the variance of each of the factor.

Scree Plot

The scree plot graphs the Eigenvalue against each factor. It can be seen from the graph that after factor 5 there is a sharp change in the curvature of the scree plot. This shows that after factor 5 the total variance accounts for smaller and smaller amounts.

Identification of the Core Factors

The Rotated Factor Matrix represents the rotated factor loadings, which are the correlations between the variables and the factors. The factor column represents the rotated factors that have been extracted out of the total factor. These are the core factors, which have been used as the final factor after data reduction. According to the grouping of the factors, each group of factors is named which will represent the grouped factor and represent the factors.

Table 4.18 VARIMAX Rotated component analysis factor matrix

S. No.	Variables	Component				
		1	2	3	4	5
1	Brand	**0.799**	-0.083	0.069	0.272	0.194
2	Availability of spare parts	-0.542	-0.021	0.357	-0.002	**0.546**
3	Easy repairability	-0.096	-0.167	**0.765**	-0.033	0.235
4	Mechanics reputation	-0.279	0.457	0.125	**0.540**	0.023
5	Engine	0.236	-0.074	0.235	**0.611**	0.153
6	Cost	-0.053	0.129	**0.574**	0.244	-0.180
7	Look of the machine	0.445	0.196	**0.574**	-0.113	-0.201
8	Performance with regard to agricultural operations	**0.886**	0.077	-0.038	-0.153	0.098
9	Offers from dealer	-0.057	**0.781**	0.011	-0.033	-0.077
10	Resale value	0.127	**0.755**	-0.017	-0.047	0.175
11	Loan availability	-0.520	0.150	0.038	**0.611**	0.106
12	Subsidy	**0.624**	0.318	0.191	-0.523	0.069
13	Media	0.229	0.124	-0.113	0.114	**0.829**

Extraction Method: Principal Component Analysis.
Rotation Method: VARIMAX with Kaiser Normalization.

a. Rotation converged in 15 iterations.

The above matrix gives the correlation of the variables with each of the extracted factors. Usually, each of the variables is highly loaded in one factor and less loaded towards the other factors. To identify the variables, included in each factor, the variable with the value maximum in each row is selected to be part of the respective factor. The values have been highlightened in each of the rows to group the 13 variables into 5 core factors.

Thus, after rotation, Factor 1 accounts for 18.50 per cent of the variance; Factor 2 accounts for 12.53 per cent of the variance; Factor 3 and 4 accounts for 11.53 per cent of the variance and Factor 5 accounts for 9.52 per cent of the variance. All the 5 factors together explain for 63.60 per cent of the variance in factors influencing the farmer in the purchase of farm machinery.

It was noted that in the rotated factor solution, variables 1, 8 and 12 loaded significantly on factor I; variables 9 and 10 loaded significantly on factor II; variables 3, 6, and 7 loaded significantly on factor III; variables 4 and 5 on factor IV; variables 2 and 13 on factor V.

Based on the loadings of the thirteen variables on each factor (factor loading greater than 0.5) and the loadings of the five summarized categories, the model was developed and was presented in table 4.19. Different researchers in many instances assign different names to the same result because of the differences in their data and interpretation.

Table 4.19 Table showing Factors influencing a farmer in selection of Farm Machinery

S. No.	Variables	Factor loading	Factor title
1	Brand reputation	0.76	Cost effectiveness
	Performance with regard to agricultural operations	0.83	
	Subsidy	0.42	
2	Offers from dealer	0.62	Returns and offers available
	Resale value	0.61	
3	Easy reparability	0.67	Services and worth
	Cost of machine	0.44	
	Look of machine	0.61	
4	Mechanics reputation	0.59	Reputation and credit availability
	Engine	0.51	
	Loan availability	0.68	
5	Availability of spare parts	0.72	Accessibility and publicity
	Media	0.78	

Thus factor analysis has thus identified 5 major factors that influence the farmer in the purchase of farm machinery. They can be categorized here under.

1. Cost effectiveness
2. Returns and offers available
3. Services and worth
4. Reputation and credit availability
5. Accessibility and publicity

The above factors are discussed here under.

Factor 1- Cost effectiveness

This factor suggests that the farmers prefer a machine with brand reputation which performs well in field conditions and should have higher amounts of subsidy. This factor explains 18.50 per cent of the variability in purchasing the farm machinery. Thus farmer always prefer good branded machinery which performs well. Similarly, this is the core factor which influences a farmer in purchasing farm machinery.

Factor 2- Returns and offers available

This factor suggests that the farmer will always look for resale value because most of the farmers go for selling their machines after the crop season completes. Thus they will go for machines whose resale value and offers from the dealers will be high. This is the second important factor as it constitutes 12.53 per cent of the total variability.

Factor 3- Services and worth

This factor suggests that the farmers were interested to purchase the machinery whose services are fast and easy. The farmer also looks for the cost of the machines and analyse based on the appearance of that machine. Hence this is the third important factor which constitutes 11.53 per cent of the total variability.

Factor 4- Reputation and Credit availability

This factor suggests that the farmer purchase machinery according to the advice from mechanics or friends regarding the capacity of the machine. Based on their suggestion, the farmer looks for loan or money available for purchasing the machinery. Thus this factor is the fourth important factor that influences a farmer in purchasing the farm machinery constituting about 11.53 per cent of the total variability.

Factor 5- Accessibility and Publicity

This factor suggests that the farmer was purchasing farm machinery after knowing about the spare parts availability through either media or newspaper. Thus this is the last important factor that influences a farmer in purchasing of farm machinery constituting about 9.52 per cent of the total variability.

Thus a total of 5 factors extracted from 13 variables explain about 63.60 per cent of the total factors that influence a farmer in the purchasing of farm machinery.

4.6 TO GROUP FARMERS INTO DIFFERENT CLUSTERS HAVING SIMILARITIES IN THEIR USAGE OF FARM MACHINERY

Cluster analysis is one of the multivariate statistical tools used to classify objects or items based on the similarities existing in them. For this data, clustering of farmer's is done based on the variables associated with farmer's usage in selection of farm machinery. After clustering is done, the objects in a particular cluster are similar whereas objects between clusters are dissimilar.

Ward's clustering method was used for clustering the farmers with minimum variance between them. The 90 farmers were grouped into four (4) clusters based on similarities by using Ward's Minimum Variance Clustering Method. Clustering pattern is presented in table 4.20.

Table 4.20 Clustering pattern of farmers using Ward's Minimum Variance Clustering Method

Cluster	Farmers	No. of Farmers	Proportion
I	62, 85, 27, 61, 34, 72, 81, 37, 70, 39, 71, 79, 46, 10,7, 11, 12, 69, 75, 30, 80, 83, 29, 77, 89, 90, 87, 88	28	31.11
II	47, 82, 40, 24, 36, 32, 59, 63, 23, 67,35, 84, 66, 65, 2, 86, 73, 33, 64, 76, 74	21	23.33
III	31, 44, 42, 43, 38, 45, 78, 41, 68, 26, 18	11	12.22
IV	53, 57, 50, 51, 17, 55, 52, 58, 21, 22, 48, 49, 6, 60, 20, 25, 3, 4, 5, 28, 9, 8, 13, 16, 14, 15, 1,19,56,54	30	33.33

The various characteristics of the above clusters are explained here under briefly.

1) Characteristics of Cluster I:

There are 31.11 per cent of the total farmers in this cluster. The farmers under this cluster are selecting the machinery based on the idea on variables like brand reputation, cost of the machine, performance with regard to agricultural operations, loan availability, subsidy and media. The farmers in this cluster are having similar characteristics with regard to the above mentioned variables.

2) Characteristics of Cluster II

There are about 23.33 per cent of the farmers existing in this cluster. The farmers under this cluster are selecting the farm machinery by criteria of variables like brand reputation, availability of spare parts, easy repairability, mechanic reputation, cost of the machine, resale value, loan availability and subsidy.

3) Characteristics of Cluster III

There are about 12.2per cent of the total farmers existing in this cluster. The farmers under this cluster are having similar characteristics with regard to variables that include brand reputation, availability of spare parts, engine, subsidy and media.

4) Characteristics of Cluster IV

There are about 33.33 per cent of the farmers in this cluster. The farmers under this cluster are selecting the farm machinery based on the variables like brand reputation, performance with regard to agricultural operations and resale value of the machines.

Thus the farmers within a cluster show similar characteristics with regarding to purchasing of farm machinery whereas the farmers between clusters show significant difference in characteristics in purchasing farm machinery.

Table 4.21 Characteristics of the clusters

Cluster I	**Cluster II**	**Cluster III**	**Cluster IV**
Brand reputation	Brand reputation	Brand reputation	Brand reputation
Cost of the machine	Availability of spare parts	Availability of spare parts	Resale value
Performance with regard to agricultural operations	Easy rapairability	Engine	Performance with regard to agricultural operations
Loan availability	Mechanic reputation	Subsidy	
Subsidy from govt.	Cost of machine	Media	
Media influence	Resale value		
	Loan availability		
	Subsidy		

The below table shows agglomeration schedule along with coefficients in the fourth column. The agglomeration schedule from stage 1 to stage 89 shows the sequence in which cases get combined with others (that is, one cluster combines with another. In the last stage 89, all the clusters combine together to one cluster. It can also be seen that stage 89 represents 1-cluster solution, stage 88 shows 2-cluster solution and so on.

In order to determine the feasible number of clusters in the data, one should use difference between rows in the coefficients column. In order to have lowest possible clusters, this start from bottom rows. There is a difference of 25.26 (183.8-158.54) in the coefficients between stage 89 (one cluster solution) and stage 88 (two cluster solution). Further, these differences are smaller between subsequent rows of coefficients. A large difference in the coefficient values between any two rows shows a solution pertaining to the number of clusters which the lower row represents. Looking at the difference in coefficients, one can have 2-cluster solution or 3-cluster solution which may be feasible.

Dendrogram is a graphical representation wherein cases link up in the sequence to form desired clusters. The dendrogram also provides a rescaled distance measure between various clusters combined at various stages.

4.7 TO ANALYSE THE MAJOR CONSTRAINTS FACED BY FARMERS DURING THE PURCHASE OF FARM MACHINERY

While there are many factors or components that influence the farmer in selection of farm machinery, there are many constraints that are facing by farmers in using of farm machinery. The constraints of farmers include small land holding and scattered farm holdings, high cost of farm machinery and their maintenance, inadequacy of repair and service facilities, negative attitude towards improved farm implements, non-availability of suitable farm implements and machines, non-availability of spare parts at nearby areas, lack of credit facilities, availability of cheap labour, lack of skilled labour for operating improved farm implements and machines, lack of awareness, feeling agriculture as seasonal as machinery remains idol for much of the time, not suitable to various type of lands and crops.

Garret ranking technique was used to give priority of the constraints based on the scores or ranks given by the farmers.

Table 4.22 Garret Ranking according to the average scores

S. No	Constraint	Total	Average Score	Rank
1	Small land holding and Scattered farm holdings	6789	75.43	2
2	High cost for farm machinery and their maintenance	5884	65.38	3
3	Inadequacy of repair and service facilities	5464	60.71	5
4	Negative attitude towards improved farm implements and machines	3086	34.29	12
5	Non-availability of suitable farm implements and machines	5633	62.59	4
6	Non-availability of spare parts	5130	57.00	6
7	Lack of credit facilities	6798	75.53	1
8	Availability of cheap labour	4385	48.72	7
9	Lack of skilled labourers for operating improved farm implements and machines	4178	46.42	9
10	Lack of awareness	4354	48.38	8
11	As agriculture is seasonal, machinery remains idol for much of the time	3500	38.90	10
12	Not suitable to various types of lands and crops	3189	35.43	11

A close study from table 4.23 revealed that among all the constraints listed above, the lack of credit facilities by the farmers to purchase farm machinery is one of the major constraint followed by small land holding and scattered farm holdings and high cost of farm machinery and their maintenance. The least constraint faced by famers in purchasing the farm machinery is not suitable for all types of lands and crops followed by negative attitude of farmers towards improved farm implements and machines. Similar findings were reported by Mottaleb *et al.*(2016).

Chapter V

SUMMARY AND CONCLUSIONS

This chapter provides brief information on the systematized efforts undertaken for the empirical study with a focus on the emerged findings. It includes summary of the findings, implications of the study and suggestions for further research.

5.1 INTRODUCTION

Farm machinery helps in increasing production, productivity and profitability in agriculture by achieving timeliness in farm operations, placement of inputs, reducing available input losses, increasing utilization efficiency of costly inputs(seed, chemical fertilizer, irrigation water etc.,) reducing unit cost of produce, enhancing profitability and competitiveness in the cost of operations. It also helps in conservation of the produce and bi-products from quantitative and qualitative damages; enables value addition and establishment of agro processing enterprises for additional income and employment generation from farm produce.

There were many variables that influence a farmer in the purchase of farm machinery. Hence current study was done to identify those factors that influence a farmer in the purchasing of farm machinery.

The study was conducted in Guntur, Prakasam and Krishna districts of Andhra Pradesh by selecting two villages from each district by listing out the number of mandals in descending order based of magnitude in usage of farm machinery, thus selecting 6 villages covering one dry land and one wet land area. In each village, 15 farmers were selected by random sampling procedure, thus making a sample size of 90 farmers.

The data were collected with the help of well-structured pre-tested interview schedule through personal interview.Collected data was used to estimate or analyze farmer's preference in purchase of farm machinery. Firstly, the collected data was analyzes for testing different parameters, such as, Z- test, Spearman's Rank correlations, factor analysis, cluster analysis and non-parametric tests like chi-square test and Garret Ranking using SPSS software.

Detailed analysis of profile characteristics of the farmers indicated that majority (52.22%) of the farmers belonged to middle age category, followed by 24.44 per cent in the old age and 23.33 per cent under young age category. In case of education levels, majority of the farmers were educated up to high school (41.11%), followed by primary school (40.00%), and then followed by Intermediate education (18.89%). With regard to farm size, it was evident that majority of the farmers were small (48.88%), followed by marginal (33.33%) and large (17.78%). A meager portion of the farmers were under landless (10.83%) category, where these farmers would takeup the land for lease few acres and cultivate. The study also revealed that majority (54.44%) of the farmers belongs to small family size bearing one to four members followed by medium family size farmers (43.33%) bearing five to seven members and large family size farmers with more than eight people (2.22%). In case of farming experience, majority (48.89%) of the farmers had medium farming experience of about ten to twenty years followed by high farming experience (30.00%), more than 20 years and a meager portion of the farmers belong to low experience category with up to 10 years (21.11%) of farming experience.Majority of farmers were growing two crops in a year (57.78%) followed by farmers who were growing one crop in a year (27.78%) and more than two crops in an year (14.44%). When comes to level of usage of machinery, majority of the farmers were having machinery usage as medium (77.78%) followed by machinery usage low (15.58%) and machinery usage high(6.67%).

After conducting Z- test, it was evident that with respect to usage of farm machinery, the wet land farmers and dry land farmers differ each other in loan availability, media influence and mechanics reputation where the rest of the variables like brand reputation, performance regarding agricultural operations etc., were not related to area to which a particular farmer belongs to.

After detailed analysis of all the independent variables age, education level, farm size, farming experience, crops grown and family size, it was concluded that there was significant association between these independent variable with usage of farm machinery by the farmers.

After conducting Spearman’s Rank correlation, it was revealed that farmers prefer branded machinery which can have best engine capacity and their performances to agricultural operations were very good. It was also revealed that the farmers were

buying the farm machinery based on the media influence. Hence, when the farmer was looking for a branded farm machinery, he was not considering spare parts availability, cost of machine, appearance of the machine, offers from the dealers, resale value and subsidy from the Government because the branded machinery will have all these characteristics automatically.

From the principal component factor analysis with Varimax rotation, it was identified that five factors were influencing the farmer's preference in purchasing of farm machinery and were classified as Efficiency at low price, Returns and Offers available, Services and worth, Reputation and Credit availability and last one was Accessibility and publicity. These five factors extracted from thirteen variables explains about 63.60% of the total variance in the factors availing in purchase of farm machinery.

Based on the similarities existing between the farmers with regard to thirteen variables, the whole 90 farmers were grouped into 4 different clusters. Out of 4 clusters obtained, cluster IV was the largest with 30 farmers contributing about 33.33% of the total proportion. The cluster I was the second largest cluster with 29 farmers contributing about 31.11% followed by cluster II with 22 farmers with 23% of the total population. The smallest cluster was cluster III with 11 farmers contributing about 12% of the total proportion. Different cluster farmers were having different characteristic features with regard to purchasing of farm machinery. But farmers of all clusters were having common characteristic of choosing the machinery based on brand reputation.

Constraint analysis was done using Garret ranking technique to know about the problems faced by the farmers while purchasing the farm machinery revealed that the lack of credit facilities majorly trouble the farmers purchase of farm machinery, followed by small land holding and scattered farm holdings and high cost of farm machinery and their maintenance. These constraints can be overcome by arranging sufficient amount of credit for purchasing the farm machinery and bearing the other maintenance costs. More awareness canto be given regarding the usage of farm machinery and benefits to the maximum extent possible.

The findings of research revealed that majority of the farmers were having medium preference in the selection of farm machinery. Depending on the various characteristics like age, education, farm size, farming experience, there was an

association with usage of farm machinery. There were five hidden factors that influence a farmer in selecting the suitable farm implements. Lack of credit facilities, small land holding and scattered farm holdings were the major constraints that were being faced by the farmers in transforming completely into modern mechanized agriculture system.

5.2 SCOPE FOR FUTURE RESEARCH

1. The investigation was conducted in only Krishna, Prakasam and Guntur districts of Andhra Pradesh. Similar studies may be undertaken in other districts, so that influence can be generalized to a greater extent.

2. The present study confined to six villages of sixmandals with a total of 90 respondents only. Similar studies may be taken with more mandals and more respondents.

3. The study included only a list of variables. Further studies may be conducted with some more variables to probe more analytical solution on usage of farm machinery.

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***Originals are not seen**

Note: The literature is cited as per the "Thesis Guidelines" prescribed by Acharya N.G. Ranga Agricultural University, Guntur.

APPENDIX-A

ACHARYA N. G. RANGA AGRICULTURAL UNIVERSITY

DEPARTMENT OF AGRICULTURAL STATISTICS

AGRICULTURAL COLLEGE, BAPATLA

Topic: ***An Analysis of Farmers Preference in Selection of Farm Machinery in Guntur, Prakasam and Krishna Districts of Andhra Pradesh***

INTERVIEW SCHEDULE

RESPONDENT NO. ☐

General Information of Farmer

1. Name of the Respondent :
2. Village :
3. Mandal :
4. District :

Profile Characteristics of Farmers

1) **Age (completed years) :**

2) Education

a) No schooling (Illiterate):
b) Primary School(1-5) :
c) High school (6-10) :
d) Intermediate/ Graduation :
e) Post-Graduation and above :

3) **Family size**

Sex	Adult	Children below 15 years
Male		
Female		
Total		

4) Farm Size(in ha)

S.No.	in hectares	Dry		Wet	
		leased in	leased out	leased in	leased out
1	Marginal(0-2.0ha)				
2	Small(2.1-5ha)				
3	Large(5+ ha)				

***5)* Farming Experience**

a) Upto 5 years :
b) 5 – 10 years :
c) Above 10 years :

6) Cropping pattern followed:

Season	Crop	Area	Method of irrigation	Cost when machinery is not used	Cost when machinery is used
Kharif					
Rabi/ Summer					

7) Farm machinery used:

MB Plough	yes/no
disc harrow	yes/no
Cultivator	yes/no
Rotovator	yes/no
Rotopudler	yes/no
Power tiller	yes/no
Drum seeder	yes/no
Conoweeder	yes/no
Sprayers	yes/no
Sprinklers	yes/no
Drip	yes/no
Combine harvestor	yes/no
Tractor	yes/no

8) Extension Contact

How often do you contact these persons? Please tick (√) the following

S.No.	Official	Frequently (3)	Occasionally (2)	Rarely (1)
1	Multi-PurposeExtension Officer(MPEO)/Agricultural Extension Officer(AEO)			
2	Mandal Agricultural Officer			
3	Assistant Director of Agriculture			
4	ATMA Officers(Project Programme Promoter)			
5	ANGRAU Scientists(KVK, DAATTC, ARS)			

9) Socio-Economic Status

a) House
    a) Shed thatched
    b) Mud walled and thatched
    c) Brick wall and tiled
    d) Concrete house

b) Family size
    a) 1 to 4
    b) 5-8
    c) 9 and above

c) Occupation
    a) Agriculture
    b) Agriculture + wage work
    c) Agriculture + livestock
    d) Agriculture + business
    e) Agriculture + job

d) Socio-Political Participation

    a) No officials position in Socio-political organization
    b) Official position in one or more organization
    c) Official position in socio-political organization
    d) Financial contribution or raising fund for common work
    e) Involvement in community works

e) Material Possessions

a) One farm animal/bicycle/furniture

b) Two farm animals/bullock cart/tv/computer

c) Three to four farm animals/improved farm implements/motor bike/pump set

d) Five to ten farm animals/tractor

e) Car/heavy farm machinery

Rate the influence of the following items in selection of farm machinery::

S.No.	**Variables**	Highly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Highly Dis Agree (1)
1	Brand's reputation					
2	Availability of spare parts					
3	Easy repairability					
4	Mechanics reputation					
5	Engine					
6	Cost					
7	Look of the machine					
8	Performance with regard to agricultural operations					
9	Offers from the dealer					
10	Resale value					
11	Loan availability					
12	Subsidy from Govt.					
13	Media influence					

Constraints for using farm machinery:

S.No.	Constraint	Rank
1	Small land holding and Scattered farm holdings	
2	High cost for farm machinery and their maintenance	
3	Inadequacy of repair and service facilities	
4	Negative attitude towards improved farm implements and machines	
5	Non-availability of suitable farm implements and machines	
6	Non-availability of spare parts	
7	Lack of credit facilities	
8	Availability of cheap labour	
9	Lack of skilled labourers for operating improved farm implements and machines	
10	Lack of awareness	
11	As agriculture is seasonal, machinery remains idol for much of the time	
12	Not suitable to various types of lands and crops	

APPENDIX - B

APPENDIX- C Agglomeration Schedule

S. No.	Cluster 1	Cluster 2	Coefficients	Cluster 1	Cluster 2	Next stage
1	89	90	0	0	0	2
2	87	89	0	0	1	80
3	84	85	0	0	0	4
4	10	84	0	0	3	10
5	80	83	0	0	0	7
6	63	82	0	0	0	19
7	29	80	0	0	5	72
8	76	79	0	0	0	10
9	45	78	0	0	0	45
10	10	76	0	4	8	14
11	71	74	0	0	0	14
12	72	73	0	0	0	13
13	33	72	0	0	12	48
14	10	71	0	10	11	18
15	39	70	0	0	0	29

16	41	68	0	0	0	57
17	64	66	0	0	0	18
18	10	64	0	14	17	21
19	14	63	0	0	6	28
20	61	62	0	0	0	21
21	10	61	0	18	20	32
22	16	59	0	0	0	37
23	52	58	0	0	0	65
24	53	57	0	0	0	46
25	40	47	0	0	0	28
26	35	46	0	0	0	32
27	42	43	0	0	0	57
28	14	40	0	19	25	36
29	37	39	0	0	15	30
30	37	38	0	29	0	66
S. No.	Cluster 1	Cluster 2	Coefficients	Cluster 1	Cluster 2	Next stage
31	23	36	0	0	0	36
32	10	35	0	21	26	34
33	6	32	0	0	0	47
34	10	27	0	32	0	55
35	20	24	0	0	0	62
36	14	23	0	28	31	38
37	11	16	0	0	22	39
38	14	15	0	36	0	53
39	11	13	0	37	0	49
40	31	69	0.5	0	0	60
41	2	65	1	0	0	59
42	17	55	1.5	0	0	51
43	21	48	2	0	0	71
44	5	28	2.5	0	0	68
45	45	67	3.17	9	0	66
46	50	53	3.83	0	24	81
47	6	44	4.5	33	0	50

48	33	81	5.25	13	0	74
49	11	56	6.05	39	0	52
50	6	9	6.88	47	0	54
51	1	17	7.72	0	42	67
52	11	34	8.58	49	0	68
53	14	25	9.47	38	0	62
54	6	8	10.37	50	0	64
55	10	86	11.31	34	0	65
56	22	88	12.31	0	0	63
57	41	42	13.31	16	27	70
58	12	30	14.31	0	0	74
59	2	77	15.81	41	0	75
60	31	75	17.31	40	0	78
61	4	19	18.81	0	0	72

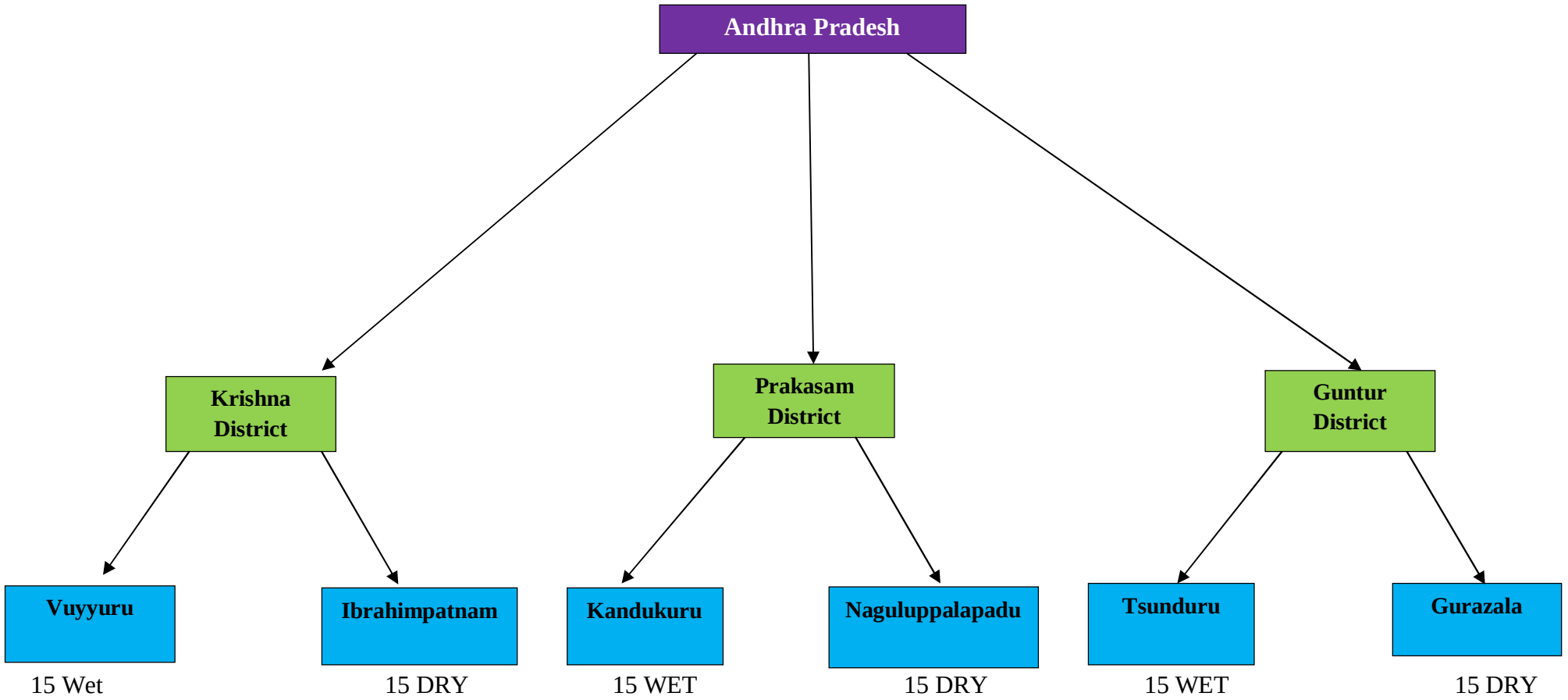
S. No.	Cluster 1	Cluster 2	Coefficients	Cluster 1	Cluster 2	Next stage
62	14	20	20.46	53	35	77
63	3	22	22.13	0	56	71
64	6	60	23.90	54	0	79
65	10	52	25.67	55	23	75
66	37	45	27.57	30	45	76
67	1	49	29.49	51	0	69
68	5	11	31.45	44	52	82
69	1	51	33.80	67	0	73
70	26	41	36.40	0	57	76
71	3	21	39.63	63	43	80
72	4	29	42.93	61	7	77
73	1	7	46.33	69	0	81
74	12	33	49.75	58	48	78
75	2	10	53.19	59	65	84
76	26	37	56.69	70	66	85
77	4	14	61.34	72	62	79

78	12	31	66.40	74	60	84
79	4	6	71.91	77	64	82
80	3	87	77.76	71	2	86
81	1	50	83.65	73	46	87
82	4	5	91.11	79	68	86
83	18	54	99.11	0	0	88
84	2	12	108.39	75	78	85
85	2	26	118.54	84	76	88
86	3	4	130.28	80	82	87
87	1	3	142.70	81	86	89
88	2	18	158.54	85	83	89
89	1	2	183.8	87	88	0

APPENDIX-D

GARRET RANKING TABLE

Percentage	Score	Percentage	Score	Percentage	Score
0.09	99	20.93	66	80.61	33
0.2	98	22.32	65	81.99	32
0.32	97	23.88	64	83.31	31
0.45	96	25.48	63	84.56	30
0.61	95	27.15	62	85.75	29
0.78	94	28.86	61	86.89	28
0.97	93	30.61	60	87.96	27
1.18	92	32.42	59	88.97	26
1.42	91	34.25	58	89.94	25
1.68	90	36.15	57	90.83	24
1.96	89	38.06	56	91.67	23
2.28	88	40.01	55	92.45	22
2.63	87	41.97	54	93.19	21
3.01	86	43.97	53	93.86	20
3.43	85	45.97	52	94.49	19
3.89	84	47.98	51	95.08	18
4.38	83	50	50	95.62	17
4.92	82	52.02	49	96.11	16
5.51	81	54.03	48	96.57	15
6.14	80	56.03	47	96.99	14
6.81	79	58.03	46	97.37	13
7.55	78	59.99	45	98.72	12
8.33	77	61.94	44	98.04	11
9.17	76	63.85	43	98.32	10
10.16	75	65.75	42	98.58	9
11.03	74	67.48	41	99.82	8
12.04	73	69.39	40	99.30	7
13.11	72	71.14	39	99.22	6
14.25	71	72.85	38	99.39	5
15.44	70	74.52	37	99.55	4
18.69	69	76.12	36	99.68	3
18.01	68	77.68	35	99.80	2
19.39	67	79.12	34	99.91	1
				100	0



3.1(b) Flow chart of sampling design

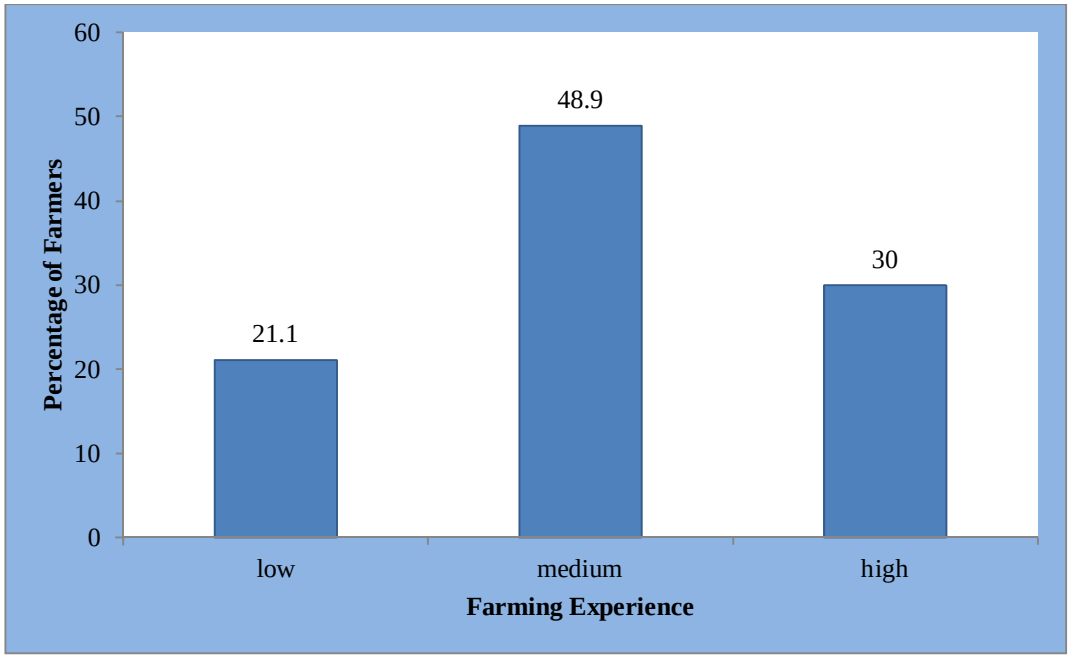


Fig. 4.5 Distribution of Farmers based on Farming Experience

Fig. 3.1 Map of India showing Andhra Pradesh

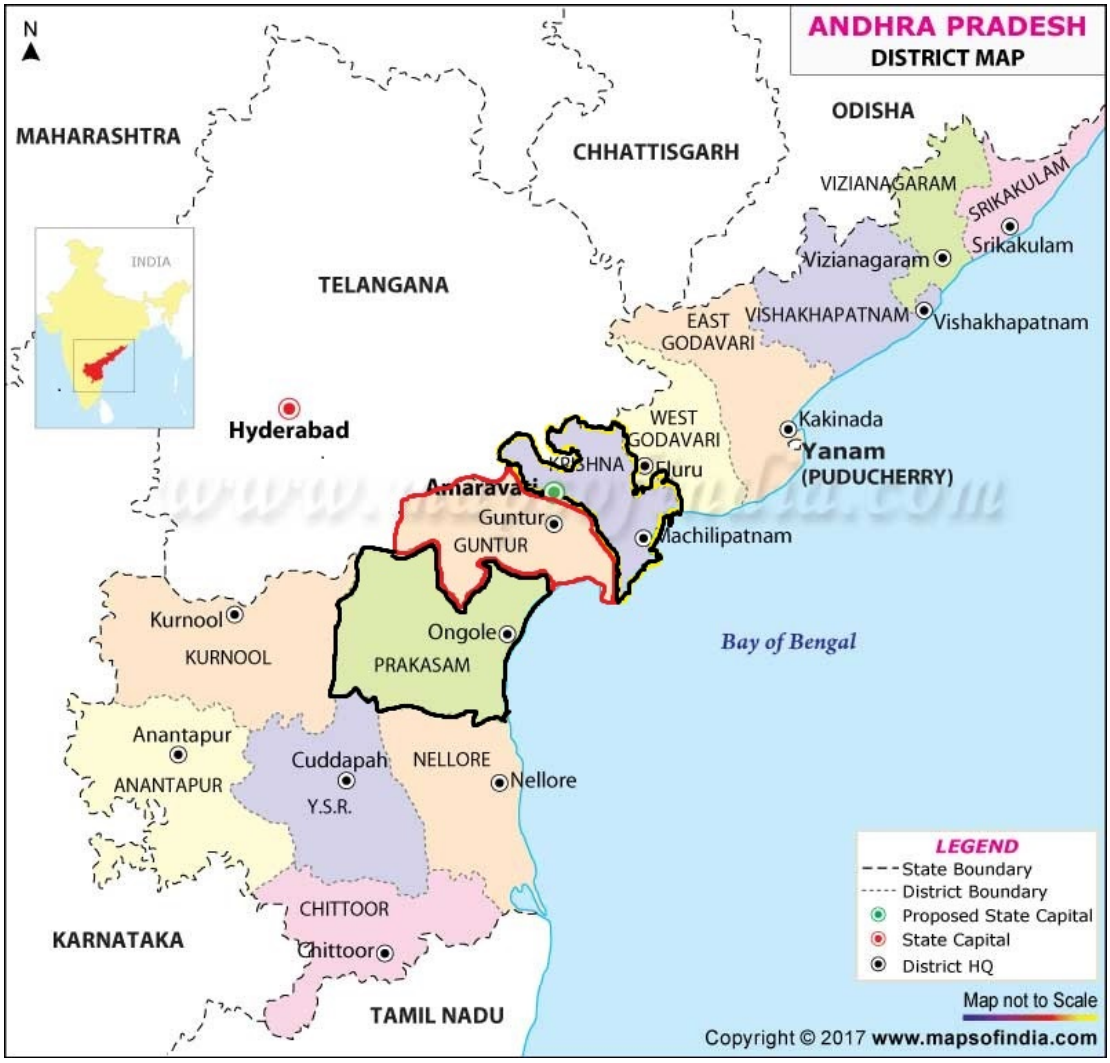


Fig. 3.2a Andhra Pradesh map showing three selected districts

Fig. 3.3 Map showing selected mandals in Guntur District

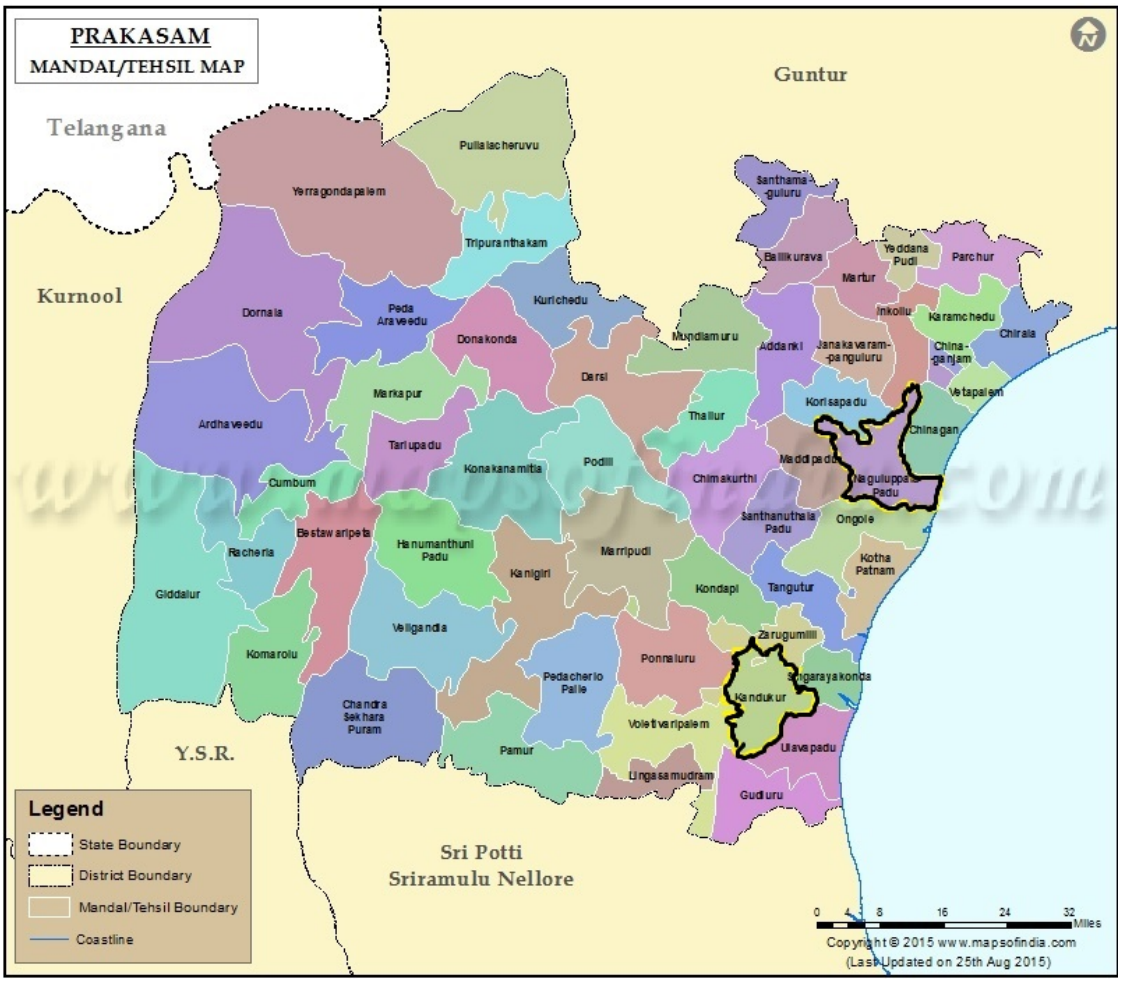
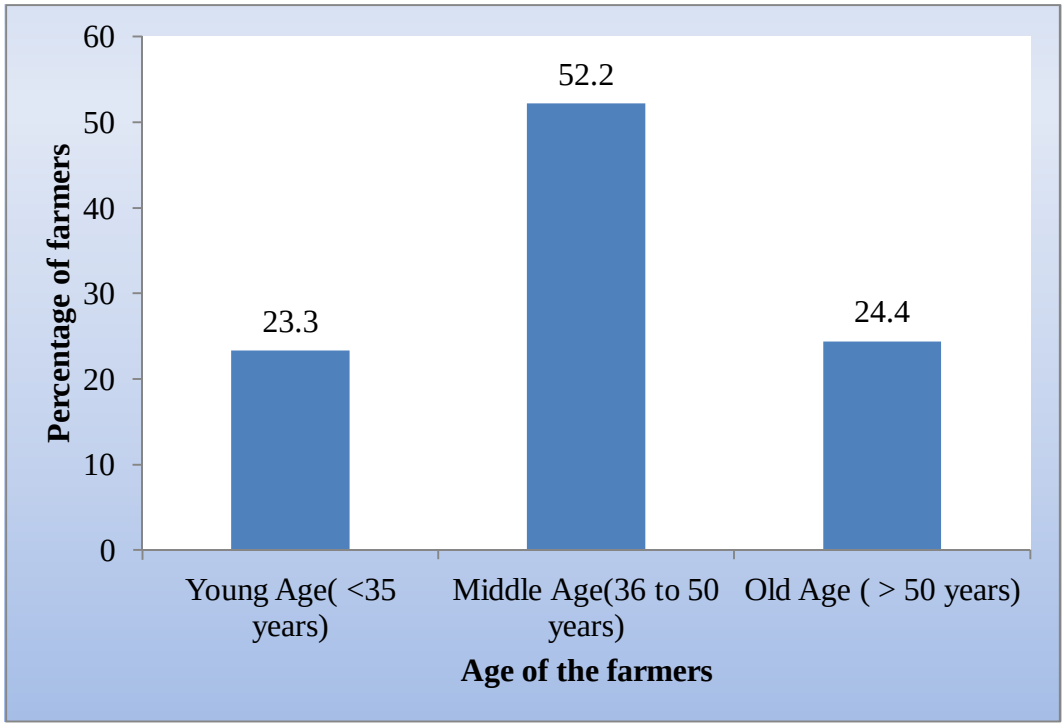


Fig. 3.4 Map of Prakasam District showing selected Villages

Fig. 3.5 Map of Krishna Districts showing villages



4.1. Distribution of the Farmers according to their Age

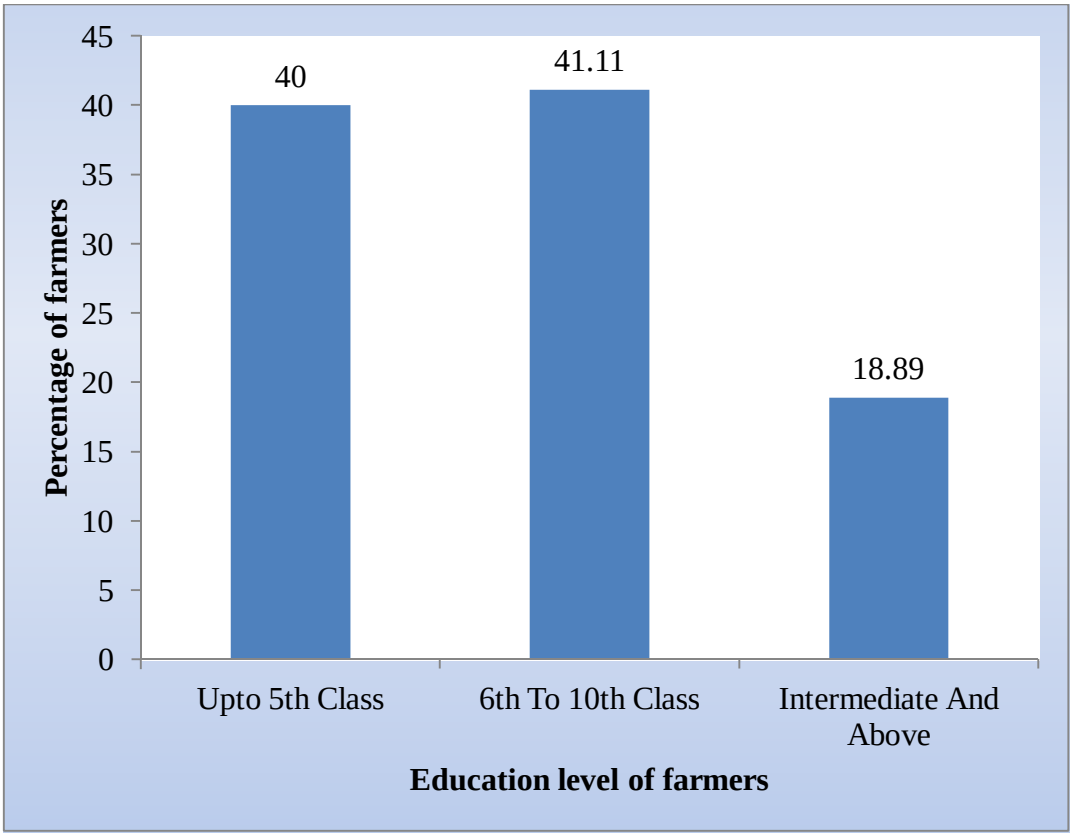


Fig. 4.2 Distribution of farmers based on their education

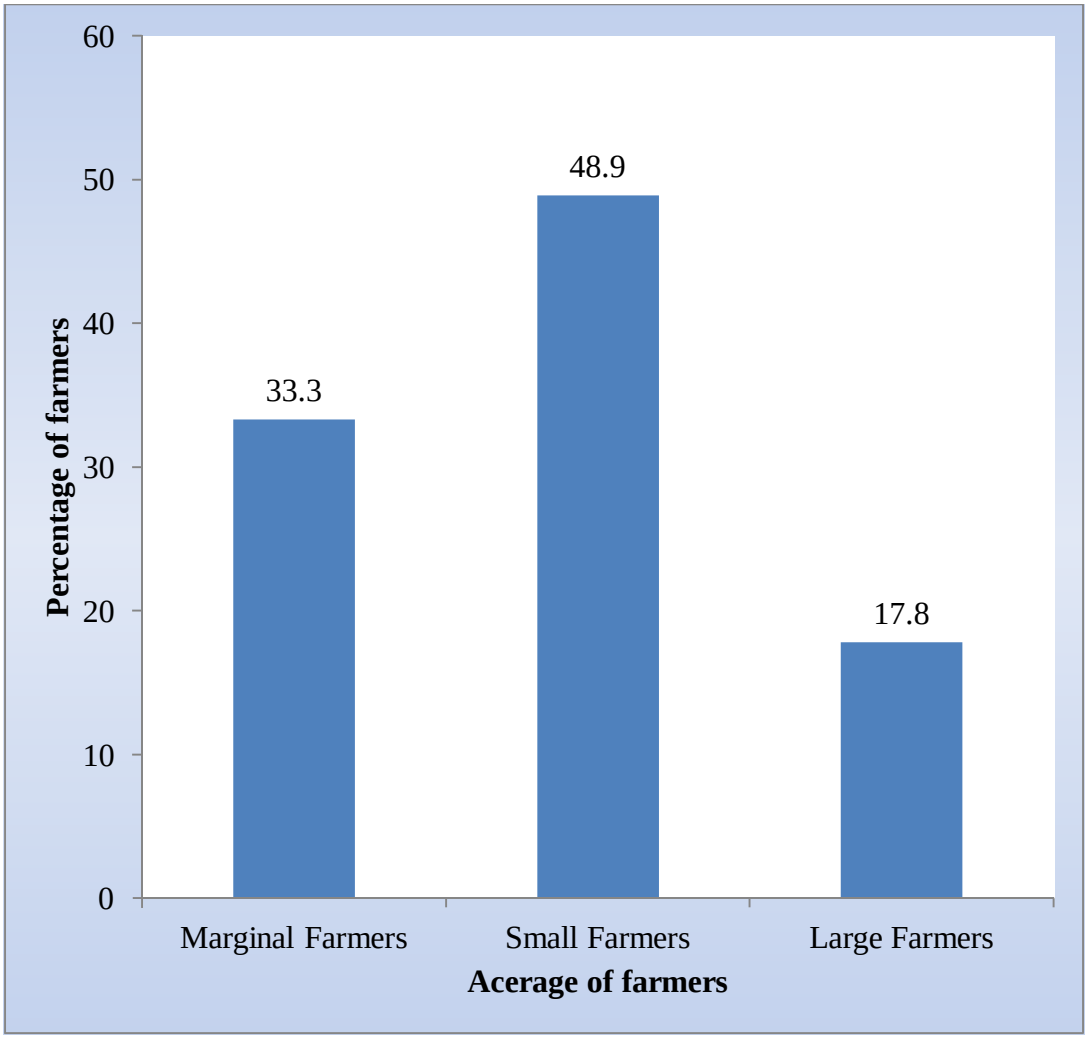


Fig. 4.3 Distribution of farmers based on their Farm Size

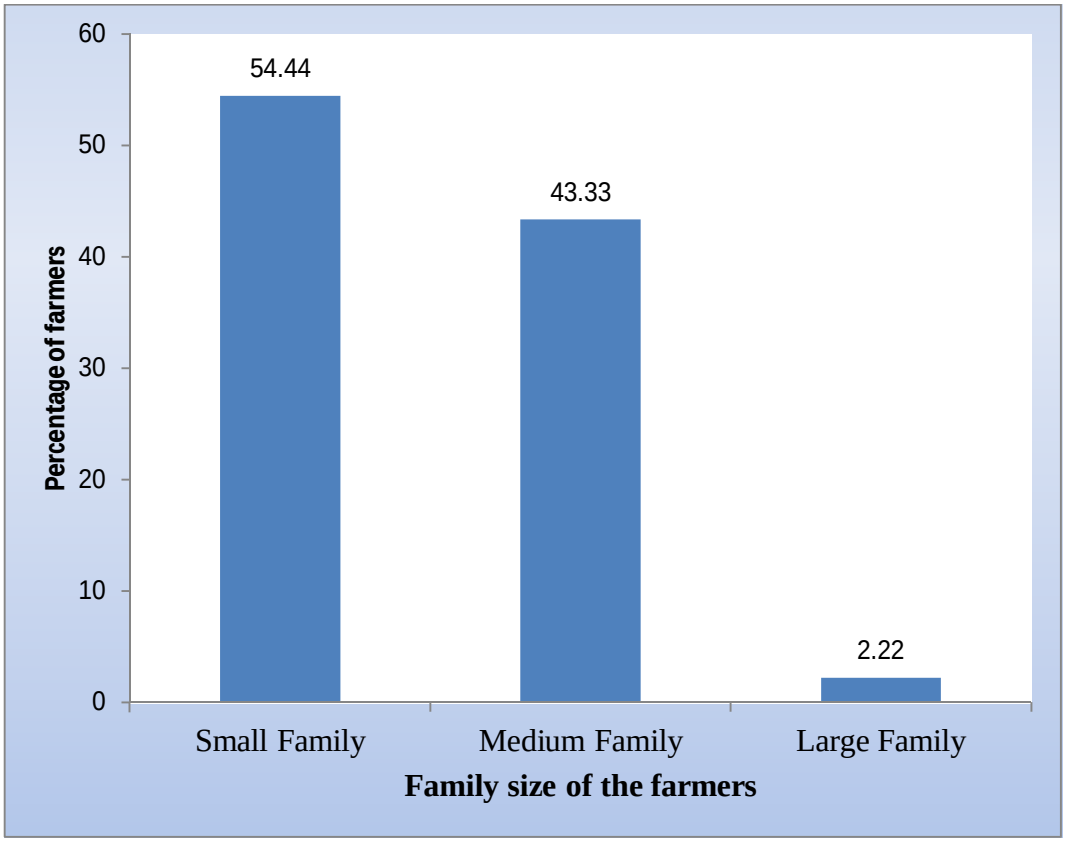


Fig. 4.4 Distribution of farmers based on their family size

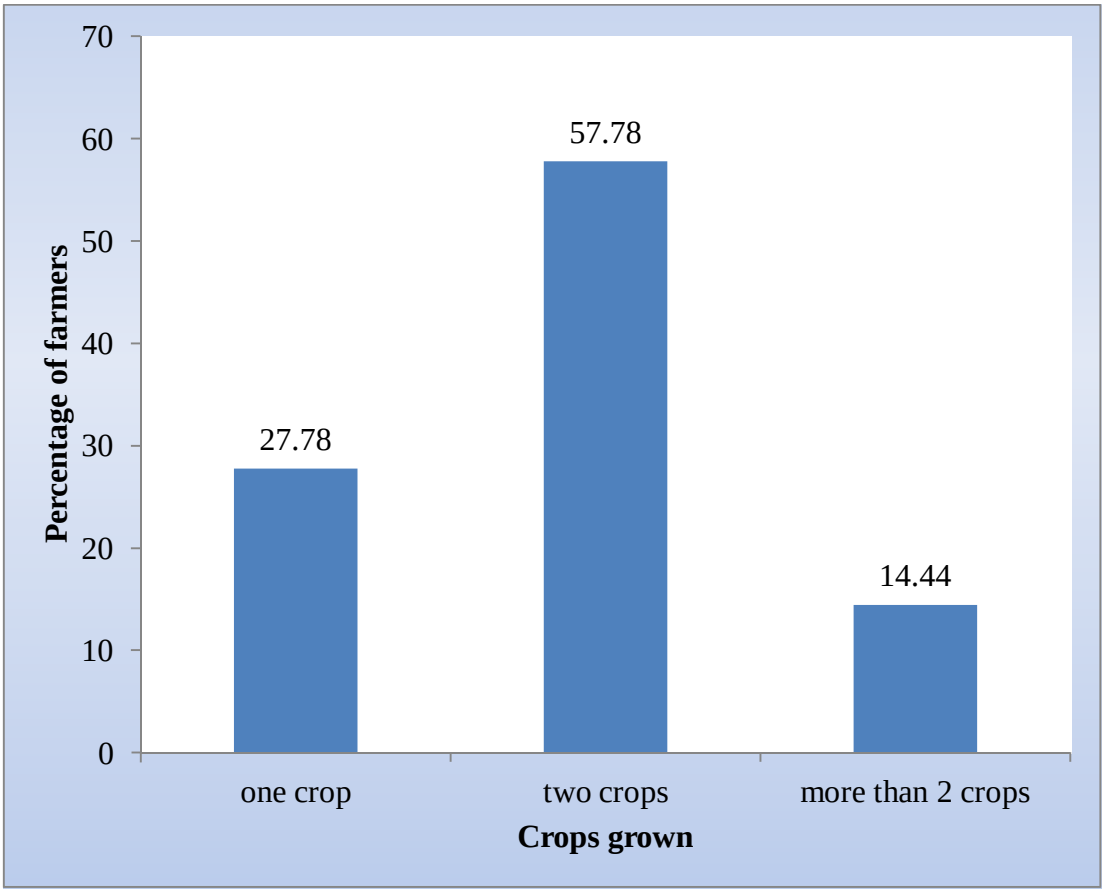


Fig. 4.6 Distribution of farmers based on crops grown

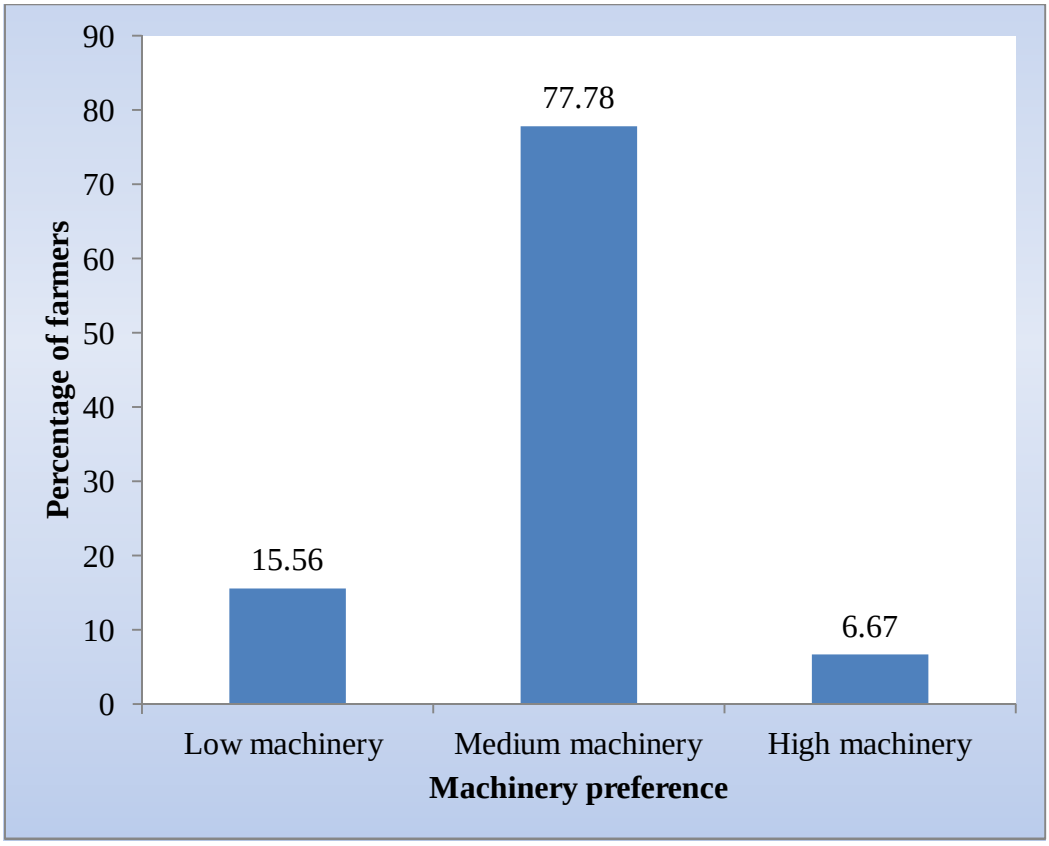


Fig. 4.7 Distribution of farmers based on machinery usage

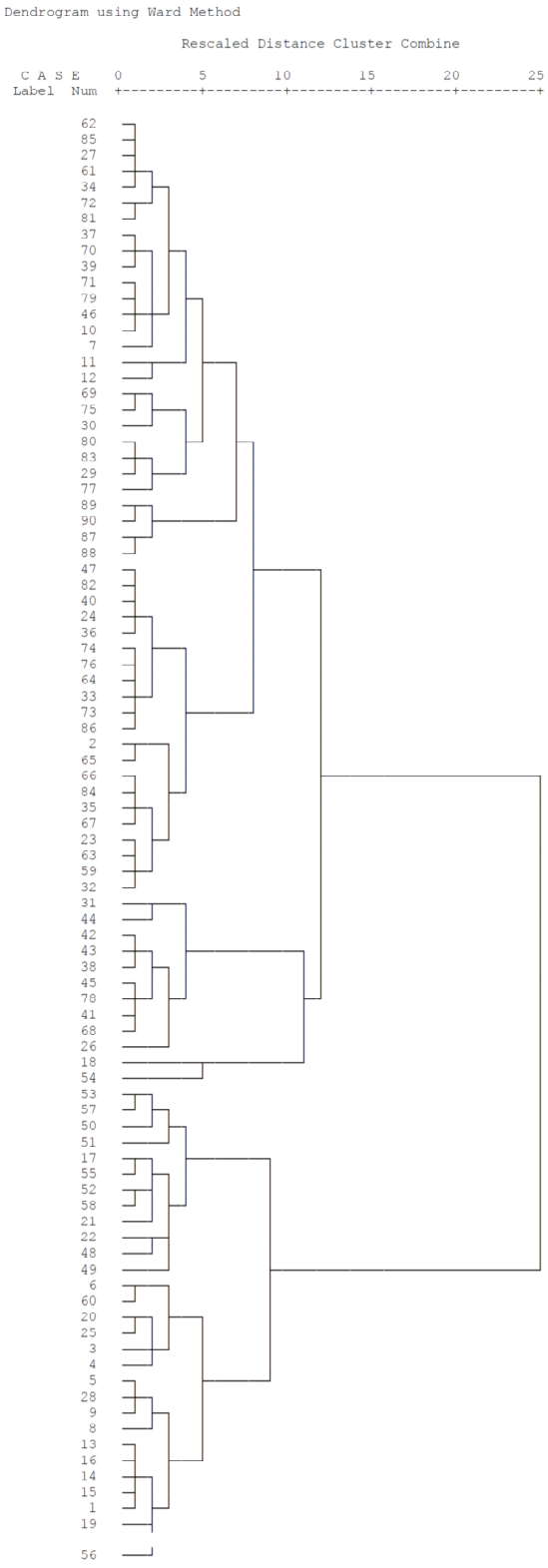


Fig. 4.9 Dendrogram showing clusters of farmers using Ward's Minimum Clustering Variance Method

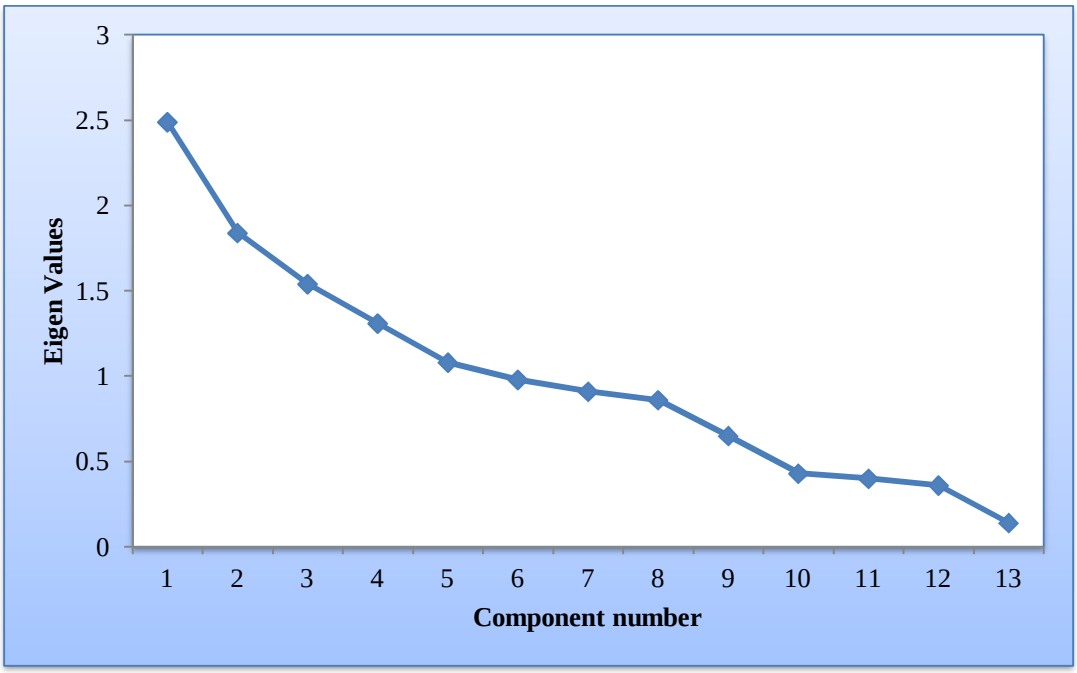


Fig. 4.8 Scree Plot

Table 4.15 Rank correlation between various factors that influence a farmer's usage in selection of farm machinery

Variables / Variables	Brand	Availability of spare parts	Easy repairability	Mechanics reputation	Engine capacity	Cost of machine	Appearance of the machine	Performance with regard to agricultural operations	Offers from dealer	Resale value	Loan availability	Subsidy from Govt.	Media influence
Brand	1												
Availability of spare parts	-0.184	1.000											
Easy repairability	-0.049	0.273**	1.000										
Mechanics reputation	0.009	0.171	0.109	1.000									
Engine capacity	0.232*	0.109	0.083	0.105	1.000								
Cost	0.009	0.143	0.242*	0.110	0.134	1.000							
Appearance of the machine	0.149	-0.089	0.249**	0.058	0.053	0.056	1.000						
Performance with regard to agricultural operations	0.494*	-0.409*	-0.049	-0.314*	0.021	0.009	0.148	1.000					
Offers from dealer	-0.148	-0.058	-0.037	0.229**	-0.079	0.155	0.074	-0.005	1.000				
Resale value	-0.078	0.141	-0.099	0.219**	0.060	0.030	0.124	0.208**	0.362*	1.000			
Loan availability	-0.018	0.222**	0.015	0.441*	0.142	0.206**	-0.189	0.130	-0.390*	0.068	1.000		
Subsidy from Govt.	-0.028	0.057	-0.061	-0.112	-0.119	0.011	0.202	-0.028	0.171	0.106	-0.039	1.000	
Media influence	0.236**	0.106	0.091	0.076	0.099	-0.080	-0.110	0.234**	0.100	0.098	0.092	-0.007	1.000

Note : * and ** indicates significance at 5% and 1% level of significance respectively.