A STUDY ON PERCEPTION UTILIZATION AND MAINTENANCE OF WATER HARVESTING STRUCTURES IN ADILABAD DISTRICT OF TELANGANA STATE

BY

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THESIS SUBMITTED TO THE PROFESSOR JAYASHANKAR TELANGANA STATE AGRICULTURAL UNIVERSITY IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE

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DECLARATION

I, Mr. S.HAREESH KUMAR, hereby declare that the thesis entitled **"A STUDY ON PERCEPTION, UTILISATION AND MAINATENANCE OF WATER HARVESTING STRUCTURES IN ADILABAD DISTRICT OF TELANGANA STATE** submitted to the **Professor Jayashankar Telangana State Agricultural University** for the Degree of **Master of Science in Agriculture** 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: Rajendranagar, Hyderabad.

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CERTIFICATE

Mr. S. HAREESH KUMAR has satisfactorily prosecuted the course of research and that the thesis entitled **"A STUDY ON PERCEPTION, UTILISATION AND MAINATENANCE OF WATER HARVESTING STRUCTURES IN ADILABAD DISTRICT OF TELANGANA STATE"** 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 part thereof has been previously submitted by his for a degree of any University.

Date:
Place: Rajendranagar,
Hyderabad.

(Dr. G.SAMUEL)
Chairperson

CERTIFICATE

This is to certify that the thesis entitled **"A STUDY ON PERCEPTION, UTILISATION AND MAINATENANCE OF WATER HARVESTING STRUCTURES IN ADILABAD DISTRICT OF TELANGANA STATE"** submitted in partial fulfillment of the requirements for the degree of **'MASTER OF SCIENCE IN AGRICULTURE'** of the **Professor Jayashankar Telangana State Agricultural University, Hyderabad** is a record of the bonafide original research work carried out by **Mr. S.HAREESH KUMAR** 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 assistance and help received during the course of the investigations have been duly acknowledged by the author of the thesis.

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Date:

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LIST OF SYMBOLS AND ABBREVIATIONS

e.g.	For example, for instance
et al.	And other people
etc.	And so on; and other people /things
H_0	Null Hypothesis
H_1	Alternate Hypothesis
R	Correlation Co-efficient
%	Percentage
ICRISAT	International Crops Research Institute for Semi Arid Tropics
CRIDA	Central Research Institute for Dry Land Agriculture
CAZRI	Central Arid Zone Research Institute
SAU	State Agriculture University
ICAR	Indian Council of Agriculture Research
NWDPRA	National Watershed Development Project in Rainfed Areas
WDP	Watershed development programme
DPAP	Drought Prone Area Programme
AP	Andhra Pradesh
NCA	National Commission on Agriculture
DC	Distributor Committee
EC	Executive Committee
PC	Project Committee
IWMP	Integrated Watershed Management Programme
DWCRA	Development of Women and Children in Rural Areas
DWMA	District Watershed Management Agency
KVK	Krishi Vigyan Kendra
ATMA	Agricultural Technology Management Agency
GOI	Government of India
Fig	Figure
AIR	All India Radio
WUE	Water Use Efficiency
GDE	Group Dynamics Effectiveness
NWDP	National Watershed Development Programme

NGO s	Non Government Organizations
SDA	State Department of Agriculture
SHG	Self Help Group
UG	User Group
VWDC	Village Watershed Development Committee
WHS	Water Harvesting Structure
MHM	Million hectare meter
WUA	Water User Associations
DAATTC	District Agricultural Advisory and Transfer of Technology Centre

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ABSTRACT

The present study entitled "A STUDY ON PERCEPTION, UTILISATION AND MAINATENANCE OF WATER HARVESTING STRUCTURES IN ADILABAD DISTRICT OF TELANGANA STATE" had been initiated mainly focusing on perception, utilization and maintenance of water harvesting structures.

Ex-post facto research design was adopted in the present investigation. Adilabad district of Telangana state was selected purposively. The study was conducted in 12 selected villages from 4 mandals of Adilabad district, which included 10 respondents from each of the selected village. A sample of 120 respondents was selected for the study.

The analysis of profile characteristics of watershed farmers indicates that majority of them were middle aged with illiterates, marginal farm size, medium level of farming experience, socio political participation, environmental awareness, scientific orientation,

risk taking ability and low level of annual income, mass media exposure, team work and group cohesiveness.

Majority of the watershed farmers had medium level of perception (39.2%) regarding water harvesting structures followed by high (33.3%) and low (27.5%).

Majority of the watershed farmers had medium level of utilization (54.2%) regarding water harvesting structures followed by low (24.1%) and high (21.7%).

Majority of the watershed farmers had low level of maintenance (60.0%) regarding water harvesting structures followed by medium (27.5%) and high (12.5%).

Correlation analysis between profile characteristics revealed that the independent variables *viz*, group cohesiveness, team work, socio political participation, farm size, environmental awareness, farming experience and risk taking ability were found positively and significantly related with the extent of utilization of water harvesting structures. Where as group cohesiveness, annual income, socio political participation, farming experience, education, team work and mass media exposure were found positively and significantly related with extent of maintenance of water harvesting structures.

The major constraints elicited by the watershed farmers were Lack of team spirit among the watershed user groups in maintenance of water harvesting structures (85.83%), Small and marginal land holdings (81.66%), Poor technical knowledge of watershed farmers both on maintenance and sustainable use of water harvesting structures (87.5%), Low income levels of the farmers to meet the cost of repairs to the water harvesting structures (91.66%), Lack of funds for maintenance of water harvesting structures (79.16%) and Lack of focused group approach in maintenance of water harvesting structures (75.00%).

The major suggestions expressed by the watershed farmers were efforts must be made to inculcate the spirit of team work among the farmers to attend various water harvesting structure by making the members understanding the objectives of the task, the process involved and benefits accrued to each member (79.16%), farmers should be motivated to take up water harvesting structures on a community mode in a large area to derive more benefits from implementation of water harvesting structures (79.16%), much emphasis should be given to improve the knowledge and skills of the farmers on importance/ relevancy /utilization of various water harvesting structures under watershed area by conducting different kinds of knowledge and skill based training programmes (85.83%), low cost water harvesting structures like farm pond, check dam, percolation pit etc should be designed and advised to the farmer (80.00%), and the members of the watershed user groups should be taken into cognizance while distributing budget to various water harvesting structures (71.66%).

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Chapter I

Introduction

CHAPTER I
INTRODUCTION

Water is an essential need for all life and is used in different ways. It is also a part of the larger ecosystem in which the reproduction of the bio diversity depends. Fresh water scarcity is not limited to the arid climate regions only, but in areas with good supply the access of safe water is becoming critical problem. Lack of water is caused by low water storage capacity, low infiltration, larger inter annual and annual fluctuations of precipitation and high evaporation demand.

The term water harvesting is defined as the collection and storage of any form of water either runoff or creek flow for irrigation use. Now a days water harvesting has become a general term for collecting and storing runoff water or creek flow resulting from rain in soil profile and reservoirs both over surface and under surface. Previously this was used for arid and semi arid areas, but recently their use has been extended to sub humid and humid regions too. In India water harvesting means utilizing the erratic monsoon rain for raising good crops in dry tracks and conserve the excess runoff water for drinking and for recharging purposes.

HISTORY OF WATER HARVESTING

Water harvesting like many techniques in use today is not new. It is practiced as early as 4500 B.C. by the people of the nabateans and other people of the Middle East. While the early water harvesting techniques used natural materials, 20^{th} century technology has made it possible to use artificial means for increasing runoff from precipitation.

Water harvesting was practiced more than 1000 years back in Southern India, by way of construction of irrigation tank, check dams, percolation tanks, farm ponds etc, but the research in India on this subject is of recent one. Work is taken up at International Crops Research Institute for Semi Arid Tropics (ICRISAT) Hyderabad, Central Arid Zone Research Institute, (CAZRI) Jodhpur, Central Research Institute for Dry land Agriculture (CRIDA) Hyderabad, State Agricultural Universities (SAUs) and other dry land research centers in the country.

When water harvesting technique is used for runoff farming, the storage reservoir will be soil itself, but when the water is to be used for livestock, supplementary irrigation or human consumption, a storage facility of some kind will have to be produced. In countries where land is abundant, water harvesting involves; harvesting or reaping the entire rainwater, storing it and utilizing it for various purposes. In India, it is not possible to use the land area only to harvest water and hence water harvesting means using the rain water at the place where it falls to the maximum and the excess water is collected and again reused in the same area. Therefore the meaning of water harvesting is different in different areas and countries. These methods are used for both agriculture and to increase the ground water availability.

Water harvesting for household and for recharging purposes is also in existence for long years in the world. During rainy days, the people in the villages used to collect the roof water in the vessels and use the same for household purposes including drinking. In South East Asian countries people used to collect the roof water (thatched roof by providing gutters) by placing 4 big earthen drums in 4 corners of their houses. They use this water for all household purposes and then it gets exhausted only they will go for well water. The main building of the Agricultural College at Coimbatore was constructed 100 years ago and they have collected all the roof water through pipes and stored in a big under ground masonry storage tanks by the sides of the building. These rainwater is used for all labs, which require pure and good quality of water. In the same way the rainwater falling on the terrace in all the buildings constructed subsequently is collected and stored in the underground masonry tanks even the surface water flowing in the Nalla's in the campus are also diverted by providing obstructions, to the open wells to recharge ground water.

Hence rainwater harvesting is as old as civilization and practiced continuously in different ways for different purposes in the world but it has not been done systematically in all places. Need has come to harvest the rainwater including roof water to solve the water problems everywhere not only in the arid but also in the humid region.

NEED FOR WATER HARVESTING

Water is becoming a scarce commodity and is considered as a liquid gold in the country. The demand for water is also increasing day by day not only for Agriculture, but also for household and Industrial purposes. It is estimated that water requirement for drinking and other municipal uses will be increased from 3.3 MHm to 7.00 MHm in

2020/25. Similarly the demand of water for industries will be increased by 4 fold i.e. from 3.0 MHm to 12.00 MHm during this period at the same time more area should be brought under irrigation to feed the escalating population of the country, which also needs more water. But we are not going to get one litre more water than we get at present though the demand is alarming.

The perennial rivers are becoming dry and ground water table is depleting in most of the areas and the depletion is about 30-50m in the last 30-40 years. Country is facing floods and drought in the same year in many states. This is because, no concrete action was taken to conserve, harvest and manage the rain water efficiently.

The rainfall is in abundant in the world and also in India. But it is not evenly distributed in all the places. India being the monsoonic country, the rain falls only for 3 to 4 months in a year with high intensity, which results more runoff and soil erosion. Total rain occurs only in about 100 hours out of 8760 hours in a year. It is also erratic and falls once in 3 or 4 years. This is a very common phenomenon in many parts of the country.

If the availability of water is 1700 M3/p/y, there will be occasional water stress, and if it is less than 1000 M3/p/y, it is under water scarcity condition. Though India is not under water stress conditions but in Tamil Nadu state is already under water scarcity condition, but there is no need for panic since it is possible to manage this condition as in the case of Israel where the availability is only about 450 M3/p/y, where it is managed by means of water harvesting, water conservation and water management.

Water scarcity is not only limited to the arid regions but also occurring in high rainfall areas. Chirapunji gets more than 11,000mm of average annual rainfall but face drinking water problem before monsoon commences whereas in Ralegoan Siddhi, in Maharastra there is no water scarcity problem though the annual average rainfall is only about 450mm. Hence to mitigate drought there is an urgent need to follow our ancestral way of water harvesting and the latest technologies adopted in soil and water conservation measures on watershed basis including roof water harvesting.

The entire rainwater is collected in masonry drains (from houses, streets/roads etc) and are taken to the sea instead of taking into the ground water aquifers or in surface reservoirs by pumping if needed. The ground water available can be used during summer and the aquifer made empty so that the rainwater can be put into the aquifers during rainy period by suitable water harvesting measures.

Therefore here is a need for water harvesting measures in urban and rural areas for agriculture, drinking and other purposes.

METHODS OF WATER HARVESTING IN RURAL AND URBAN AREAS

There are different systems of water harvesting depending upon the source of water supply and places as shown below.

a) In situ Rainwater harvesting

- Bunding and terracing.
- Vegetative / stone contour barriers.
- Contour trenching.
- Contour stone walls.
- Contour farming.
- Micro catchments.
- Tie ridging methods
- Farm ponds.

b) Direct surface runoff harvesting

- Roof water collection
- Dug out ponds / storage tanks
- Tankas
- Kundis
- Ooranis
- Temple tanks
- Diversion bunds
- Water spreading

c) Stream flow / runoff harvesting

- Nalla bunding
- Gully control structures
- Check dams – Temporary (or) Permanent
- Silt detension tanks
- Percolation ponds

d) Sub surface flow harvesting

- Sub surface dams
- Diaphragm dams

e) Micro catchment's / watershed

- Inter terrace / inter plot water harvesting
- Conservation bench terrace

f) Runoff inducement by surface treatment

- Roaded catchments
- Use of cover materials – Aluminum foils, Plastic sheet, bentonite, Rubber, etc
- Using chemicals for water proofing, water repellent etc. to get more runoff water.

WATERSHED DEVELOPMENT PROGRAMME IN TELANGANA STATE

Telangana is the twelth largest agrarian state in the country covering an area of 274.4 lakh hectare. Out of it an area of 123.5 lakh hectare is under cultivation and 69.4 percent of cultivated area defends on precipitation alone. About 66 percent of state population is dwelling area defends in these areas. To mitigate the migrations of the farmers, the Government of India started with three model Watershed programmes of ICAR at chinnatekuru in Kurnool, chevella in Medak, and yerracheruvu in Ananthapur district in 1983-84. During the same year World Bank aided marco-watershed was started at maheshwaram of Rangareddy district. Subsequently at centre National Watershed Programmme for Rainfed Agriculture (NWDPRA) was started in 1986-87 in 59 watersheds covering 13 districts. In the year 1987-88 and 1988-89 the programme was implemented in 68 watersheds. During 1989-91, the programme has been extended to 80 watersheds. In 1990-91, the programme further extended to 94 watersheds covering 20 districts with the financial outlay of Rs.620.40 lakhs. Besides these, the state government has also introduced Watershed Development Programme (WDP) under Drought Prone Area Programme (DPAP).

During 1989-90, the World Bank asked the Andhra Pradesh state government to take up more area under watershed development programme with the spill over money of the Maheshwaram watershed. Thus, under the same credit No.1424-IN, seven additional watersheds were sanctioned in the districts of Adilabad, Nizamabad, Medak, Mahaboobnar, Nalgonda, Warangal and Khammam with approval of Government of India and World Bank for a period of four years.

WATERSHED DEVELOPMENT PROGRAMME IN ADILABAD

Adilabad is one the backward districts of telangana state with a total geographical area of 16,128 Sq.km. it forms 14.04 percent of the total area of telangana having 52 mandals. The district head quarter is located at 343 km from the state capital.

The soil groups in the district are red and black. Though black soil predominates accounting for almost 72% of the soil in the district. The average rainfall 1049 mm per annum. It receives the maximum rainfall during South-West monsoon and in the beginning of North-East monsoon. The maximum and minimum temperature ranges from 46°C and 28°C. The watershed development concept was adopted since 1985-86

only in the district. Soil and moisture conservation programmes were initially started in 16 watersheds during 1985-86 and by the end of the seventh five year plan i.e., 1989 to 1990 the programme was extended to 20 watersheds (NWDPRA-8 and DPAP-12) in the district treating an area of 20.000 hectares of arable land of 34.000 hectares of the total area in watershed utilizing an amount of Rs.158 lakhs.

Because of the importance of the dry land agriculture in sustainability of production, the researcher felt that there is a need to make an attempt to study about the perception, utilization, and maintenance of water harvesting structures in Adilabad district of Telangana state.

OBJECTIVES OF THE STUDY

1. To study the selected profile characteristics of watershed farmers.
2. To reveal the perception of farmers on selected water harvesting structures.
3. To unearth the utilisation of water harvesting structures by the farmers.
4. To analyse the maintenance of water harvesting structures by the farmers.
5. To find out the relationship of utilisation and maintenance with the profile characteristics of the farmers.
6. To identify the constraints encountered by the farmers in maintaining water harvesting structures.
7. To elicit suggestions from the farmers for better maintenance of water harvesting structures.
8. To evolve a suitable extension strategy for better maintenance of water harvesting structures.

SCOPE OF THE STUDY

It is hoped that the findings of the study would be helpful to the watershed development planners, administrators, scientists and extension workers and to know the effectiveness of water harvesting structures. The strategy developed based on the findings of the study would help personnel involved in watershed development programmes in taking up appropriate measures for effective implementation of watershed programmes in future.

IMPORTANCE AND NEED FOR THE STUDY

According to National Commission on Agriculture (1975) an estimated 150 million hectares out of the total geographical area of 328 m.ha. is subjected to serious water and wind erosion. The area affected by gullies and ravines for about 4 million ha. There is 70 m.ha. area under rainfed farming in the country.

Because of the fragile nature of ecosystem, soil and water conservation programme is of paramount importance. Realising this, Government of India have given top priority for treating catchment areas of different river valleys with intensive soil and water conservation measures. Of late experiences of different model watersheds have also indicated that there is urgent need of treating lands with different soil and water conservation measures, production of food, fodder and fibre as well as mitigation of droughts.

Implementation of improved dry farming technology on watershed basis is new concept introduced during 1982-83 under 20 point economic programme at national level. In the present Telangana state watershed development programme is being implemented since 1983-84 onwards. Great emphasis and importance is being given in eighth five year plan. Any programme of the magnitude of dry farming technology on watershed basis, not only aims at increasing and stabilizing yields of rain fed areas, but also involves the behavioural changes of farmers to words new technology needs systematic probe and periodic evolution to know its impact in bringing about the desired behavioural changes in existing farming practices of farmers. Very limited research work has been done on the impact of the improved dry farming technology on watershed basis with reference to changes in farmer's socio-economic aspects, and whatever little which is available, turned out to be scanty in nature.

The findings of the study could gainfully be utilized by the scientists and extension workers to know the existing status of the dry land farmers, the various problems in receiving the technology, and also its adoption. The results of the study could be effectively used in other areas where similar conditions exist with necessary structural changes.

Keeping these factors in view, the present field of investigation entitled a study on perception, utilization, and maintenance of water harvesting structures in Adilabad district of Telangana state was undertaken.

LIMITATIONS OF THE STUDY

The present study suffered from the limitations of time, finance, and other amenities generally confronted by single student researcher. These limitations compelled to the restricted purposive selection of only one integrate watershed development programme as the locale of the study. Again most of the data collected were based on the expressed opinion of the respondents. The study therefore may not be free from their bias involved with the respondents within the social investigation.

Despite these it is believed that the findings depicted and conclusions drawn could stand the test of more varied field observations.

The findings will be applicable wherever similar conditions prevailing though the generalizations over a wide geographical area call for the replication of similar types of studies by minimising mental bias from the respondent beneficiaries.

PRESENTATION OF THE STUDY

The report of the study has been presented in five chapters. The first chapter deals with a brief introduction including objectives, scope, and importance as well as limitations of the study. In the second chapter review of literature deals with review of available and related studies in the light of the present investigation. Chapter three deals with material and methods used in the study together with research design, sampling procedure, the variables and their measurement, collection of data, scoring, categorisation and statistical procedures explained in detail and the findings and discussions in the fourth chapter. The concluding chapter five contains summary, conclusions, implications and suggestions. At the end literature cited and appendices were given.

Chapter II

Review of Literature

CHAPTER II

REVIEW OF LITERATURE

A thorough review of literature is necessary to acquaint with the research area and was felt essential in developing sound research methodology and operationalizing the needed concept. This also helps to find out the available information related to the objectives of the proposed research and provides a basis for interpretation of findings. It helps to identify the gaps in research findings, the documentation and the events relating to a particular aspect of investigation. A brief review of the available literature has been incorporated in the light of the objectives of study under the following heads:

2.1 The selected profile characteristics of respondents.

2.2 The perception of farmers on selected water harvesting structures.

2.3 The utilisation of water harvesting structures by the farmers.

2.4 The maintenance of water harvesting structures by the farmers.

2.5 The constrains encountered by the farmers in maintaining water harvesting structures.

2.6 The suggestions from the farmers for better maintenance of water harvesting structures.

2.1 Profile characteristics of the watershed farmers

2.1.1 Age

Banerjee (2002) reported that members in the age group of above 40 years participated actively in the group activities. Groups, which were more than 3 years old, had 42.00 per cent of the members of age above 40 years. On the other hand increased participation of members below 40 years was observed among newly formed groups.

Sridhar (2002) found that 44.67 per cent of the watershed farmers were middle aged, while, 28.00 per cent of them were young and remaining 27.33 per cent belonged to old age.

Raghunandan (2004) reported that, 45.00 per cent of the respondents belonged to the middle age group, followed by old age (36.25%) and young age group (18.75 %), repectively.

Chandracharan (2005) in his study on profile of sujatha watershed project beneficiary farmers revealed that majority (46.00%) of the respondents were middle aged.

Doli (2006) found that most of the respondents were grouped under medium (39.58%) category followed by low (35.83%) and high (24.50%) categories with respect to the age.

Rahman and Yamao (2006) revealed that 52.00 per cent of farmers belonged to the old age group followed by 27.00 per cent middle age and 1.20 per cent belonged to young age group.

Fakoya *et al.* (2007) found that the mean age of the women farmers in the state was 45.30 years.

Khalkheili and Zamani (2008) found that the age of respondents in the study area ranged from 17 to 86 years with a mean of 41 years.

Reddy (2009) found that 60.56 per cent of tank management farmers belonged to middle age group followed by old age (23.33%) and young age (16.11%).

Alam *et al.* (2012) revealed that 39.56 per cent of the farmers fell under the young aged category while 35.71 per cent of them fell under the middle and 24.72 per cent fell under the old aged category.

Archana (2012) reported that most of the respondents were middle age group (40.83%) followed by 32.50 per cent were old age and rest of them (26.67%) were young age group.

Divaker (2013) found that majority of the respondents were categorized into old age group (49.37%) followed by middle aged (31.87%) and rest of them (18.75%) were young age group.

Prathyusha (2014) found that majority of the respondents were categorized into middle age group (53.00%), 38.00 per cent were young age group and rest of them (9.00%) were old age group.

Prashanth (2015) found that majority of the project tank users were belonged to middle age followed by young (36.66%) and old (10.00%) age whereas majority (48.33%) of the non project tank users were middle aged followed by old (31.60%) and young (20.00%) aged.

2.1.2 Education

Sridhar (2002) found that the respondents (26.67%) were educated up to middle school only.

Raghunandan (2004) revealed that majority (73.75%) of the respondents were literates of which 22.50 per cent studied up to primary school. 20.00 per cent studied middle school, 15.00 per cent up to high school, 11.25 per cent up to pre university,

whereas, 5.00 per cent had graduation, and 23.28 per cent of the respondents were illiterate.

Chandracharan (2005) revealed that the respondents were educated up to high school (28.00%), followed by up to middle school (27.33%), and illiterate (10.67%).

Reddy (2005) reported that 30.00 per cent of the respondents had education up to high school, followed by middle school (28.00%) and primary school (27.33%). Nearly 12.00 per cent of them were illiterates, while a meager 4.00 per cent of them had education up to college and degree programme.

Doli (2006) found that majority were in low (42.50%) category followed by high (32.08%) and medium (25.40%) level of family education.

Rahman and Yamao (2006) revealed that 30.00 per cent of farmers had secondary education. The rest of the 26.00 per cent, 12.00 per cent and 12.00 per cent were primary, higher secondary and illiterate level of education respectively.

Fakoya *et al.* (2007) revealed that 29.37 per cent of farmers were illiterate. The rest of the 18.75 per cent, 21.88 per cent, 23.75 per cent and 6.25 per cent were adult literacy, primary, secondary and tertiary level of education respectively.

Khalkheili and Zamani (2008) found that the majority of the respondents (36.00%) had 1–5 years of education, while 15.50 per cent were illiterate.

Reddy (2009) found that 32.78 per cent tank management farmers had middle school education followed by 26.11 per cent belonged to illiterate group, 22.22 per cent of the respondents completed preschool education, 13.33 per cent of respondents have completed high school education and only 5.55 per cent of the respondents have got college education.

Alam *et al.* (2012) revealed that more than two-fifths (42.86%) of the respondents had secondary level of education compared to 18.14 per cent having primary level of education and 35.71 per cent was above secondary level. Only 3.29 per cent of the respondents were illiterate.

Divaker (2013) inferred that majority of farmers were illiterate (70.62%), followed by read and write (10.00%), primary school (6.25%), read only and middle school 5.00 per cent each and high school 3.12 percent.

Prathyusha (2014) opined that majority of the *Bt* cotton farmers were educated up to primary school (27.00%), followed by illiterate (23.00%), high school (22.00%), intermediate (21.00%) and degree (7.00%).

Prashanth (2015) found that majority of the project tank users were educated up to primary school level (41.66%) followed by upper primary school (21.66%), high school (11.66%), post graduate and illiterate each (8.33%) and intermediate (5.00%) whereas, majority of the non project tank users were educated upto primary school level (31.66%) followed by illiterate (25.00%), upper primary school (18.33%), high school (10.00%) and intermediate (8.33%)

2.1.3 Farm size

Reddy (2001) indicated that 35.00 per cent of the respondents were marginal farmers, 26.00 per cent were small farmers and 21.80 per cent were medium farmers.

Sridhar (2002) unfolded that majority of the respondents (30.00%) had medium size land holdings. Whereas, least number of respondents (2.00%) were found to be having big size land holdings.

Chandracharan (2005) found that majority (37.33%) of the respondents had land holding up to 5 acres and 34.67 per cent of the respondents had land holding above 10 acres.

Reddy (2005) reported that comparatively more number of farmers *i.e* 64.00 per cent belonged to semi medium land holding category, followed by 22.00 per cent in medium category, where as 10.67 per cent of them had small land holding and a meager 3.33 per cent of them belonged to big land holding category.

Doli (2006) found that 41.50 per cent of the respondents belonged to medium category of land holding, followed by low (39.16%) and high (19.58%).

Rahman and Yamao (2006) revealed that a great majority (78.80 %) of the farmers had small farm size while 16.20 per cent had medium farm size and 5.00 per cent had large farm size.

Fakoya *et al.* (2007) stated that the mean farm size of the women farmers in the state was 3.2 ha.

Khalkheili and Zamani (2008) expressed that farmers had an average irrigated farm size of 5.31 ha, non-irrigated farm size of 0.63 ha and total farm size of 5.91 ha.

Archana (2012) revealed that majority (46.67%) of the respondents had small farm size followed by marginal (29.17%) and large (24.16%) farm size.

Divaker (2013) found that majority of the respondents were marginal farmers (70.62%), followed by small 20.62 per cent and big farmers 8.75 per cent.

Prathyusha (2014) found that majority of the respondents were small farmers (44.17%), followed by marginal (30.83%), semi-medium (15.83%), medium (6.67%) and large (2.50%) farmers.

Prashanth (2015) found that majority (46.66 %) of the project tank users had small farm size followed by marginal (35.00 %) and large (18.33%). Whereas, majority (40.00%) of the non project tank users had marginal farm size followed by small (38.33%) and large (21.66 %).

2.1.4 Farming experience

Raju (2002) revealed that majority of watershed farmers (63.00%) had medium level of farming experience followed by low (20.50%) and high (16.50%) respectively.

Farinde *et al.* (2005) showed that majority of the respondents (78.75%) claimed to have between 2 and 4 years of experience. Only 2.50 per cent of the respondents had less than 2 years of experience while 18.75 per cent had an experience of 5 years and above.

Khalkheili and Zamani (2008) found that the agricultural experience of farmers ranged from 2 to 70 years with a mean of 23.2 years.

Reddy (2009) found that majority 33.89 per cent of tank management farmers were having 20 years and above farming experience, where as 23.89 per cent of the farmers were having 10-15 yrs of experience, 20.56 per cent of the farmers were having 15-20 years of experience, 16.66 per cent of the farmers were having 5-20 years of experience and only 5.00 per cent of farmers were having less farming experience *i.e.* up to 5 years.

Umamaheshwara (2009) confirmed that nearly half of the farmers possessed medium farming experience (40.83%) followed by high (32.50%) and low, (26.67%) farming experience.

Archana (2012) revealed that majority of the respondents had medium farming experience (49.17%), followed by high (26.67%) and low farming experience (24.16%).

Mohan and Ramesh (2012) revealed that majority (33.89%) of the respondent farmers were having 20 years and above farming experience, where as 23.89 per cent of them 10-15 years of experience, 20.56 per cent had 15-20 years of experience, 16.66 per cent had 5-10 years of experience and only 5.00 per cent of farmers had less farming experience *i.e.*, up to 5 years.

Nirmala (2012) observed that majority (52.50 %) of the respondents had medium farming experience followed by low (30.00%) and high (17.50%) farming experience.

Omid *et al.* (2012) revealed that majority (53.40%) of farmers had 18-30 years of experience followed by up to 18 (26.00%) and above 30 years (20.50%).

Divaker (2013) observed that majority of respondents were having high level of farming experience (68.12%), followed by medium (21.87%) and low level (10.00%) of experience.

Prathyusha (2014) indicated that majority of the farmers were grouped under medium farming experience (61.00%) followed by low (29.00%) and high farming experience (10.00%).

Prashanth (2015) found that majority of the project tank users had medium farming experience (45.00%) followed by low (30.00%) and high farming experience (25.00%) whereas, majority of the non project tank users had medium farming experience (50.00%) and equal percentage (25.00%) had high and low farming experience.

2.1.5 Annual Income

Ramesh (2004) indicated that little more than one fourth of the credit borrowers (27.00%) had an annual income between Rs.14000-Rs.18000, 16.00 per cent of each belonged to Rs.8,000 – Rs.10,000 range and above Rs.24, 000 income groups respectively. The rest of borrowers were equally (9.00%) distributed under below Rs.8000 and Rs.18000 – Rs.24000 annual income categories respectively.

Viresh and Kiran (2007) reported that majority (42.50%) of the paddy farmers had low level of annual income followed by medium (35.00%) and high (22.50%) levels respectively.

Anup *et al.* (2010) reported that majority (42.66%) of respondents belonged to Rs 50,000 to 1,00,000 annual income group followed by 34.66 per cent belonged up to Rs 50000 annual income group and about 22.66 per cent belonged to more than 1,00,000 annual income group.

Mandal and Dipak (2010) revealed that majority of farmers (58.67%) were in annual income up to Rs. 25,000 category followed by 16.67 per cent farmers in annual income between Rs. 25,000 to 50,000, 16.00 per cent farmers having annual income between Rs. 50,000 to 75,000, 3.67 per cent farmers in annual income in between Rs. 1,00,000 to 1,25,000, 2.67 per cent farmers in annual income in between Rs 75,000 to 1,00,000, 1.32 per cent farmers in annual income in between Rs. 2,25,000 to 2,50,000,

0.67 per cent farmers in annual income between Rs. 1,75,000 to 2,00,000 categories.

Painkra *et al.* (2010) revealed that majority of the respondents i.e. 49.17 per cent farmers had annual income up to Rs 30,000 followed by 33.33 per cent farmers with annual income between Rs 30,000 to 60,000 and 7.50 per cent farmers had annual income more than Rs 60,000.

Satish (2010) indicated that 36.66 per cent of paddy growers belonged to high income group followed by medium (31.66%), semi medium (27.50%) income groups and 4.16 percent of them were in low income group respectively

Farida *et al.* (2011) reported that majority of paddy growers i.e. 40.00 per cent farmers had annual income more than Rs.12,000 followed by less than Rs.12,000 (20.00%), Rs. 12000 to 60,000 (20.00%), Rs. 60,000 to 12,0000 (20.00%) categories respectively.

Prashanth (2011) observed that majority (48.33%) of the organic cotton farmers had medium annual income followed by low (35.00%) and high (16.66%) whereas, majority (43.33%) of the conventional cotton farmers had high annual income followed by medium (31.66%) and low (25.00%) respectively.

Archana (2012) opined that majority of respondents (36.67%) had very low farm income, followed by low (32.50%), medium (30.00%) and high (0.83%) farm income respectively.

Shashikant (2013) reported that majority of the respondents (66.87%) had very low followed by low (13.75%), medium (11.25%), high (5.00%) and very high annual income (3.12%) respectively.

2.1.6 Environmental awareness

Ishaya and Abaje (2008) found that 73.00 per cent of respondents believe that temperature has been raising over the past few decades. and 83.50 per cent of them expressed that rainfall is decreasing every year.

Bhusal (2009) reported that 90.00 per cent of the respondents perceived the temperature has increased and 97.00 per cent said they are experiencing unpredictable rainfall patterns since last 10 years. Additionally, more than 50.00 per cent respondents

explored that late start of monsoon, incidents of drought has increased, hail storm occurs abnormally, wind flow pattern is getting warmer, decreasing water sources, changes in flowering and fruiting time, invasion of new weeds like *Ageratina adenophora* and *Ageratum sps*., and reduction of some indigenous plants like *Artemisia indica.*

Rao *et al.* (2009) expressed that above 80.00 per cent of the farmers of Akola, Mohanpur, Pharbhani and Solapur and 50.00 per cent of farmers from Bangalore, Anantapur and Kovilpatti and 41.00 per cent of farmers in Anand region expressed that rainfall is the most important weather parameter that affects agriculture considerably. Farmers from Akola (5.00%), Anand (14.00%), Ananthapur (13.00%), Banglore (14.00%), Hissar, Jabalpur (19.00%), kovilpatti (25.00%), Mohanpur (10.00%) and Solapur (20.00%) expressed that temperature is another important parameter that influences agriculture.

Mandleni and Anim (2011) reported that 57.00 per cent of livestock farmers were more aware of climate change and 43.00 per cent were not aware.

Thaddeus chidi Nzeadible *et al*. (2011) reported that the level of awareness of local communities on climate change impacts was still low in the delta region of Nigeria. Nearly 60.00 per cent of respondents know little or nothing about climate change and its impacts.

Archana (2012) found that majority of the respondents had medium climate change awareness (42.50%), followed by low (40.83%) and high (16.67%) climate change awareness.

2.1.7 Socio-Political Participation

Purnima (2004) reported that majority (42.92%) of the respondents were under high social participation, followed by medium (33.33%) and low (23.75%).

Rao and Ramachandrudu (2004) observed that majority of the farmers (50.00%) had membership in one organisation followed by no membership (26.00%), member in more than one organiation (9.34%), officer bearer (7.33%) and wide public leader (7.33%).

Singh *et al.* (2004) revealed that majority of command area farmers had no participation (48.00%), followed by high (29.00%) and low (23.00%) participation.

Shrishail (2006) found that majority (83.00%) of farmers had low socio-political participation followed by high (25.83%) and medium (3.33%).

Chandrashekhar (2007) said that majority of the respondents (58.34%) had no membership in any organization, where as 28.33 per cent were members in one of the organization. Only 3.33 per cent were members of more than one organization and 10.00 per cent were office bearers in organizations.

Satyanarayana (2008) revealed that 79.00 per cent of respondents had low participation followed by 17.00 per cent medium and 4.00 per cent high participation.

Umamaheshwara (2009) found that 7.50 per cent of respondents were members and 10.00 per cent were office bearers. Further, 35.22 per cent of the respondents never participated, while 41.66 and 23.12 per cent of respondents had occasional and regular participation, respectively.

Swetha (2010) revealed that 41.11 per cent of the respondents had medium level of participation, followed by 32.23 per cent had low level of participation and 26.66 per cent of them had high level of participation.

Priya (2010) revealed that 35.80 per cent of the respondents had medium level of participation, followed by 34.20 per cent had high and 30.00 per cent had low level of participation.

Savita (2011) noticed that regarding participation in gram panchayat, it was found that 6.66 per cent of respondents were members and 10.66 per cent were office bearers. Further, 36.00 per cent of the respondents never participated, while 42.66 and 21.34 per cent of respondents had occasional and regular participation, respectively.

Mohan and Reddy (2012) revealed that majority (49.44%) of the respondents had medium socio-political participation, followed by low (30.56%) and high (20.00%) socio-political participation.

Sharma *et al.* (2012) found that majority of fisher women (82.66%) had no membership, while 13.33 per cent were office holders. Only 1.33 per cent of respondents had membership in one organisation, whereas nobody had membership in more than two organisations.

2.1.8 Mass media exposure

Veerendranath (2000) revealed that 25.00 per cent of respondents had low mass media exposure, 52.78 per cent of them had medium mass media exposure and the rest of them 22.22 per cent had high mass media exposure.

Gattu (2001) reported that majority of the respondents (66.67%) had medium mass media contact, followed by low (18.33%) and high (15.00%) mass media exposure.

Neelaveni *et al.* (2002) reported that half of the respondents belonged to medium mass media consumption category, followed by low (32.50%) and high (14.16%) categories.

Anitha (2004) reported that one-fifth of farm women (20.00%) had high level of mass media exposure. More than half of the respondents (52.50%) were having medium and 27.50 per cent of them had low level of mass media use.

Sunil Kumar (2004) revealed that 59.17 per cent of the respondents were listening agricultural programmes of AIR occasionally, whereas, 30.00 per cent of them viewed agricultural programmes in television occasionally and 70.83 and 85.00 per cent of them never used to read the news papers and farm magazines respectively.

Suresh (2004) reported that 64.17 per cent of the respondents were exposed to mass media to a moderate extent, followed by 21.25 per cent of them to low extent and 14.58 per cent of them to high extent.

Khalkheili and Zamani (2008) showed that farmer access to mass media is low.

Reddy (2009) revealed that majority (66.67%) of tank management farmers had medium exposure to mass media followed by high (25.00%) and low (8.33%).

Thaddeus chidi Nzeadible *et al.* (2011) found that farmers received information on climate change from radio/ television (61.00%) and news paper (44.00%) in the delta region of Nigeria.

Archana (2012) found that majority of the respondents (40.83%) had medium extent of exposure to mass media, while 36.67 per cent and 22.50 per cent had low and high level of exposure to mass media respectively.

Adilaxmy (2015) found that majority of the respondents (39.33%) had medium extent of exposure to mass media, while 36.00 per cent and 24.67 per cent had low and high level of exposure to mass media respectively.

2.1.9 Risk Taking Ability

Raju (2002) revealed that majority of watershed farmers (62.00%) had medium level of risk taking ability followed by high (22.00%) and low (16.00%).

Ningareddy (2005) reported that 56.00 per cent belonged to medium risk taking ability followed by high 28 per cent and low 19.33 per cent risk taking ability respectively.

Prasad (2005) revealed that three fourths (74.17%) of crop loan beneficiary had medium risk taking ability, followed by high (19.16%) and a very meagre percentage (6.67%) had low risk taking ability.

Chandrashekhar (2007) revealed that majority of the respondents (63.33%) had high level of risk taking ability followed by 26.67 and 10.00 per cent had medium and low level of risk taking ability.

Manjunath (2007) revealed that, 43.75 per cent of the respondents belonged to medium level of risk taking ability category while, 32.50 and 23.75 per cent of the respondents belonged to low and high level of risk taking ability category respectively.

Tamilselvi and Vasanthkumar (2008) revealed that about an equal proportion of the respondents had high (41.00%) and medium (40.00%) level of risk taking ability, whereas only 19 per cent of them had low level risk taking ability.

Reddy (2009) revealed that majority (58.89%) of tank management farmers had medium level of risk taking ability followed by low (31.11%) and high (10.00%).

Swetha (2010) revealed that majority (40.00%) of the respondents belonged to medium risk taking ability, whereas 36.66 percent and 23.34 per cent of them belonged to low and high risk orientation.

Priya (2010) reported that majority (37.00%) of the respondents belonged to low risk taking ability category whereas, 33.30 per cent and 29.70 per cent of them belonged to medium and high risk taking ability categories, respectively.

Savita (2011) revealed that the risk taking ability of beneficiaries indicated that, more than two-third of the respondents belonged to medium level of risk taking ability category (65.34%) followed by low (16.00%) and high (18.66%).

Mohan and Reddy (2012) indicated that majority (58.89%) of the respondents had medium risk taking ability, followed by low (31.11%) and high (10.00%) risk taking ability.

Prashanth (2015) found that majority (50.00%) of the project tank users had medium level of risk taking ability followed by low (29.00%) and high (21.00%) whereas, majority (54.00%) of the non project tank users had low level of risk taking ability followed by high (26.00%) and medium (20.00%).

2.1.10 Group cohesiveness

Mangasri (1999) revealed that majority (60.00%) of Development of Women and Children in Rural Areas (DWCRA) women had medium level of group cohesiveness followed by low (23.33%) and medium (16.67%).

Purnima (2004) revealed that maximum number of respondents (40.00%) were in the medium category for group dynamics effectiveness followed by low (35.00%) and high (25.00%).

Neelima (2005) revealed that majority of non-traditional (70.00%) and traditional (72.00%) respondents were from group size of 13-16 members. The other 30.00 per cent of non-traditional and 28.00 per cent of traditional women were from group which had 10-12 members.

Ghosh *et al.* (2006) revealed that overall Group Dynamics Effectiveness (GDE) value ranged from 6.17 to 6.98 representing the medium to high level of group effectiveness. Three groups (2 pump user and 1 tank user group) have received GDE values of 7.1, 6.98 and 6.93 therefore fell in the high category of group effectiveness while 2 groups (1 pump user and 1 tank user group) were found at border of high and medium category of group effectiveness with GDE value of 6.66.

Prashanth (2015) opined that the membership feeling of majority (53.33%) of tank users in project tanks was high followed by low (25.00%) and medium (21.66%).

Prashanth (2015) found that inter-personal trust was medium (52.50%) followed by high (26.66%) and low (20.83%) in case of project tank users. Whereas it was medium (60.00%) followed by low (21.66%) and high (18.33%) in non project tank users.

2.1.11 Team work

Prashanth (2015) opined that majority (50.00%) of non project tank users had low level of attitude of collective behaviour followed by medium (37.50%) and high (12.50%) collective behaviour towards community participation in tank management.

Prashanth (2015) revealed that 42.00 per cent of the project tank users were found in medium responsibility, whereas, 30.00 per cent fell in high and only 20.00 per cent tank users had low level of responsibility in community participation.

Prashanth (2015) expressed that 62.50 per cent of the project tank users had high level of attitude of involvement of community participation in tank management, followed by medium (30.00%) and low (16.66%) level of involvement.

Prashanth (2015) observed that 36.66 per cent of the project tank users were found in medium, whereas, 33.33 per cent fell in high and 30.00 per cent had low level of collectivism.

2.1.12 Scientific Orientation

Natarajan (2004) reported that majority of respondents (43.33%) belonged to medium scientific orientation followed by low (37.78%) and high (18.89%) from his study on impact of farmers field school on rice in Pondicherry.

Sangeetha (2004) reported that 40.83 per cent of the respondents had high scientific orientation followed by those with low (35.00%) and medium (24.17%) scientific orientation.

Acharya (2005) revealed that majority (48.34%) of the respondents had high scientific orientation followed by medium (42.50%) and low (9.16%) scientific orientation.

Ramu (2005) reported that 68.67 per cent of the turmeric farmers had medium scientific orientation followed by respondents with low (16.67%) and high (14.66%) scientific orientation.

Naik (2006) stated that majority (42.67%) of the respondents had medium scientific orientation followed by low (34.00%) and high (23.33%) from his study on training needs of groundnut farmers in Ananthapur District.

Gowda (2009) reported that majority (70.89%) of the respondents had medium scientific orientation followed by low (20.8%) and high (8.31%) scientific orientation.

Dhillon *et al* (2011) reported that majority (51.67%) of the respondents had low scientific orientation followed by medium (38.33%) and high (10.00%) scientific orientation.

Rathod *et al.* (2012) reported that majority (47.50%) paddy farmers had low scientific orientation followed by medium (40.00%) and high (12.50%) scientific orientation.

Mohan and Reddy (2012) revealed that, the majority (49.44%) of the respondent farmers had medium scientific orientation, followed by low (30.56%) and high (20.00%) scientific orientation.

2.2 The perception of farmers on selected water harvesting structures

Tiwari and Mal (2000) observed that the water harvesting structures collection and storage of run-off water in suitable reservoir or pond, reducing the seepage and

evaporation losses and use of conserved water most efficiently at critical time to provide life saving irrigation to crops.

Rockström (2002) observed that water harvesting structures has the potential of contributing to mitigate rainfall fluctuations, and thereby stabilize yields over time and increase overall yield levels.

Ngigi (2003) revealed that rainwater harvesting structures increases cropland water conservation to enhance soil infiltration and water holding capacity of the soils. And he observed that even though rainwater harvesting practices can yield positive results through effective increase of soil moisture for crops in water scarce areas.

Wangkahart T., *et al*., (2004) revealed that the farm pond impacts indicate not only increasing crop yields in both the rainy and the dry seasons, but also reduction of downstream sediment load.

Bewket (2007) observed that the rainwater harvesting structures were effective measures for soil erosion and improving land productivity.

Desai *et al.* (2007) reported that the average net income generated with farm-pond to be relatively higher than that of the farmers without farm-pond.

L.B.Kunnal, *et al*. (2007) observed that Farm ponds are water harvesting structures used for storing the monsoon rainwater, which is used for irrigation. Farm ponds are expected to have an impact on cropping pattern, productivity, employment, and income of the farmers.

Rajeshwari, *et al*. (2007) observed that the farm fonds are water harvesting structures which can make changes in cropping pattern and providing additional employment among farmers.

Saha *et al*. (2007) revealed that the water harvesting structure restricts the potential loses like infiltration, percolation, seepage flow and evaporation to great extent.

Vohland and Barry (2009) observed that in situ rainwater harvesting systems that improve hydrological indicators such as, infiltration and ground water recharge, soil nutrients are enriched, and biomass production increases with subsequent higher yields leading to food security.

Biazin *et al*. (2012) reported that the rainwater harvesting techniques could improve the soil water content of the rooting zone, nearly six fold of crop yields have been obtained, reduces risk of crop failure due to dry spells but also improving water and crop productivity.

2.3 The utilisation of water harvesting structures by the farmers

Tian *et al*. (2003) found that micro water harvesting of ridges and furrows with plastic mulch increased the tuber yield of potatoes by 158 – 175% for two years. and corn yield by 1.9 times because of the higher Water User Efficiency (WUE).

Barron and Okwach (2005) observed that the harvesting runoff water for supplemental irrigation is a risk-averting strategy. Water harvested and stored in an earthen dam provided a technically feasible option to supplement crop water demand\

Fox *et al*. (2005) studied that using of Rain Water Harvesting structures for supplemental irrigation in semi-arid Kenya can generate economic benefits and improve long-term food self-sufficiency compared to rain fed agriculture. However, they stressed that the investment in supplementary irrigation is economically viable, but only if it is combined with growing a cash crop during the dry season.

Hatibu *et al*. (2004) found that using rainwater harvesting for vegetable production is consistently very beneficial to the farmer with returns to labor exceeding US$ 10 per person day and in some years reaching nearly US$ 200 per person day. It is against this background that the following crops have been selected for the study area.

Awulachew *et al.* (2007) observed that water harvesting structures has the potential to reduce risk of crop failure during moisture deficit periods when implemented and managed properly

Oweis and Hachum (2009) revealed that water harvesting structures can play a key role in the attempt to increase water productivity and improve rain-fed crop yields if implemented carefully by considering the related socio-economic and technical issues.

Singh *et.al.*(2006) observed that the harvested rain water could be used to irrigate winter season vegetable crops through irrigation system to enhance productivity and profitability.

Adriano *et al*. (2011) observed that the harvested rainwater was used for drinking water and for other uses were in the form of vegetable crop irrigation and provision for backyard animal water requirement.

Tamimi (2011) found that in situ water harvesting with a sand ditch proved that run0ff and sediment loss were significantly reduced by 46% and 60% respectively and infiltration and soil moisture were increased.

Biazin *et al*. (2012) found that supplemental irrigation during dry spells with micro catchment harvesting could improve the soil water content of the rooting zone by up to 30 per cent.

2.4 Extent of maintenance of water harvesting structures by the farmers

Brikke *et al*. (2003) observed that the water harvesting structure should be also checked and cleaned after every dry period of more than one month. The outsides of metal tanks may need to be painted about once a year. Leaks have to be repaired throughout the year, especially from leaking tanks and taps, as they present health risks. Chlorination of the water may be necessary. Removal of debris and overhanging vegetation from gutters and the roof is important to prevent the gutter being clogged. Tank maintenance consists of physical inspection and repairing cracks with cement. Several studies have shown that water from well maintained and covered rooftop tanks generally meets drinking water quality standards if maintained rightfully.

2.5 The constraints encountered by the farmers in maintaining water harvesting structures

Gulati *et al.* (2005) found that the tank beds have been silted up, particularly near the dam, reducing their storage capacity. Siltation near the sluice gates often blocks the gates partially and raises the silt level. Because of siltation, the carrying capacity of canals has been reduced. Most of the tanks have only unlined earthen canals and seepage rates during conveyance are high. Lack of maintenance and repairs has created breaches in the tank bunds. On many old canals, there are no outlets; so farmers themselves make breaches and divert the flow to their fields, and frequent breaching has made the canal walls weak. Numerous smaller water-collecting structures built by villagers with the help of NGOs in the catchment area further decrease the amount of water gathering in the tanks.

Somaratne *et al.* (2005) pointed out that the tank cascade farmers of Srilanka felt that bunds have deteriorated in 46 per cent of tanks in the Kadawarawewa cascade and the tank bed has silted, reducing the tank capacity; in 92 per cent of the tanks, the sluices are damaged and inoperable or leaking in a further 46 per cent; and the tanks spills are damaged or not in good condition in another 37 per cent. The canals are physically deteriorated in 92 per cent of the cases.

Vadivelu (2005) found two types of constraints during government interventions in the watershed area. Poor farmer’s participation and inability of ground level govt staff in achieving policy framework at top level.

Jennifer and Ganesh (2006) indicated that majority of the farmers (66.00%) had lack of money to pay water fees was the main reason for default. Series of droughts, severe shortages of water which further led to no or very less crop production,

Moreover, there has been a substantial hike in the water fees over a period of time, default with intention (20.00%) and dissatisfaction with the delivery services (7.00%) were major constraints in the repayment of water fee to WUA.

Palanisami (2006) reported that encroachment, privatization and government appropriation of the tanks have been the main outcomes of the failure of local authority system to enforce the institutional arrangement under the common property resource management regime. About 2.00 per cent of the tanks in the tank less intensive region and 67.00 per cent of the tanks in the intensive region have become defunct. Wells that are supposed to be security against late season tank water scarcity have of late become a major threat to the very survival of the tanks. Taxes from multiple uses of the tanks, if collected by a single agency are sufficient to meet the operation and maintenance expenditures of the tanks both in the short run and in the long run.

Sharma (2007) observed poor involvement of farmers at the planning stage (88.33%), poor participation of farmers in trainings, campaigns, and meetings (72.66%), poor planning at grass root level (71.66%) and lack of transport facility for the field work (55.33%), contact farmers sometimes do not disseminate new technology among the farmers (50.66%), inadequate skilled labour (55.00%), lack of teamwork feeling among staff members (39.22%), non co-operation from the sub-ordinate staff (36.90%), and in effective co-ordination with other line departments (36.33%).

Golyanaik (2008) found that nearly three fourths of watershed beneficiaries expressed that lack of knowledge (81.90%) was the main constraint in participation, followed by lack of interest to participate (76.10%), unfavorable attitude towards extension personnel (73.33%), not concerned to local needs (71.42%), groupism and political interference (69.52%), lack of free time to participate in watershed activities (64.67%), lack of motivation from the village leaders (60.95%) and the implementing agency (59.94%), lack of resources (45.70%) and poor quality of work (34.28%).

Sisodia and Chitranjan (2008) revealed that major technical constraints faced by the watershed beneficiaries were the improved breed of the buffaloes and ram were not provided, trainings were not given under household production system for masses of backward castes, high mortality of horticultural plants. Whereas, major physical constraints were field visit of well established watershed were not conducted, audio-visual aids were not used and reference material were not provided during training period to the farmers. While watershed beneficiaries were not taken in confidence

during budget utilization, progress and future plans were not discussed among the beneficiaries

Passouant *et al.* (2009) insisted that the sustainability of self-governing irrigation schemes was currently under pressure in many countries as public financial support is decreasing. Further, he studied water pricing and sustainability of self governing irrigation schemes and reported that nevertheless choosing a relevant water charge does not ensures by itself the sustainability of an irrigation scheme, combined support providing WUAs and farmers with efficient advice regarding management and organizational skills should also contribute significantly to achieve sustainability.

Subhaschand *et al.* (2009) found that constraints faced by the watershed functionaries (Watershed President, Chairman, Secretary and Volunteers and Watershed Committee Members) were insufficient honorarium to the watershed secretary and volunteers, lack of follow up action of training programme, difficulty in getting contribution for common works and difficulty in maintaining plantations in common lands.

Anil *et al.* (2010) found that illiteracy (71.25%), lack of capital (65.00%), complexity of loan procedures (62.50%), high cost of fertilizer and seeds (61.25%), lack of training (57.50%), lack of transport facilities (46.25%) and lack of irrigation facilities (42.50%) were perceived as major constraints in adoption of watershed technologies. However, lack of active workers (33.75%), uncertainty of forthcoming fund (30.00%), unavailability of fertilizer at proper time (27.50%) and distant training centre (23.75%) were also important constraints in the adoption of watershed technologies as perceived by respondents.

Priya (2010) indicated that majority of the farm women perceived lack of participation of farm women (95.00%), lack of female trainer/facilitator (90.80%), pressure of household work (89.20%), male dominance at home (85.00%) and restriction at home (81.70%) as the constraints.

Rajamanickam (2011) found rapid population growth, depletion of water resources at a rate faster than replenishment, ever increasing demand among the competing sectors, increasing occurrence of droughts, unabated flooding of major rivers, declining groundwater quality, perennial inter-state river water disputes even after judicial pronouncements, inadequate financial resources and lack of institutional reforms and enforcement were the major problems faced by our country's water sector.

2.6 Suggestions from the farmers for better maintenance of water harvesting structures

Parthasarathy (2004) identified four critical areas, *viz.*, rational supply of water, water distribution rights, government and policy and political participation are identified as necessary conditions for the participatory approach in irrigation management transfer programmes to success.

Purnima (2004) reported major suggestions given by head reach farmers were that all canals must be repaired immediately (71.11%) and all works or repairs must be undertaken before monsoon (63.33%), while, majority (83.33%) of the tail ended farmers suggested that severe punishment must be given to unauthorized irrigation followed by the suggestion that all works must be undertaken before monsoon (68.88%).

Sakthivadivel *et al.* (2004) emphasised that there was a need to revisit the methods of tank rehabilitation and creation of WUAs to improve the gross tank product per cubic meter of tank water.

Singh (2004) suggested that in order to evolve participation at local level within watershed area publicity material may be used and training programmes should be organized at the village to acquaint the are acknowledge about latest improved technology and their advantage. Overall the performance of non-government organizations was found to be better than the government organization.

Verma *et al.* (2004) said that adoption of soil and water conservation practices by farmers, better co-ordination between development agencies and voluntary organizations and land development activities were the major suggestions offered by the farmers for effective implementation of NWDP in rainfed areas.

Keikajisa *et al.* (2005) suggested that there is every need to introduce less labour intensive systems for better collective tank management. One promising possibility suggested was to use lined channels with tank systems. This technology significantly reduces the labour required for maintenance work and also increases the availability of water by minimizing seepage and enhances collective management due to labour intensive technology and return investment was assured.

Peterpaul (2005) concluded that irrigation farming will had a future only if the farmers take on responsibility in all matters of planning, implementation, maintenance and operation.

Reddy and Reddy (2005) c suggested to enhance the financial viability of the WUAs through plantation and horticultural crops on common riverbeds, canal banks, etc. Further, social forestry can be taken up on the encroached lands. The cooperation and co-ordination between president, EC and irrigation engineers should be strengthened. The quantity and distribution of water shall be carried out by PCs, DCs and WUAs through general body depending on the availability of water. In the absence of PC/DC, WUA be held responsible for water distribution. Laskars should be placed under the direct control of the WUAs.

Reddy and Reddy (2005) a made it clear that the prominent suggestions offered for effective implementation of PIM are deepening of the tank and raising the height of the tank, equal distribution of water, needed cooperation and coordination by the other water users.

Reddy and Reddy (2005) b reported that majority of the respondents are willing to contribute for maintenance of the irrigation system by their labour. In case of cash contribution farmers were willing to contribute based on per unit cropped area.

Ratnakar and Govardhandas (2006) suggested the strengthening of village institutions, improving the extension network and enhancing the skills of water users in social cohesiveness, village institutional management, gender balance, increased agricultural productivity, adoption of proper water management practices, hydrological monitoring, improved cropping patterns, and environmentally sound interventions in resource conservation.

Easter (2008) insisted that procedure of closing the sluices during the rainy days, when there is no demand for water has been shown to increase the net irrigated area by more than 20.00 per cent and minimizing the risk of crop failure at a 17.00 per cent.

Palanisami *et al.* (2011) suggested that overall value of tank output was estimated here to be maximized when tank storage is about 71.00 per cent under PU tanks and 67.00 per cent under PWD tanks giving indication that PU tanks need more attention compared to PWD tanks in restoring the tank storage. Enhancing tank rehabilitation, desilting, supplemental role of ground water reducing tank catchment level encroachment and siltation in the tank bed had resulted in lower storages even in a normal rainfall periods. Also tanks used to get 100 per cent storage levels in 2 out of 10 years.

Savita (2011) indicates the suggestions given by the respondents, to improve the participation of beneficiaries in community based tank management project in the order

of priority were provide inputs like seeds, fertilizer and pesticides (46.66%), followed by equal importance should be given to all members (43.33%), entire farm families should be covered (34.00%), involve local people while planning for construction of community tank (32.00%), inclusion of other agro-based income generating enterprises in the programme (30.00%), equal benefits to all the beneficiaries (26.66%), training on management of community tank (23.33%), conduct more extension educational activities (22.66%), training on proper utilization of community tank for enhancing their income through fish culture (21.33%), involve local institutions organizations while implementing programme (17.34%), increase the frequency of visits of field staff to villages (16.66%) and training on desilting (14.33%).

Basavaraj and Siddaramaiah (2012) reported suggestions such as increasing the volume of water released in the main canal, allow the tail enders to utilize irrigation water first, frequent transfer of irrigation department officers, crop violators should be fined ten times than actual and educate the head-reach farmers on the importance of protective irrigation.

2.7 CONCEPTUAL MODEL OF THE STUDY AND DERIVATION OF HYPOTHESIS

In the light of inferences derived from recorded evidences in the literature, conceptual frame work has been developed (Figure 2.1.) for the study which diagrammatically presented the variables and their relationships.

Conceptual model is a diagrammatically representation out lining the dominant elements of a system and their inter relationship with respect to criterion variable.

It is clear from the model that the perception of farmers on selected water harvesting structures, the utilization of water harvesting structures the maintenance of water harvesting structures were the dependent variables and a relationship was proposed with the selected twelve profile characteristics of the respondents.

The intended outcome was given at the end of the model.

Hypotheses derived for the investigation

Null Hypothesis: The perception, extent of utilization and extent of maintenance of water harvesting structures of the farmers may not influence the overall water harvesting structures maintenance by the farmers.

Alternate Hypothesis: The perception, extent of utilization and extent of maintenance of water harvesting structures of the farmers will influence the overall water harvesting structures maintenance by the farmers.

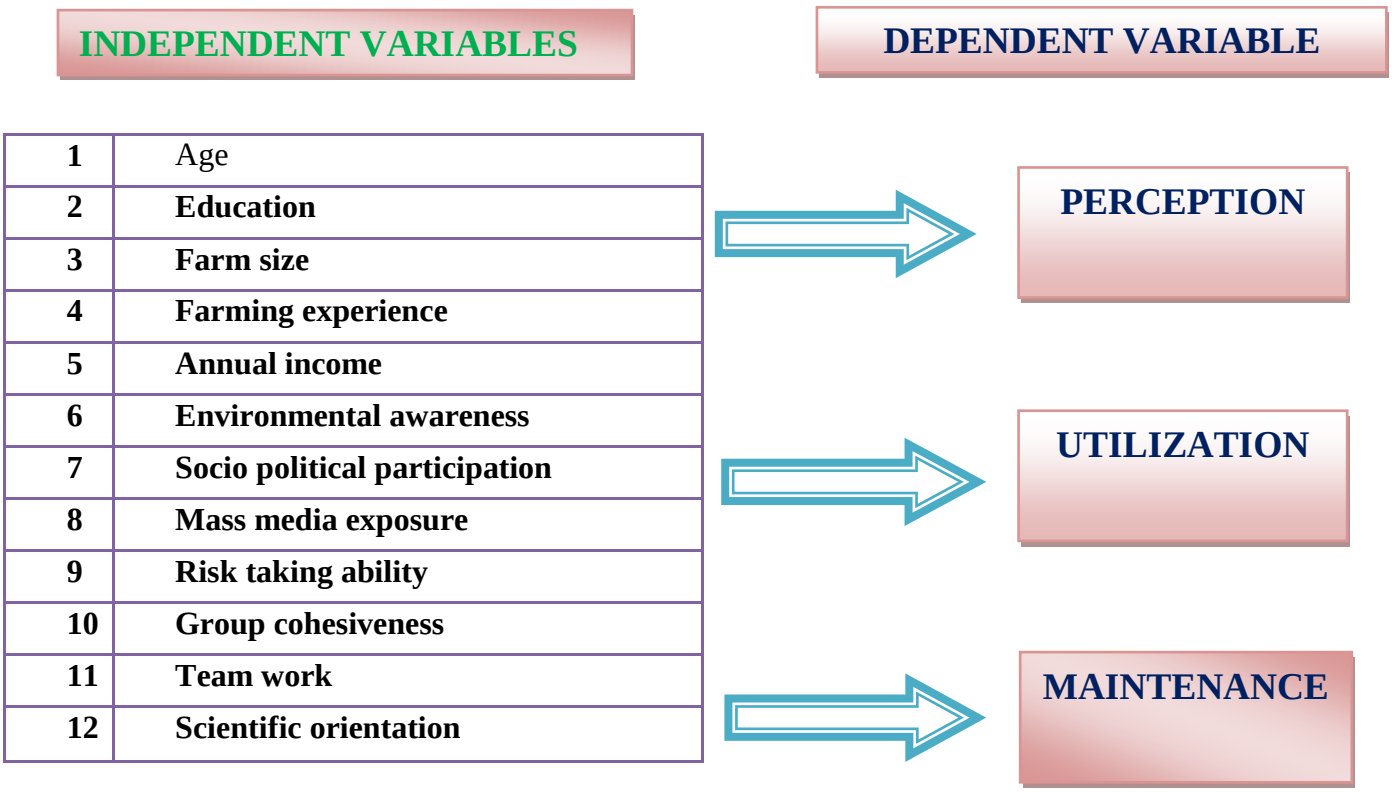

Fig. 2.1 CONCEPTUAL MODEL OF THE STUDY

Chapter III

Material and Methods

CHAPTER III

MATERIAL AND METHODS

This chapter consists of six major parts, the first part describes the research design, the second part gives the sampling procedure, the third part deals with the variables and their empirical measurement, the fourth part explains the instruments and methods used for data collection and the fifth part focuses on statistical tools used in analyzing the data and final part covers the compilation of findings in the form of a report.

3.1 Research Design

3.2 Sampling procedure

3.3 Variables and their empirical measurement

3.4 Collection of data

3.5 Statistical tools used

3.6 Preparation of report

3.1 RESEARCH DESIGN

Research designs are developed to enable the researchers to answer research questions as validly, objectively, accurately and as economically as possible. The research design used for the study was ex-post-facto, with the main objective of measuring perception, utilization and maintenance of water harvesting structures by the respondents.

An ex-post-facto research design was followed in the study as the manifestations of the variables had already occurred. Ex-post-facto research is a systematic enquiry in which the researcher does not have direct control on the independent variables because their manifestations have already occurred or because they are inherently not manipulable, Kerlinger (1973).

3.2 SAMPLING PROCEDURE

3.2.1 Locale of the study

The state of Telangana was selected purposively for the study as the researcher hails from the same state and is familiar with the regional language and cultural patterns, which facilitate the researcher in avoiding the problems in rapport building with the respondents.

3.2.2 Selection of the District

Telangana state is divided into three agro climatic zones viz., Southern Telangana, Northern Telangana and Central Telangana. Comprising of total 10 districts namely Hyderabad, Rangareddy, Mahaboobnagar and Nalgonda in Southern Telangana Nizamabad, Karimnagar and Adilabad in Northern Telangana Medak, Warangal and Khammam in Central Telangana. Among the three agro climatic zones the Northern Telangana zone receives comparatively more rainfall then the other two zones. Among the districts in Northern Telangana Adilabad receives higher rainfall of 1157 mm. significant area is covered under soil and moisture conservation measures in Adilabad district and hence it is selected for the study purposively.

3.2.3 Selection of mandals

Out of total 52 mandals in the district four mandals namely Adilabad, Bela, Jainath, and Thamsi were selected purposively as maximum number of soil and water conservation structures were constructed under Integrated Watershed Management Proramme (IWMP) of the Department of Agriculture.

3.2.4 Selection of villages

From each of the selected mandals three villages were chosen at random by following simple random sampling method. A total of 12 villagges namely Kachkanti , Anukunta and Ankoli in Adilabad mandal and Khogdur, Syedpur, Junoni in Bela mandal and Deepaiguda, Belluri and Bahadurpura in Jainath mandal and Gunjala, Wadgoan and Bheempur in Thamsi mandal were selected randomly for the study.

3.2.5 Selection of respondents

About 10 farmers from each village were selected purposively to make a total sample of 120 respondents for the present study.

3.3 VARIABLES AND THEIR EMPIRICAL MEASUREMENT

In order to study the selected profile characteristics of respondents, their perception, utilization and maintenance of water harvesting structures, problems faced by them and suggestions offered for tackling their problems suitable variables were selected in consultations with the experts in the field of agricultural extension, agricultural engineering, scientists of Agricultural Research stations and District Agricultural Advisory and Transfer of Technology Centre (DAATTC), officials of Department of Agriculture etc.

The variables selected for the study and their measurement is shown in following Table 3.1.

Table 3.1. Variables and their empirical measurement

	Variables	Empirical Measurement
I	Dependent Variables	
1	Perception on water harvesting structures	Schedule developed for the study.
2	Utilization of water harvesting structures	Schedule developed for the study.
3	Maintenance of water harvesting structures.	Schedule developed for the study.
II	Independent variables	Empirical Measurement
1	Age	Chronological age
2.	Education	Number of years of formal education
3.	Farm size	Number of acres possessed
4.	Farming experience	Number of years of experience in farming
5.	Annual income	Schedule developed for the study.
6.	Environmental awareness	Schedule developed for the study.
7.	Socio-political participation	Schedule developed for the study.
8.	Mass media exposure	Schedule developed for the study.
9.	Risk taking ability	Schedule developed for the study.
10	Group cohesiveness	Schedule developed for the study.
11	Team work	Schedule developed for the study.
12	Scientific orientation	Schedule developed for the study

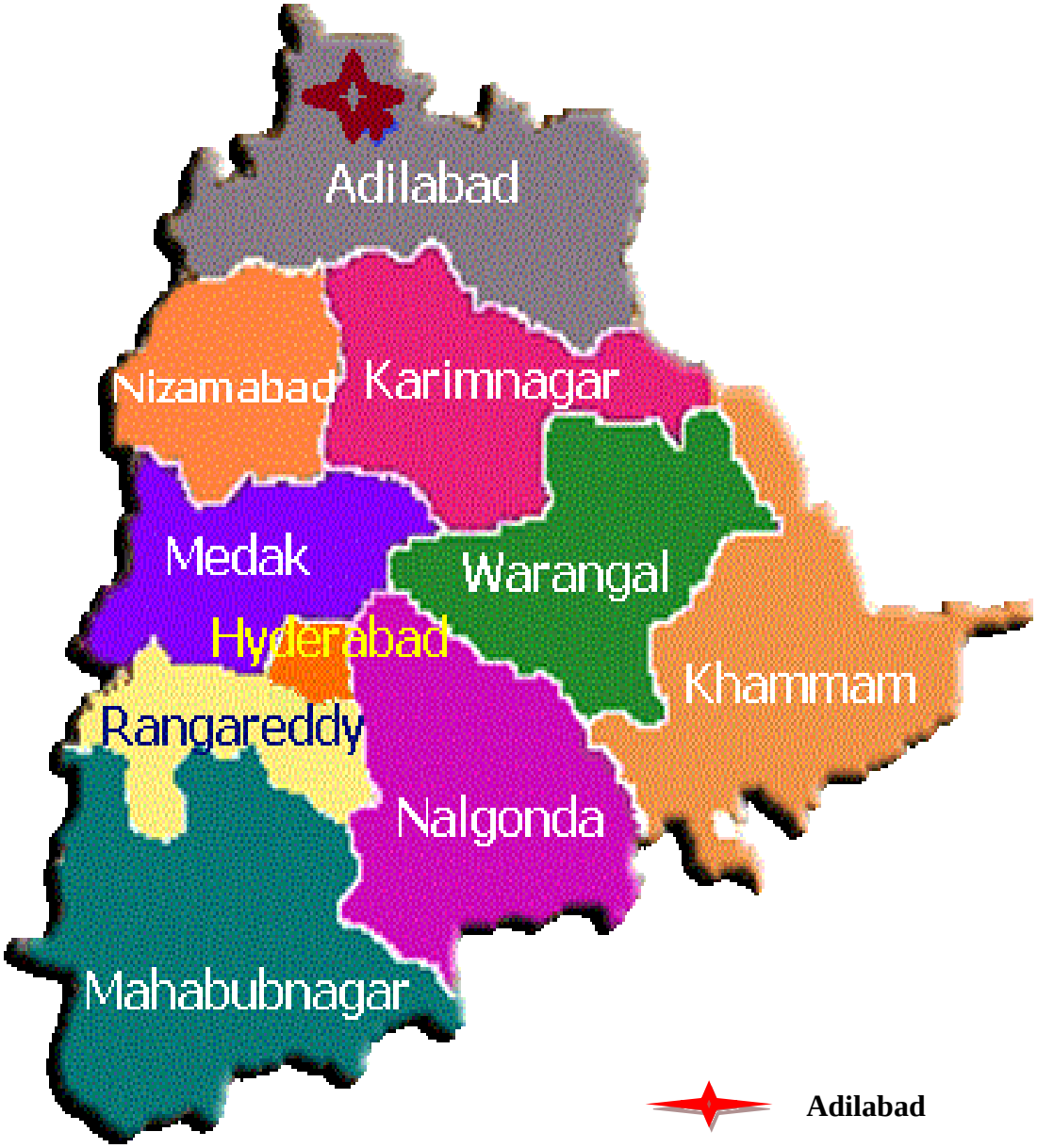

Fig 3.1 Map of Telangana showing selected district of Adilabad

Fig 3.2 Map of Adilabad showing selected mandals of Adilabad, Jainath, Thamsi and Bela

3.3.1 Profile characteristics of respondents

3.3.1.1 Age:

Age was operationally defined as the chronological age of the watershed farmer in terms of the total number of years completed at the time of investigation.

Categorization: The respondents were grouped into young, middle and old age categories based on their chronological age. Scoring of 3, 2 and 1 were given for young, middle and old age categories respectively. The results were shown in the form of frequencies and percentages.

S. No	Category	Score
1	Young age (below 35 years)	3
2	Middle age (36-50 years)	2
3	Old age (above 50 years)	1

3.3.1.2 Education:

Education was operationally defined as the level of formal schooling received by the watershed farmer at the time of investigation.

Categorization: A schedule was developed to measure the level of education possessed by the watershed farmers and were classified into following seven categories.

S. No	Category	Score
1	Illiterate (No formal education)	1
2	Primary school (1^{st} to 5^{th} Class)	2
3	Upper primary school (6^{th} and 7^{th}Class)	3
4	High school (8,9& 10^{th} Class)	4
5	Intermediate	5
6	Under graduation	6
7	Post graduation and above	7

3.3.1.3 Farm size:

Farm size was operationally defined as the number of acres of land possessed by the watershed farmer.

Scoring: a score of 1 was assigned for each acre of land possessed by the watershed farmer. The total score of each farmer was worked out by summing up the total number of acres of land possessed by the farmer.

Categorization: The watershed farmers were grouped into following three categories depending upon on possession of extent of land as.

Category	Score
Marginal farmer	< 2.5 acres
Small farmer	2.5 to 5.0 acres
Large farmer	>5.0 acres

3.3.1.4 Farming experience:

Farming experience was operationally defined as the number of years completed by watershed farmer in farming at the time of investigation.

Scoring: A score of one was assigned to each completed year of experience. The maximum and minimum obtained scores were 45 and 02 respectively.

Categorization: The watershed farmers were grouped into following three categories based on scores obtained by following the exclusive class interval technique

Category	Class interval
Low farming experience	2-16
Medium farming experience	16-30
High farming experience	30-44

3.3.1.5 Annual income

Annual income was operationally defined as the actual income of the respondent acquired from various sources in a year. The farm income of the individual respondent's families was obtained in rupees and were categorized into three groups depending up on the range of income as.

S.No	Category	Income (Rs.)
1.	Low income	Below 50000

2.	Medium income	50000-75000
3.	High income	75000-100000

3.3.1.6 Environmental awareness

Environmental awareness refers to cognizance of the watershed farmers on changes and happenings in environment at global level.

A set of seven statements were framed to elicit the extent of awareness of watershed farmers on changes and happenings in environment at global level.

Scoring: A score of 2 and 1 is assigned to every yes and no responses respectively. The minimum and maximum possible scores are 7 and 14, whereas the obtained scores were 7 and 13 respectively. The total score of individual watershed farmers was worked out by summing up scores of all the seven statements.

Categorization: The watershed farmers were grouped into following three categories based on exclusive class interval technique.

Category	Class interval
Low environmental awareness	7-9
Medium environmental awareness	9-11
High environmental awareness	11-13

3.3.1.7 Socio political participation

Socio political participation was operationally defined as the degree of involvement of watershed farmer in social and political organizations in the village such as Village panchayat, Youth club, Water User Association (WUA), Self Help Group (SHG), User Group (UG) and Village Watershed Development Committee (VWDC).

A schedule was developed to measure the socio-political participation of watershed farmer consisting of six statements.

Scoring : It was measured in terms of holding organizational positions as not a member, member, active member, committee member and office bearer. with scores of '1', '2', '3' '4' and '5'respectively. The minimum and maximum possible scores are 6 and 30, whereas the obtained scores were 6 and 21 respectively.

Categorization: The watershed farmers were grouped into following three categories based on exclusive class interval technique.

Category	Class interval
Low Socio-political participation	6-11
Medium Socio-political participation	11-16
High Socio-political participation	16-21

3.3.1.8 Mass media exposure :

Mass media exposure refers to the exposure of watershed farmer to different mass media sources. The watershed farmers were asked "how often" they expose to each of the mass media source. Such as radio, television, education films, news paper, books on agriculture and allied fields and magazines on agriculture and allied fields.

A schedule was developed to measure the mass media exposure consisting of five statements.

Scoring: Mass media exposure was measured in terms of regular, occasional and never with assigned scores of 3, 2 and 1 respectively. The minimum and maximum possible scores are 7 and 21, whereas the obtained scores were 7 and 16 respectively.

Categorization: The watershed farmers were grouped into following three categories based on exclusive class interval technique.

Category	Class interval
Low exposure to mass media	7-10
Medium exposure to mass media	10-13
High exposure to mass media	13-16

3.3.1.9 Risk taking ability:

Risk taking ability was operationally defined as the degree to which the watershed farmer is oriented towards risk and uncertainty related to soil and water conservation practices.

A set of six statements were prepared related to risk taking ability and administrated to watershed farmers for assessing their risk taking ability in water harvesting structures.

Scoring: A scoring of 1, 2 and 3 were assigned to disagree, undecided and agree responses respectively. The minimum and maximum possible scores are 6 and 18, whereas the obtained scores were 8 and 11 respectively. The total score of each watershed farmer is worked out by summing up the scores of all the statements.

Categorization: The watershed farmers were grouped into following three categories based on exclusive class interval technique.

Category	Class interval
Low risk taking ability	8-9
Medium risk taking ability	9-10
High risk taking ability	10-11

3.3.1.10 Group cohesiveness

Group cohesiveness was operationally defined as the amount of unity in the group in terms of interpersonal attractions, ability of members to get along with psychological or social interactions, feeling of loyalty, pride, co-operation and identification with the group.

A schedule with six statements was framed related to cohesiveness of the group.

Scoring : A score of 5, 4, 3, 2 and 1 is assigned to very true, true, somewhat true, not true and not at all true respectively. The minimum and maximum possible scores are 6and 30, whereas the obtained scores were 12 and 15 respectively. The total score of each watershed farmer is worked out by summing up the scores of all the statements.

Categorization: The watershed farmers were grouped into following three categories based on exclusive class interval technique.

Category	Class interval
Low group cohesiveness	12-13
Medium group cohesiveness	13-14
High group cohesiveness	14-15

3.3.1.11 Team work:

Team work was operationally defined as how far the members in the team work collectively for their individual development apart from the actual works of watershed development.

A set of ten statements were prepared related team work of the group.

Scoring: A score of 3, 2 and 1 is assigned to agree, undecided and disagree, respectively. The minimum and maximum possible scores are 10 and 30, whereas the

obtained scores were 12 and 27 respectively. The total score of each watershed farmer is worked out by summing up the scores of all the statements.

Categorization: The watershed farmers were grouped into following three categories based on exclusive class interval technique.

Category	Class interval
Low team work	12-17
Medium team work	17-22
High team work	22-27

3.3.1.12 Scientific orientation:

Scientific orientation was operationally defined as the degree to which the watershed farmer is oriented towards the use of scientific methods in farming and decision making.

Scoring: A score of 1, 2 and 3 is assigned to disagree, undecided and agree responses respectively. The minimum and maximum possible scores were 6 and 18 respectively. Whereas Maximum and minimum obtained scores were 6 and 18 respectively.

S. No	Category	Class Interval
1	Low scientific orientation	6-10
2	Medium scientific orientation	10-14
3	High scientific orientation	14-18

3.3.2 Dependent Variables

3.3.2.1 Perception on water harvesting structures:

Perception on water harvesting structures was operationally defined as the feeling of the watershed farmers towards the various aspects of the soil and water harvesting structures.

It was measured by the listing of about 14 statements with reference to all the components of water harvesting structures such as the water harvesting structures facilitate to reduce the run off of rainwater, prevents the soil erosion, changes the cropping system, increases the ground table in the surrounding areas, gives life saving

irrigation to the crops, increases the crop yield, good source of drinking water for cattle etc. and was quantified against two point continuum as follows. Under this dimension the scores were allotted for perception on water harvesting structures.

A set of 14 statements were prepared related perception on water harvesting structures.

Scoring: A score of 2 and 1 is assigned to every yes and no responses respectively. The maximum and minimum possible scores are 28 and 14, whereas the obtained scores were 26 and 20 respectively. The total score of individual watershed farmers was worked out by summing up scores of all the 14 statements.

Categorization: The watershed farmers were grouped into following three categories based on exclusive class interval technique.

S. No	Category	Class Interval
1	Low	20-22
2	Medium	22-24
3	High	24-26

3.3.2.2 Utilization of water harvesting structures

Utilization of water harvesting structures is the degree of usage of water harvesting structures by the watershed farmers for various agricultural purposes.

Total score of a respondent is obtained by summing up individual scores obtained for each Purpose of usage of water harvesting structures . Based on total scores of individual watershed farmers on utilization of water harvesting structures, they were grouped into three categories of low, medium and high.

In order to have an in-depth understanding of extent of use, the respondents extent of utilization of water harvesting structures was found out operation wise i.e. soil conservation, rain water saving, life saving irrigation, drought mitigation, drinking for live stock, Increases crop yield, establishing the allied enterprises, to grow high value commercial crops, changes to profitable cropping systems and reducing soil erosion etc. The scores were summed up operation wise and respondents were categorized into low, medium and high. The results were expressed in the form of frequencies and percentages.

A set of 15 statements were prepared related utilization of water harvesting structures.

Scoring: A score of 4, 3, 2 and 1 is assigned to every frequently, occasional, rarely and never responses respectively. The minimum and maximum possible scores are 15 and 60, whereas the obtained scores were 35 and 50 respectively. The total score of individual watershed farmers was worked out by summing up scores of all the 15 statements.

Categorization: The watershed farmers were grouped into following three categories based on exclusive class interval technique.

S. No	Category	Class Interval
1	Low	35-40
2	Medium	40-45
3	High	45-50

3.3.2.3. Maintenance of water harvesting structures.

Maintenance of water harvesting structures operationally defined as the way the resources both financial and human are pooled to attend the repairs safeguarding and supervising the water harvesting structures.

A set of 26 statements were prepared related maintenance of water harvesting structures.

Scoring: A score of 3, 2 and 1 is assigned to every always, occasional and never responses respectively. The minimum and maximum possible scores are 26 and 78, whereas the obtained scores were 50 and 71 respectively. The total score of individual watershed farmers was worked out by summing up scores of all the 26 statements.

Categorization: The watershed farmers were grouped into following three categories based on exclusive class interval technique.

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S. No	Category	Class Interval
1	Low	50-57
2	Medium	57-64
3	High	64-71

3.3.4 Problems and suggestions in usage of water harvesting structures.

The problems in the usage of water harvesting structures as faced by the watershed farmers were collected and the results expressed in the form of frequencies and percentages. The suggestions to overcome these problems were also simultaneously documented from the farmers for the commonly used water harvesting structures. Percentages were computed for 120 respondents.

3.4 COLLECTION OF DATA

3.4.1 Instruments used for the study

Data were collected from the selected watershed farmers by using the interview schedule developed for the study. in consultation with the Advisory committee, experts in the field of Agricultural Extension and officials of Integrated Watershed Development Programme, Department of Agriculture. The finalized interview schedule used for the study was shown in Appendix A.

Interview schedule consisted of information regarding the respondents name, village, mandal, district, profile characteristics of respondent, dependent variables, i.e. Perception on water harvesting structures , Utilization of water harvesting structures, Maintenance of water harvesting structures and problems and suggestion in the usage of water harvesting structures.

3.4.2 Method of data collection

Each selected watershed farmers was personally contacted and interviewed with the help of interview schedule. It was made sure that the questions were correctly understood by the respondent by repeating the questions wherever necessary. Observation of respondent's background, behavior, emotions, feelings, ideas, aspirations and surroundings were also made use of during interview.

3.5 STATISTICAL TOOLS USED

The following statistical tools were used for the analysis and interpretation of the data.

3.5.1 Frequency and percentage

The data were subjected to frequencies and used to know the distribution of the respondents according to selected variable.

Frequency is the number of items a variable is repeated.

Percentage is the number, amount, rate etc. expressed as part of a total of 100.

3.5.2 Class interval

Exclusive method of class intervals was used to categorize certain variables. Class interval is difference between the upper and lower limit of a class and is calculated using the following formula.

$$C.I = \frac{\text{Maximum score} - \text{minimum score}}{\text{No. of classes}}$$

Under exclusive type of class intervals, the items whose values are equal to the upper limit are grouped in the next higher class.

3.5.3 Coefficient of Correlation

It was used to find out the relationship between the scores of dependent and independent variables using the following formula.

$$r = \frac{\Sigma xy - \frac{\Sigma(x)\Sigma(y)}{n}}{\sqrt{\left[\Sigma x^2 - \frac{(\Sigma x)^2}{n}\right]\left[\Sigma y^2 - \frac{(\Sigma y)^2}{n}\right]}}$$

Where

r = Co-efficient of correlation between x and y

Σx = Sum of scores of variable x

Σy = Sum of scores of variable y

Σx^2 = Sum of squares of scores of variable x

Σy^2 = Sum of squares of scores of variable y

$(\Sigma x)^2$ = Square of sum of variable x

$(\Sigma y)^2$ = Square of sum of variable y

Σxy = Sum of product of variable x and y

n = Size of sample

3.6 PREPARATION OF REPORT

The data thus collected through interview schedule were coded, tabulated, analyzed and presented in tables to make findings easily understandable. The findings

emerged out of data were suitably interpreted, necessary conclusions and inferences were drawn.

Chapter IV

Results and Discussion

CHAPTER IV

RESULTS AND DISCUSSION

In this chapter, based on the objectives of the study, the empirical evidences obtained through research have been analyzed by using and subjecting them to appropriate statistical and analytical tests and the findings are presented in the following sequence.

4.1. Profile characteristics of watershed farmers.

4.2. Perception of farmers on water harvesting structures.

4.3. Utilization of water harvesting structures.

4.4. Maintenance of water harvesting structures.

4.5. The relationship of extent of utilisation and maintenance with independent variables.

4.6. Constraints faced by the farmers in maintaining water harvesting structures.

4.7. Suggestions of the farmers for better Maintenance of water harvesting structures.

4.8. A suitable extension strategy for better maintenance of water harvesting structures.

4.1 PROFILE CHARACTERISTICS OF WATERSHED FARMERS

4.1.1 Age

It is evident from the Table 4.1 and Figure 4.1 that majority (60.9%) of the watershed farmers were of the category of middle aged, followed by Young (25.8%) and old (13.3%) age.

Table 4.1. Distribution of farmers according to their age n=120

S. No.	Category	Frequency	Percentage
1	Young age (<35 years)	31	25.8
2	Middle age (35-50years)	73	60.9
3	Old age (> 50 years)	16	13.3

The profession of agriculture is predominantly practiced by the middle and old aged farmers in the villages. Most of the time non- agricultural vocations or enterprises are sought after by the people. Youth are preferring to opt more remunerative and less risky professions other than agriculture. The results are in accordance with the findings of Sridhar (2002) and Doli (2006).

4.1.2 Education

It could be observed from the Table 4.2 and Figure 4.2 that majority of the farmers were illiterate (44.2%), followed by Primary school (37.5%), upper primary school (11.7%), high school (4.2%), intermediate (0.8%), under graduate (0.8%) and Post graduation (0.8%) respectively

Table 4.2. Distribution of farmers according to their education n=120

S. No.	Category	Frequency	Percentage
1	Illiterate	53	44.2
2	Primary school (up to 5^{th} class)	45	37.5
3	Upper primary school(6^{th} to 7^{th} class)	14	11.7
4	High school (8,9& 10^{th} class)	5	4.2
5	Intermediate	1	0.8
6	Under graduation	1	0.8
7	Post graduation and above	1	0.8

It is evident from the above results that majority of the watershed farmers were found to be Illiterate.

The middle age of most of the farmers might be due to the unavailability of enough formal education institutions and also discontinuation of education at primary level. Majority of the farmers would be small and marginal farmers under watershed area not go for higher education because of their financial status and livelihood sustenance. Further, lack of awareness of farmers on possessing the formal schooling for better socio-economic development might be another reason for this trend. Hence, efforts are needed to provide higher education facility in rural areas. Also functional literacy campaigns must be taken up to educate the farmers. The results are in accordance with the findings of Raghunandan (2004) and Divaker (2013).

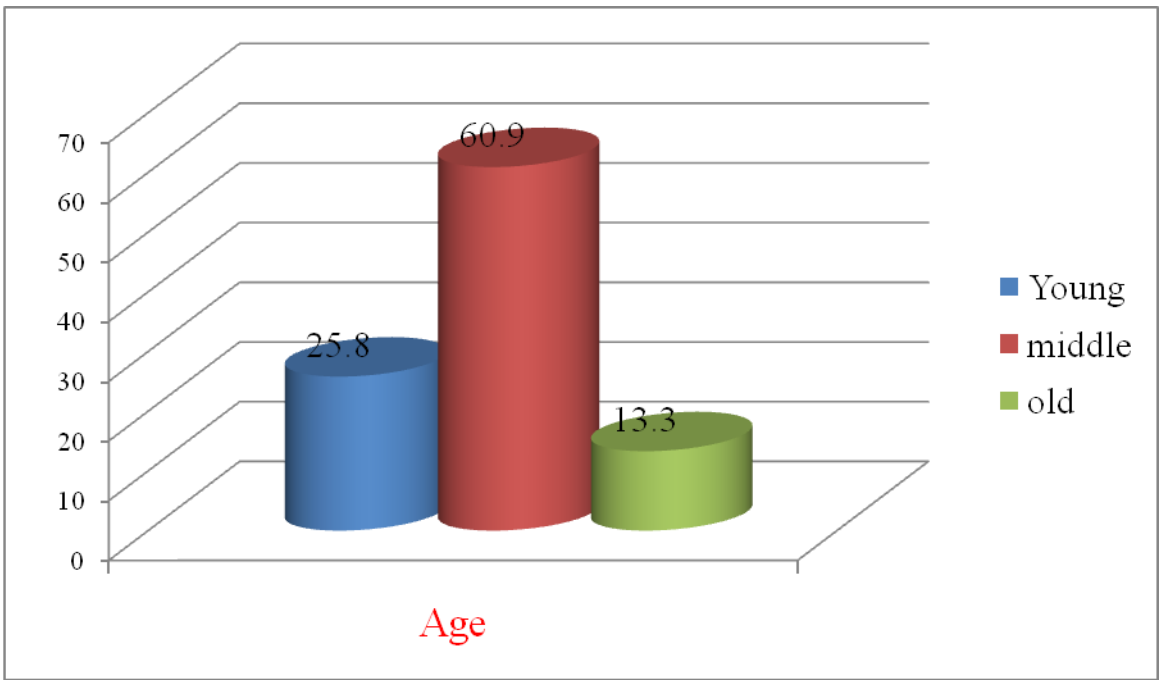

Fig 4.1. Distribution of the respondents according to their age

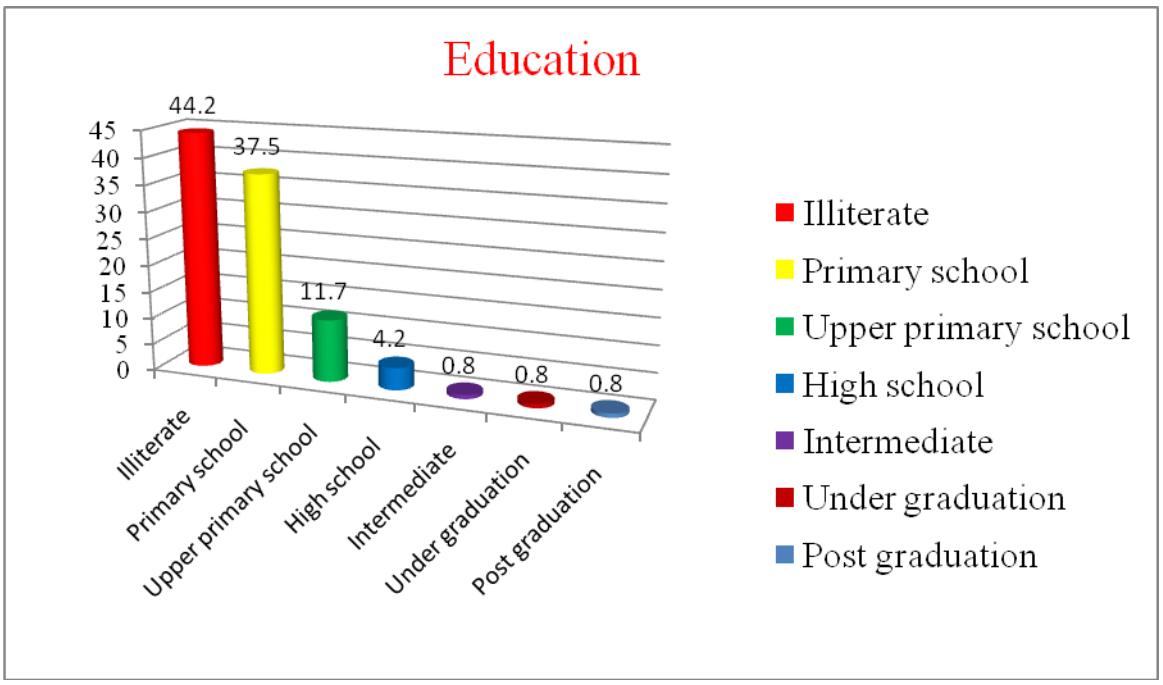

Fig 4.2. Distribution of the respondents according to their education

4.1.3 Farm size

It could be observed from the Table 4.3 and Figure 4.3 that, majority (89.2%) of the watershed farmers had marginal farm size followed by small (10.1%) and large (0.8%) farm size respectively.

Table 4.3. Distribution of farmers according to their farm size n=120

S. No.	Category	Frequency	Percentage
1	Marginal (< 2.5 acres)	107	89.2
2	Small (2.5 to 5 acres)	12	10.0
3	Large (>5 acres)	1	0.8

Due to subdivision and fragmentation of the farm size is decreasing there by more small and marginal land holdings and risk taking ability also may be minimum for these farmers possessing such kind of holdings. The results are in accordance with the findings of Rahman (2006) and Archana (2012).

4.1.4 Farming experience

The results in the Table 4.4 and Figure 4.4 indicated that, majority of the farmers had medium farming experience (51.7%) followed by high (27.5%) and low farming experience (20.8%).

Table 4.4. Distribution of farmers according to their farming experience n=120

S. No.	**Category**	**Class interval**	**Frequency**	**Percentage**
1	Low farming experience	2-16	25	20.8
2	Medium farming experience	16-30	62	51.7
3	High farming experience	30-44	33	27.5

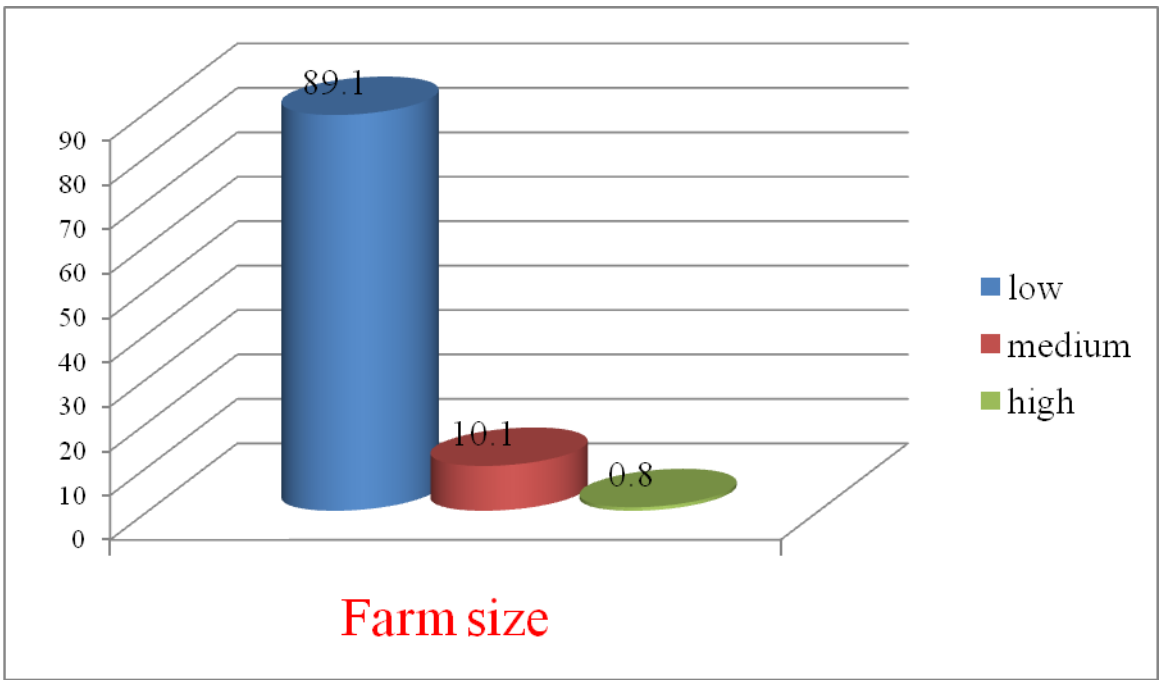

Fig 4.3. Distribution of the respondents according to their farm size

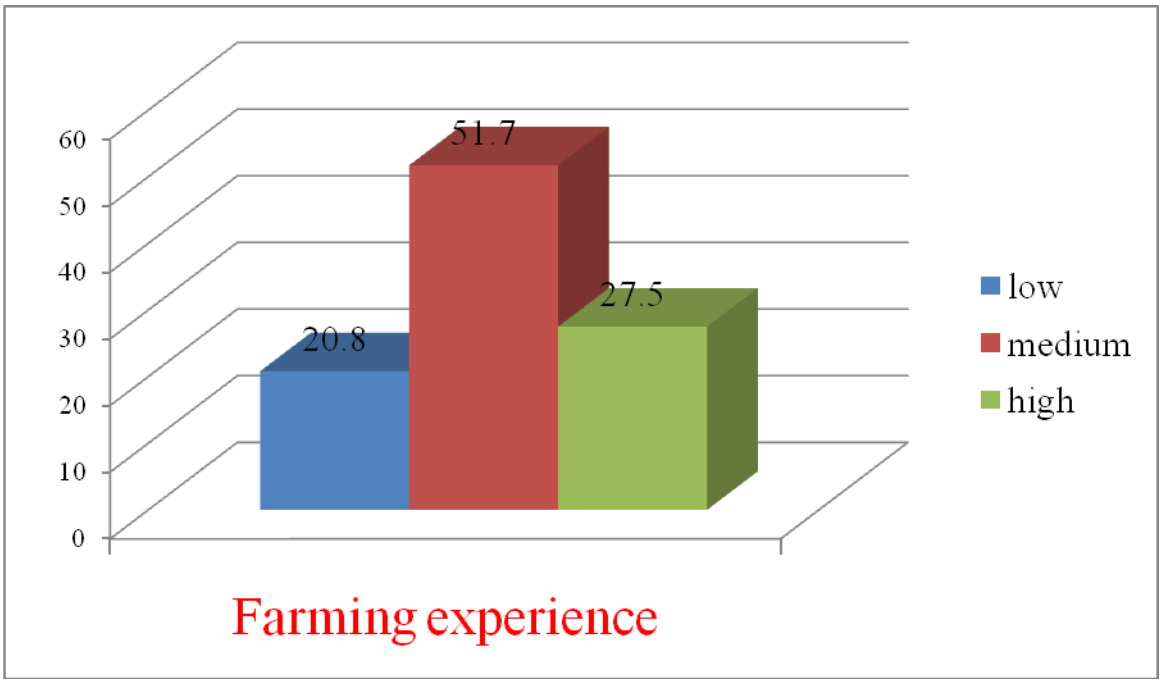

Fig 4.4. Distribution of the respondents according to their Farming experience

From the above results, it could be concluded that majority of farmers had medium farming experience. This trend could be due to their middle age and it could be inferred that their experience could be better exploited to take up more water harvesting structures.

Definitely the farming experience is an important factor which influences the farmers to accept, evaluate and experiment the innovative technologies in water harvesting structures. But the richness of farming experience is more important than quantity. Hence, to improve the quality and richness of experience of watershed farmers the extension agencies need to conduct extension activities like trainings, demonstrations, meetings, exposure visits and group discussions etc. The results are in accordance with the findings of Umamaheswara (2009) and Archana (2012).

4.1.5 Annual income

The results in the Table 4.5 and Figure 4.5 indicated that, majority of the farmers fell under the category of low annual income (53.3%) followed by medium (43.4%) and high (3.3%) annul income.

Table 4.5.Distribution of farmers according to their annual income n=120

S. No.	Category	Class interval	Frequency	Percentage
1	Low annual income	<50000	64	53.3
2	Medium annual income	50000-75000	52	43.4
3	High annual income	75000-10000	04	3.3

It could be concluded that majority of the watershed farmers belonged to low income groups followed by medium income.

Majority of farmers were marginal and small could be one of the reasons for low level of income. Agriculture being the main activity for the farmers. And lack of subsidiary activities and following mono cropping might be the reason for this trend. Heavy rains at the time of picking cotton cause a great loss of yield and decrease in annual income. More expenditure on farm inputs increased the cost of cultivation and decreased farmer income. The results are in accordance with the findings of Viresh (2007) and Archana (2012).

4.1.6 Environmental awareness

The results in the Table 4.6 and Figure 4.6 indicated that, majority of the farmers comes under the category of medium (47.5%) environmental awareness followed by low (28.3%) and high (24.2%) environmental awareness.

Table 4.6. Distribution of farmers according to their environmental awareness

n=120

S. No.	Category	Class interval	Frequency	Percentage
1	Low environmental awareness	7-9	34	28.3
2	Medium environmental awareness	9-11	57	47.5
3	High environmental awareness	11-13	29	24.2

The medium level of awareness on environment indicates from the Fig 4.6 that the farmers were not inclined much to be in touch with the changes in environment. This trend may be due to the idiosyncratic behaviour established by the virtue of their medium to old age, poor education and possession of low degree of other profile characteristics. The results are in accordance with the findings of Archana (2012).

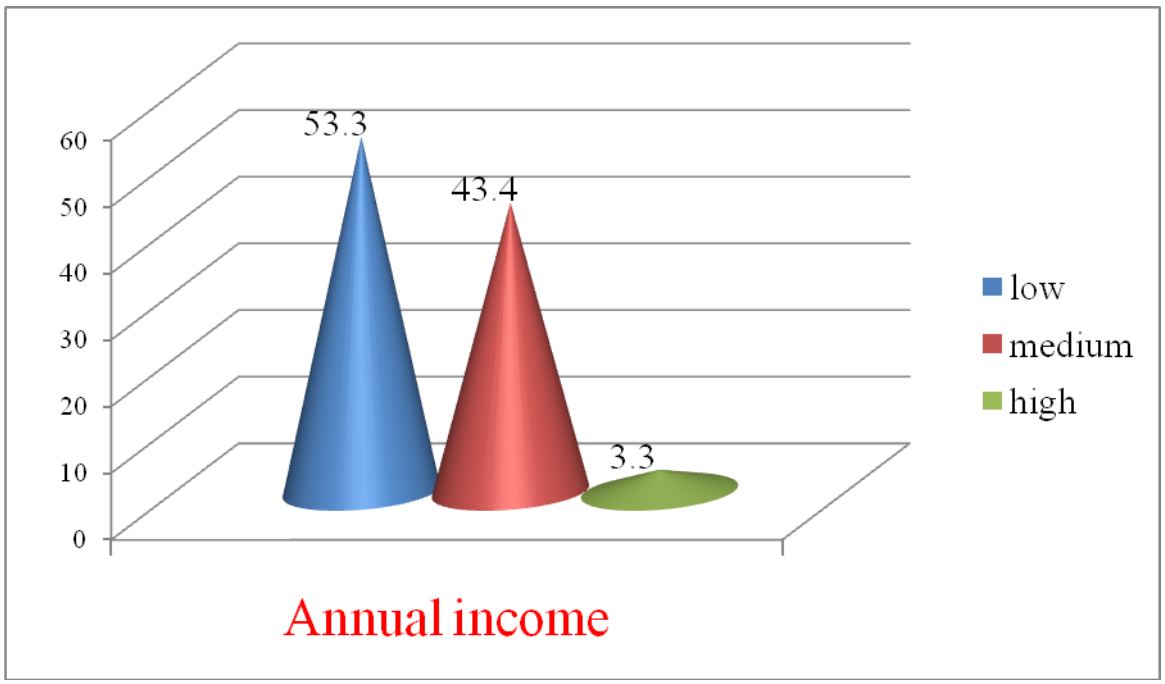

Fig 4.5. Distribution of the respondents according to their annual income

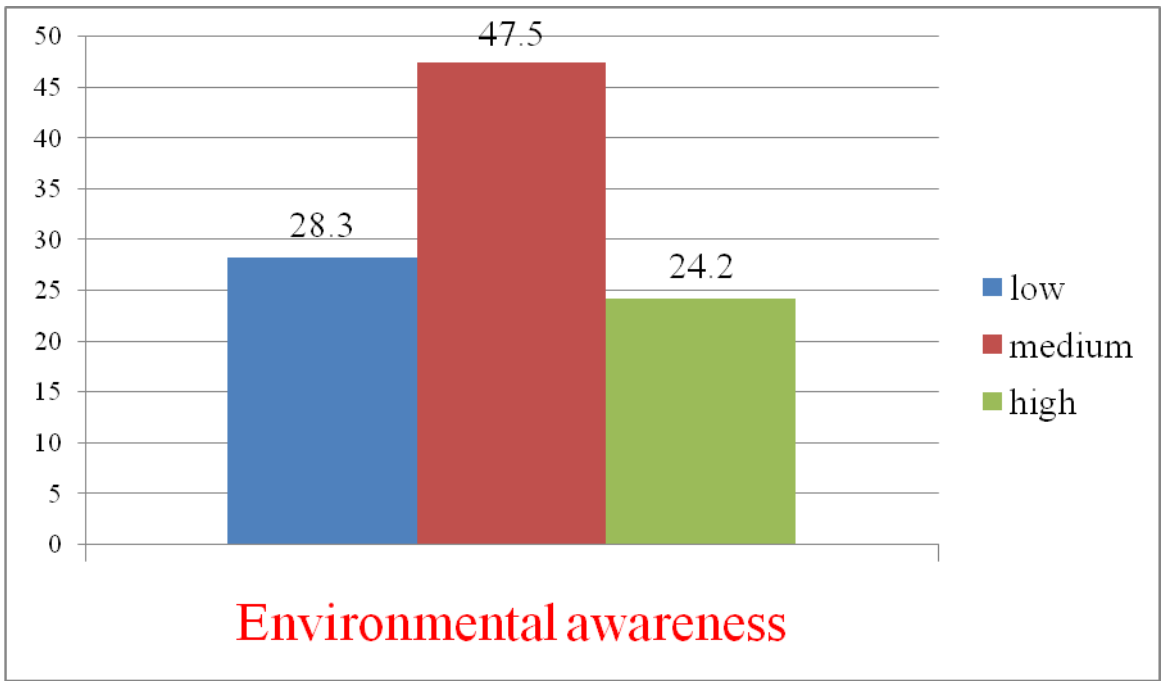

Fig 4.6. Distribution of the respondents according to their environmental awareness

4.1.7 Socio-political participation

The results in the Table 4.7 and Figure 4.7 indicated that, majority of the farmers comes under the category of medium (51.7%) socio-political participation followed by high (25.8%) and low (22.5%) socio-political participation.

Table 4.7.Distribution of farmers according to their socio-political participation n=120

S. No.	Category	Class interval	Frequency	Percentage
1	Low socio-political participation	6-11	27	22.5
2	Medium socio-political participation	11-16	62	51.7
3	High socio political participation	16-21	31	25.8

The medium level of socio-political participation of the watershed farmers might be due to the fact that, majority of the farmers are belonged to medium age group and majority of the farmers are illiterates. The results are in accordance with the findings of Shrishail (2006).

4.1.8 Mass media exposure

The results in the Table 4.8 and Figure 4.8 indicated that, majority of the watershed farmers comes under the category of low (56.7%) mass media exposure followed by medium (25.0%) and high (18.3%) mass media exposure.

Table 4.8. Distribution of farmers according to their mass media exposure n=120

S. No.	Category	Class interval	Frequency	Percentage
1	Low mass media exposure	7-10	68	56.7
2	Medium mass media exposure	10-13	30	25.0
3	High mass media exposure	13-16	22	18.3

The low trend of mass media exposure might be due to the fact that majority of the farmers were small farmers and are illiterates. Due to their low education level, they do not depend on reading newspapers, farm magazines and agricultural news articles. Their poor financial status also does not facilitate the farmers to own electronic mass media devices like television, cable net work *etc*.

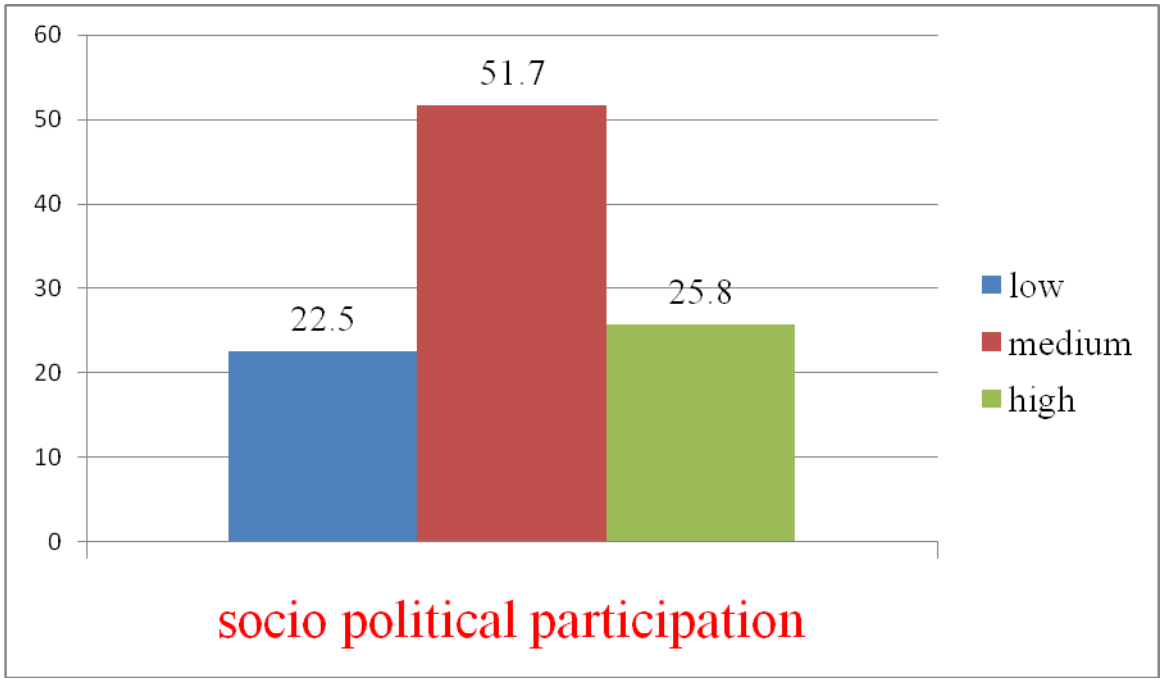

Fig 4.7. Distribution of the respondents according to their socio political participation

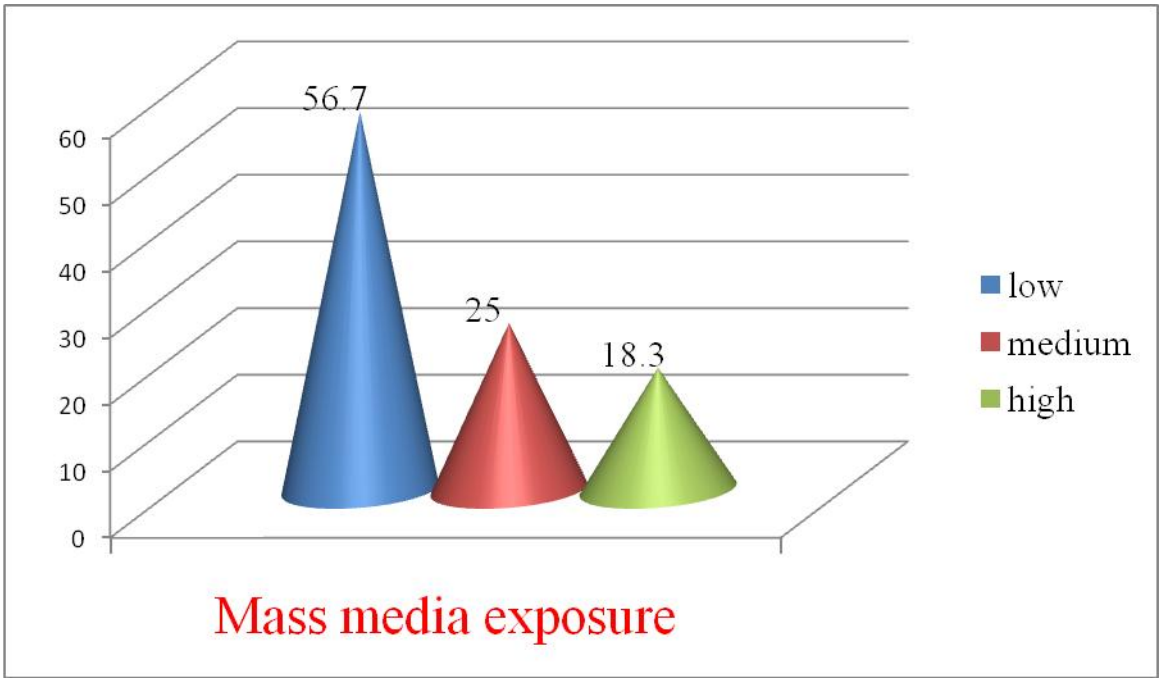

Fig 4.8. Distribution of the respondents according to their mass media exposure

Mass media consumption facilitates for quick acquisition and evaluation of technologies. Mass media is also considered as the most credible source of information. Hence the officials should concentrate on more mass media exposure for the watershed farmers. The results are in accordance with the findings of Verendranath (2000).

4.1.9 Risk taking ability

The results in the Table 4.9 and Figure 4.9 indicated that majority of the farmers fell under the category of medium (47.5%) risk taking ability followed by high (29.2%) and low (23.3%) risk taking ability.

Table 4.9. Distribution of farmers according to their risk taking ability n=120

S. No	Category	Class interval	Frequency	Percentage
1	Low risk taking ability	8-9	28	23.3
2	Medium risk taking ability	9-10	57	47.5
3	High risk taking ability	10-11	35	29.2

The medium level of farming experience, small farm size, middle age of the farmers coupled with lack of established institutional mechanism to take up water harvesting structure activities might have drove them to take medium level of risk in construction of water harvesting structures. Most of the existing watershed groups are not functioning in true spirit as per the envisaged mandate mainly due to rivalry, groupism and ethnocentrism still existing in farmers. The team work and favorable work culture have to be instilled among these groups. The results are in accordance with the findings of Prashanth (2015).

4.1.10 Group cohesiveness

The results in the Table 4.10 and Figure 4.10 indicated that, majority of the farmers fell under the category of low (39.2%) group cohesiveness followed by medium (35%) and high (25.8%) group cohesiveness.

Table 4.10. Distribution of farmers according to their group cohesiveness n=120

S. No.	Category	Class interval	Frequency	Percentage
1	Low group cohesiveness	12-13	47	39.2
2	Medium group cohesiveness	13-14	42	35.0
3	High group cohesiveness	14-15	31	25.8

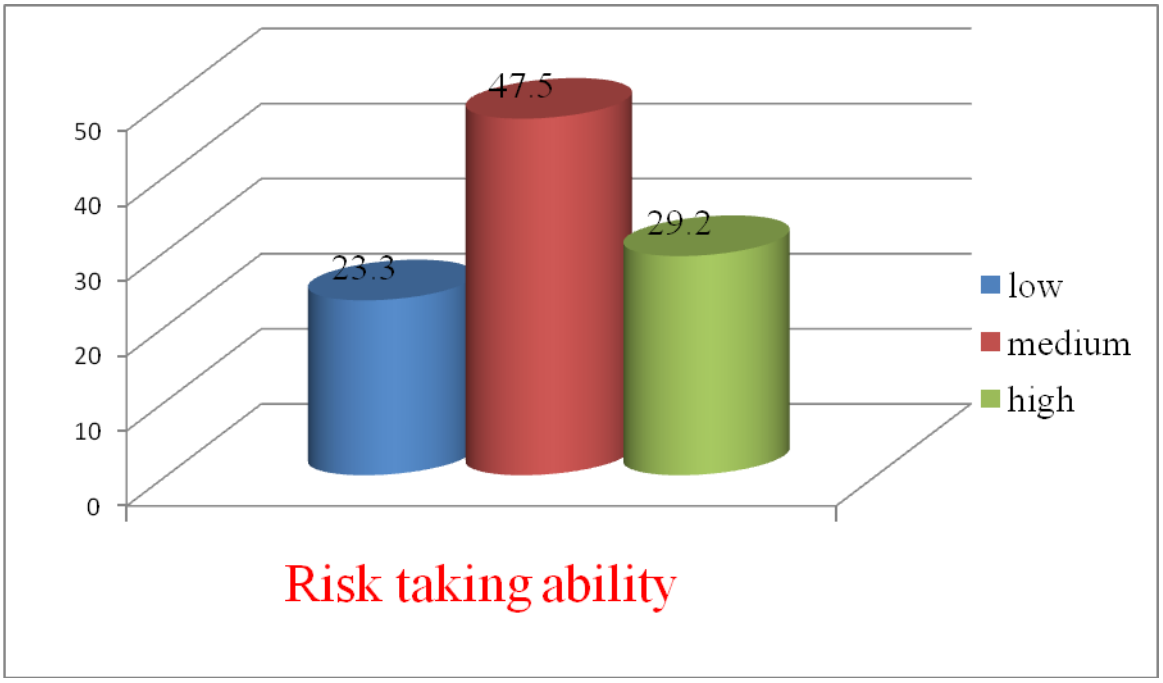

Fig 4.9. Distribution of the respondents according to their risk taking ability

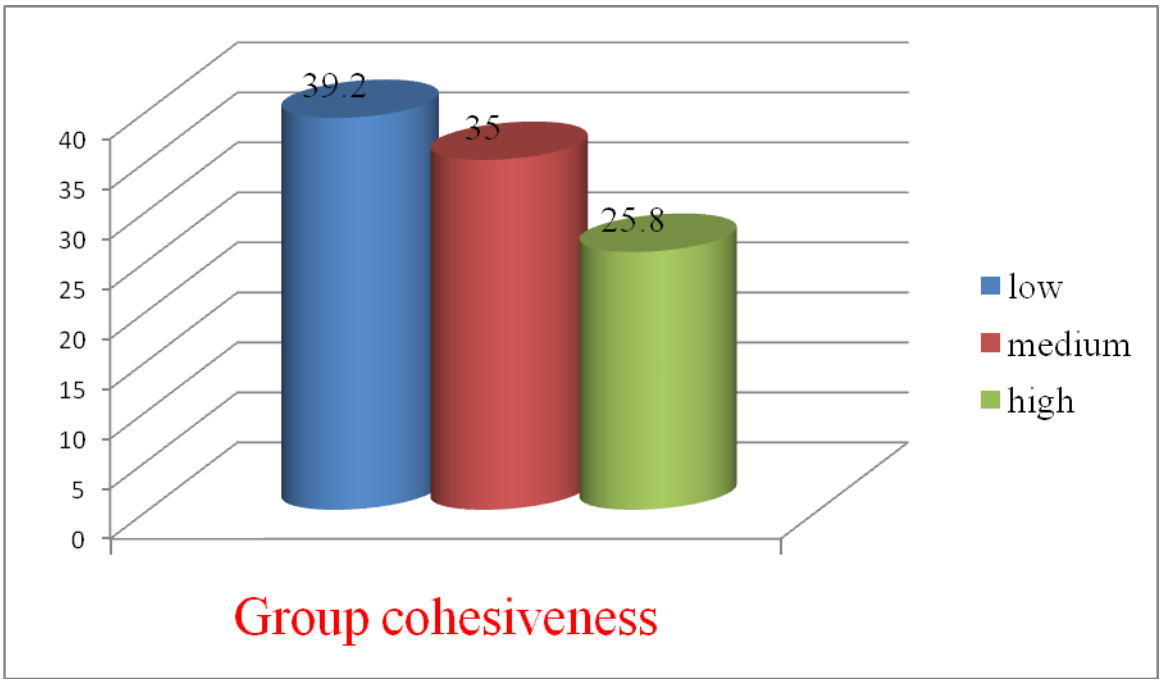

Fig 4.10. Distribution of the respondents according to their group cohesiveness

The results indicated that majority of groups were found with low to medium cohesiveness which imply that inadequate motivation, interest and awareness was created among the watershed group members regarding maintenance of cohesiveness of the group. Majority of the members have formed into groups with the motive of attaining economic benefits. The initiation of collective activities and collective thinking which promote cohesiveness was also found lacking in the group. The vibrancy and concern among the members is more where "felt-need" for the group was emphasized.

4.1.11 Team work

The results in the Table 4.11 and Figure 4.11 indicated that, majority of the farmers fell under the category of low (49.2%) team work followed by medium (35.8%) and high (15%) team work respectively.

Table 4.11. Distribution of farmers according to their team work n=120

S. No	Category	Class interval	Frequency	Percentage
1	Low team work	12-17	59	49.2
2	Medium team work	17-22	43	35.8
3	High team work	22-27	18	15.0

It is seen that almost half of the watershed farmers had low level of team work. This was because the user group members were not realized that their efficiency levels were depends on efficient group organization. It was found that every member was not sympathetic and helpful to the others in terms of need and distress. The group meetings were not held regularly and complete attendance was not maintained, thereby each and every aspect of group action was not discussed. It was also noticed that the group leader was not showing keen interest in the group's success and was not maintaining relationship with all the members. The leader should ensure that before implementing any plan, he should seek the satisfaction of the team members in achieving group goals. The results are in accordance with the findings of Prashanth (2015).

4.1.12 Scientific orientation

The results in the Table 4.12 and Figure 4.12 indicate that majority of the watershed farmers fell under the category of medium (41.7%) scientific orientation followed by low (33.3%) and high (25.0%) scientific orientation respectively.

Table 4.12. Distribution of farmers according to their scientific orientation

n=120

S. No.	Category	Class interval	Frequency	Percentage
1	Low scientific orientation	6-10	40	33.3
2	Medium scientific orientation	10-14	50	41.7
3	High Scientific orientation	14-18	30	25.0

It is evident that majority of watershed members belonged to medium level of scientific orientation. As majority of the farmers are illiterate, medium aged and had low level of mass media exposure and medium level of socio political participation. Their scientific orientation seems to be at minimum level. The results are in accordance with the findings of Natarajan (2004) and Ramu (2005).

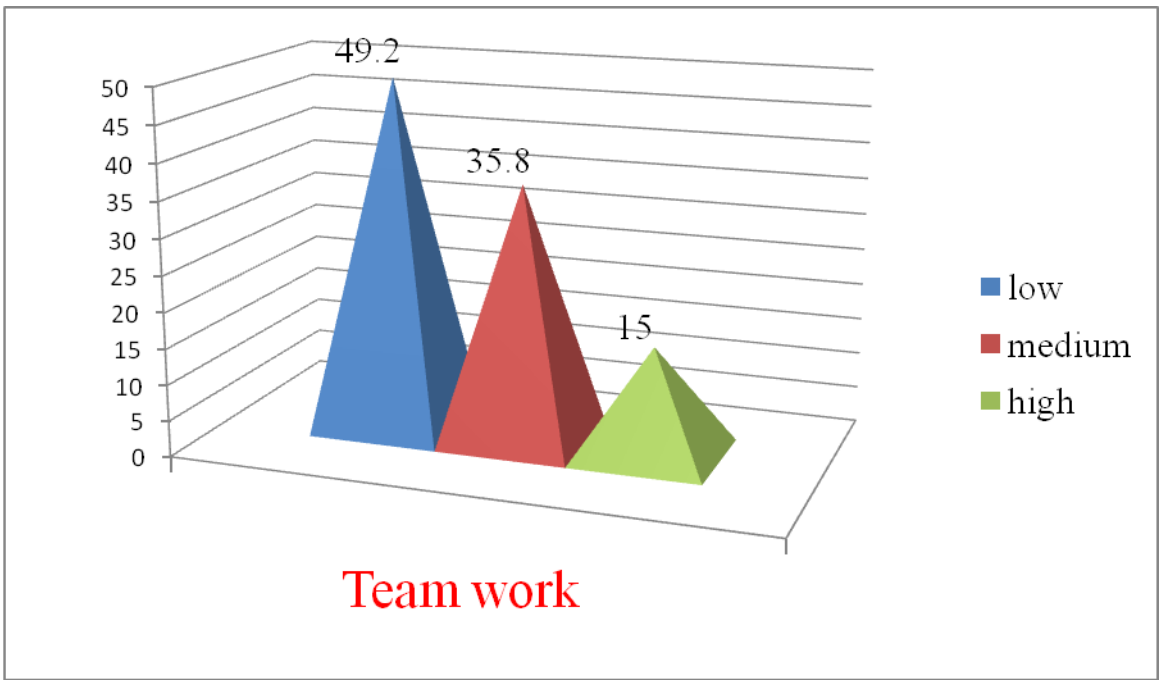

Fig 4.11. Distribution of the respondents according to their team work

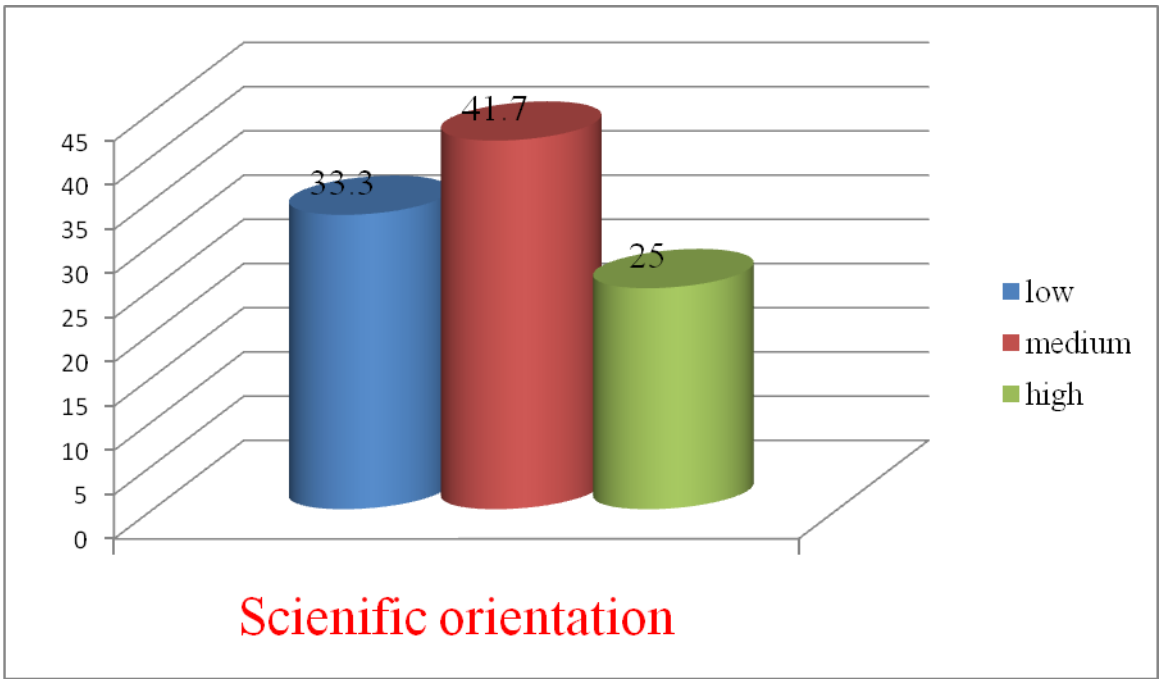

Fig 4.12. Distribution of the respondents according to their scientific orientation

4.2 Perception of farmers on water harvesting structures

The results in the Table 4.13 and Figure 4.13 indicated that majority of the farmers (39.2%) had Medium perception, followed by high (33.3%), and low (27.5%).

Table 4.13. Distribution of farmers according to their perception n=120

S. No.	Category	Class interval	Frequency	Percentage
1	Low level perception	20-22	33	27.5
2	Medium level perception	22-24	47	39.2
3	High level perception	24-26	40	33.3

The medium trend of perception of farmers on water harvesting structures might be due to the fact that majority of the farmers were small farmers and are illiterates. Due to their low education level, they do not depend on reading newspapers, farm magazines and agricultural news articles. And low level of environmental awareness and mass media exposure. The government needs to take measures to inculcate team spirit in forming the groups among the watershed farmers to follow the community approach. Measures may also be taken up to conduct more awareness programmes on highlighting the importance of water harvesting structures. The state department of agriculture, DWMA and KVKs should conduct more awareness programmes, campaigns, exposure visits to inculcate the spirit of sensing the importance of water harvesting structures in watershed programme.

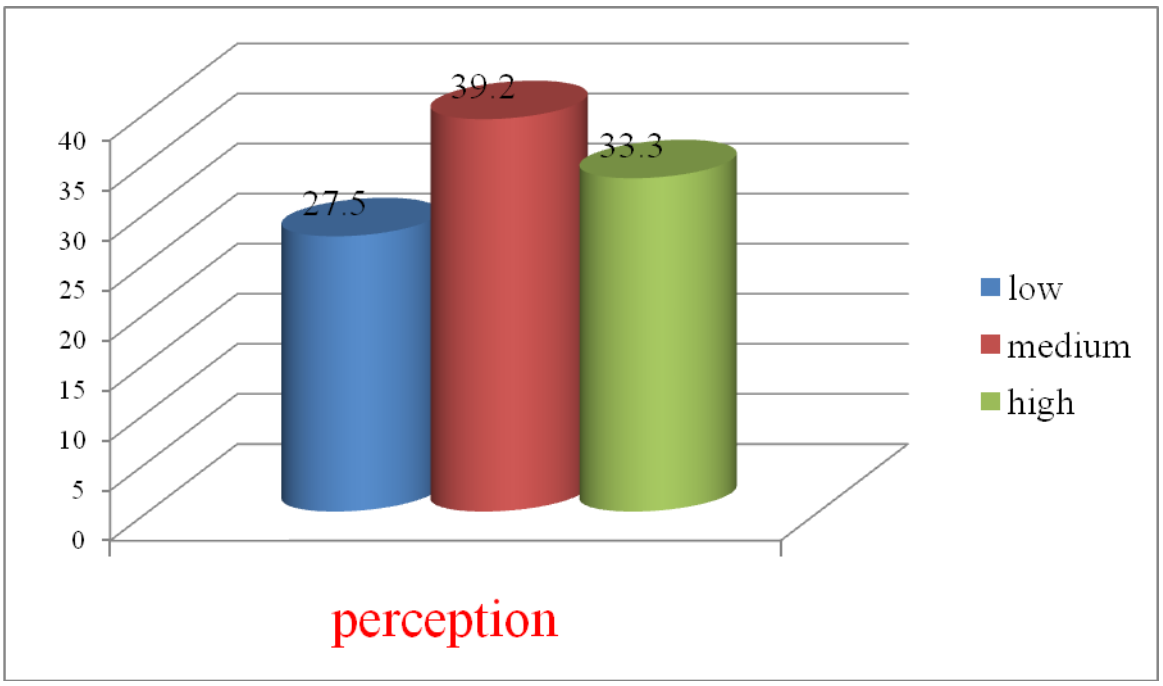

Fig 4.13. Distribution of the respondents according to their perception on water harvesting structures

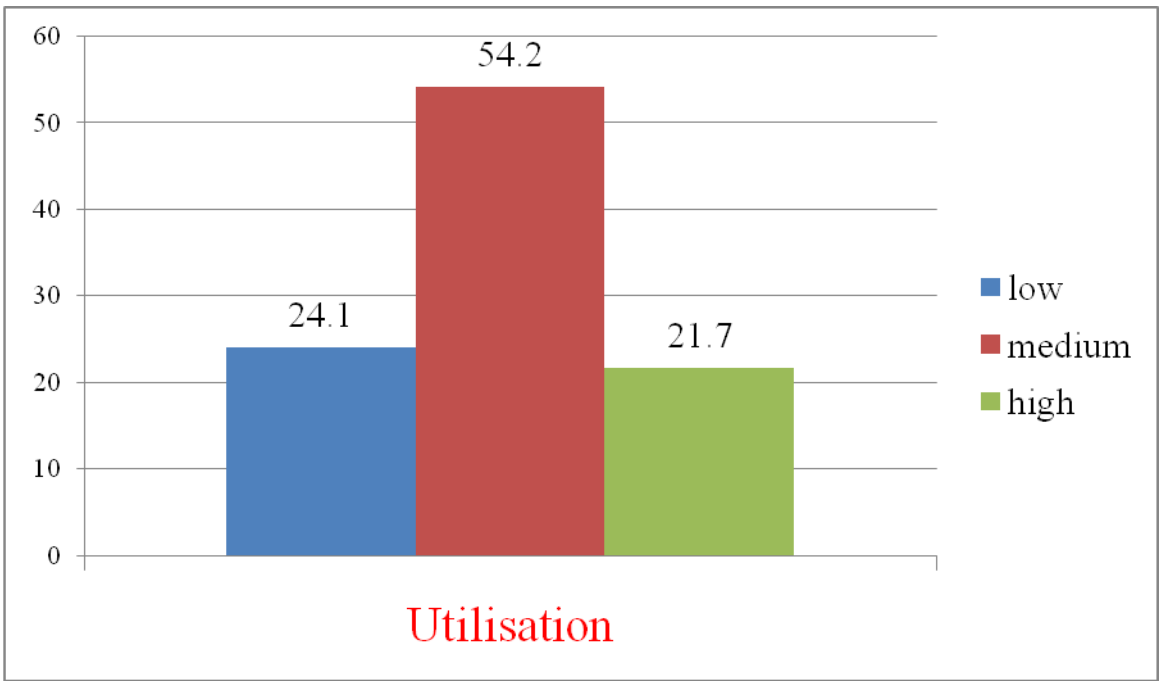

Fig 4.14. Distribution of the respondents according to their extent of utilisation on water harvesting structures

4.3 Extent of utilization of water harvesting structures

The results in the Table 4.14 and Figure 4.14 indicate that majority of the farmers (54.2%) had medium utilization, followed by low (24.1%), and high (21.7%).

Table 4.14. Distribution of farmers according to their utilization n=120

S. No.	Category	Class interval	Frequency	Percentage
1	Low level utilization	35-40	29	24.1
2	Medium level utilization	40-45	65	54.2
3	High level utilization	45-50	26	21.7

The medium trend of extent of utilization of watershed farmers on water harvesting structures might be due to the fact that majority of them were small farmers and are illiterate. Due to their low level of group cohesiveness, team work and medium level of risk taking ability, sociopolitical participation and farming experience. It was also found that for the last few years there was no sufficient rainfall in the district hence no water in sources where water harvesting structures constructed. Because of these reasons the extent of utilization of farmers on water harvesting structures is medium.

4.4 Extent of maintenance of water harvesting structures

The results in the Table 4.15 and Figure 4.15 indicate that majority of the farmers (60.0%) had low maintenance, followed by medium (27.5%), and high (12.5%).

Table 4.15. Distribution of farmers according to their maintenance n=120

S. No.	Category	Class interval	Frequency	Percentage
1	Low level maintenance	50-57	72	60.0
2	Medium level maintenance	57-64	33	27.5
3	High level maintenance	64-71	15	12.5

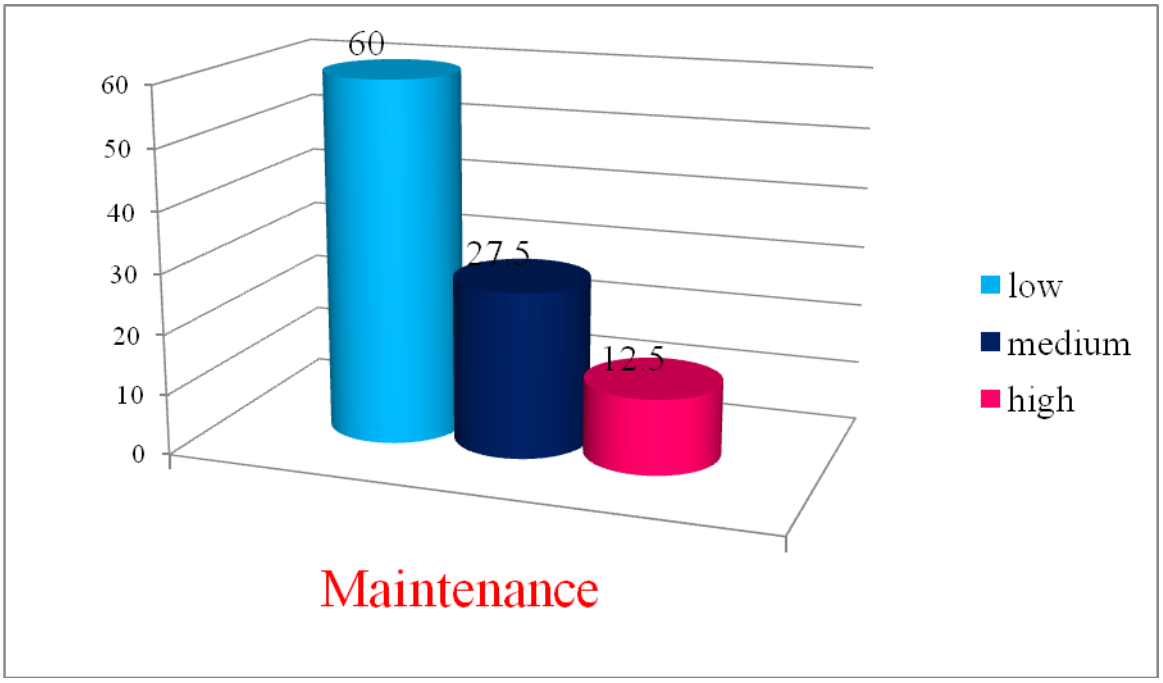

Fig 4.15. Distribution of the respondents according to their extent of maintenance on water harvesting structures

It is evident from the table that majority of watershed farmers have shown low level of maintenance of water harvesting structures. This trend may be due to their illiteracy and low level of income, group cohesiveness, team work and mass media exposure. The other reasons could be lack of support from government, lack of funding for maintenance, negligence in maintenance of water harvesting structures due to non availability of water, lack of awareness among the farmers on improved techniques on maintenance of water harvesting structures, lack of collective and cooperative efforts by all the line departments concerns in maintaining the water harvesting structures and no continuous supervision and monitoring by the District Water Management Authority(DWMA) and Integrated Watershed Management Programme (IWMP) officials.

4.5 Relationship of extent of utilisation and maintenance of water harvesting structures with independent variables.

4.5.1 Relationship between profile characteristics and extent of utilization of water harvesting structures.

Null hypothesis: There will be no significant relationship between profile characteristics of watershed farmers and their extent of utilization of water harvesting structures.

Empirical hypothesis: There will be a significant relationship between the profile characteristics of watershed farmers and their extent of utilization of water harvesting structures.

It is clearly evident from the Table 4.16 that, the calculated 'r' values between extent of utilization and group cohesiveness and team work were greater than table 'r' value at 1 per cent level of probability which indicated positive and significant relationship. Socio political participation, farm size, environmental awareness, farming experience and risk taking ability were also positively significantly correlated to utilisation at 5per cent level of probability. Hence, null hypothesis was rejected and empirical hypothesis was accepted for these variables. Therefore, it can be concluded that there was a positive and significant relationship between above profile characteristics and extent of utilization.

On the other hand the calculated 'r' values between extent of utilization and age, education, annual income, mass media exposure and scientific orientation were less than table 'r' value. Hence null hypothesis accepted and empirical hypothesis was rejected for these variables. Therefore, it can be concluded that there was no significant relationship between above profile characteristics and extent of utilization.

4.5.2 Relationship between profile characteristics and extent of maintenance of water harvesting structures.

Null hypothesis: There will be no significant relationship between profile characteristics of respondents and extent of maintenance of water harvesting structures.

Empirical hypothesis: There will be significant relationship between profile characteristics of respondents and extent of maintenance of water harvesting structures.

It is clearly evident from the Table 4.16 that, the calculated 'r' values between extent of maintenance and group cohesiveness and annual income were greater than table 'r' value at 1 per cent level of probability which indicated positive and significant relationship. Socio political participation, farming experience, education, team work and mass media exposure were also positively significantly correlated to maintenance at 5per cent level of probability. Hence, null hypothesis was rejected and empirical hypothesis was accepted for these variables. Therefore, it can be concluded that there

was a positive and significant relationship between above profile characteristics and extent of maintenance.

On the other hand the calculated 'r' values between extent of maintenance and age, farm size, environmental awareness, risk taking ability and scientific orientation were less than table 'r' value. Hence null hypothesis accepted and empirical hypothesis was rejected for these variables. Therefore, it can be concluded that there was no significant relationship between above profile characteristics and extent of maintenance.

Table 4.16 Correlation coefficient values between profile characteristics and dependent variables.

S.NO	VARIABLES	UTILIZATION	MAINTENANCE
1	Age	0.165 ^{NS}	0.170 ^{NS}
2	Education	0.127 ^{NS}	0.181*
3	Farm size	0.192*	0.161 ^{NS}
4	Farming experience	0.187*	0.195*
5	Annual income	0.159 ^{NS}	0.473**
6	Environmental awareness	0.187*	0.129 ^{NS}
7	Socio political participation	0.179*	0.185*
8	Mass media exposure	0.154 ^{NS}	0.199*
9	Risk taking ability	0.184*	0.133 ^{NS}
10	Group cohesiveness	0.292**	0.669**
11	Team work	0.525**	0.191*
12	Scientific orientation	0.144 ^{NS}	0.140 ^{NS}

Index:

***Significant at 5 % level of probability; (0.1793)**

****Significant at 1% level of probability: (0.2343)**

NS- Non-Significant.

4.6 Constraints encountered by the farmers in maintaining water harvesting structures

The Table 4.17 illustrated the constraints elicited by the watershed farmers on maintenance of water harvesting structures these constraints were grouped under five categories namely psychological, situational, technical, socio-economic and financial constraints. The constraints under each category were ranked based on frequency and percentage

It is pointed out from the Table 4.17 that the major constraints elicited by the watershed farmers the constraints like lack of team spirit among the watershed user groups in maintenance of water harvesting structures (85.83%) and lack of focused group approach in maintenance of water harvesting structures (75.00%) were covered under psychological category; small and marginal land holdings (81.86%) and no innovative practices were introduced in maintenance of water harvesting structures (71.66%) under situational category; Poor technical knowledge of watershed farmers both on maintenance and sustainable use of water harvesting structures (87.50%), lack of coordination among various concerned departments in maintenance of water harvesting structures (80.00%) under technical constraints; whereas low income levels of the farmers to meet the cost of repairs to the water harvesting structures (91.66%) and more cost is involved in establishing the water harvesting structures (70.83%) under socio-economic category; lack of funds for maintenance of water harvesting structures (79.16%) and no transparency in allocation of budget for maintenance of water harvesting structures under watershed programme (69.16%) under financial constraints category.

Table 4.17. Constraints elicited by the farmers in maintaining water harvesting structures **n=120**

S. No	Constraints	F	%	Rank
I	Psychological constraints			
1	Lack of team spirit among the watershed user groups in maintenance of water harvesting structures	103	85.83	I
2	Poor participation in group discourses in designing and constructing water harvesting structures	62	51.66	IV
3	Lack of focused group approach in maintenance of water harvesting structures	90	75.00	II
4	Poor knowledge on finance management by the members of groups in maintenance of water harvesting structures	75	62.5	III
II	Situational constraints			
1	Small and marginal land holdings	98	81.66	I
2	Lack of adequate support from IWMP for the farmers in maintaining of water harvesting structures	72	60.00	III
3	Poor follow-up action by the officials of DWMA in the process of utilization of water harvesting structures	65	54.16	IV
4	No innovative practices were introduced in maintenance of water harvesting structures	86	71.66	II
III	Technical constraints			
1	Poor technical support in terms of advisory and process in maintaining the water harvesting structures	78	65.00	IV
2	Poor technical knowledge of watershed farmers both on maintenance and sustainable use of water harvesting structures	105	87.5	I
3	The skills followed in maintenance of water harvesting structures are obsolete and traditional	83	69.16	III
4	Lack of coordination among various concerned departments in maintenance of water harvesting structures	96	80.00	II
IV	Socio-economic constraints			

1	Lack of enough social organizations in the villages	70	58.33	III
2	Low income levels of the farmers to meet the cost of repairs to the water harvesting structures	110	91.66	I
3	More cost is involved in establishing the water harvesting structures	85	70.83	II
V	Financial constraints			
1	No transparency in allocation of budget for maintenance of water harvesting structures under watershed programme	83	69.16	II
2	Local bodies are not empowered to use the budget allotted for maintenance of water harvesting structures under watershed programme	62	51.66	III
3	Lack of funds for maintenance of water harvesting structures	95	79.16	I

4.7 Suggestions given by the farmers for better Maintenance of water harvesting structures.

The Table 4.18 envisages the suggestions expressed by the watershed farmers on maintenance of water harvesting structures. As seen in the table the suggestions were grouped into five categories namely psychological, situational, technical, socio-economic and financial suggestions. The suggestions under each category were ranked based on frequency and percentage.

The major suggestions expressed by the watershed farmers with regard to the psychological category the suggestions offered are efforts must be made to inculcate the spirit of team work among the farmers to attend various water harvesting structure by making the members understanding the objectives of the task, the process involved and benefits accrued to each member (79.16%) and farmers should be told the importance of attending and participation in various group discussions and interface meetings to unearth the problems mutual understanding, mutual sharing the repairs and mutual benefits in maintenance of water harvesting structures (72.5%); under situational category, the suggestions offered are - farmers should be motivated to take up water harvesting structures on a community mode in a large area to derive more benefits from implementation of water harvesting structures (79.16%), more extension activities like training programmes interface meetings/ group discussions/exposure visits, networking of innovate farmers should be organized to disseminate latest information on

maintenance of water harvesting structures to the farmers (63.33%) and the officials should take up more follow up actions after completion of the implementation of water harvesting structures (55.83%); with regard to technical category the suggestions given are much emphasis should be given to improve the knowledge and skills of the farmers on importance/ relevancy /utilization of various water harvesting structures under watershed area by conducting different kinds of knowledge and skill based training programmes. (85.83%) and a mechanism has to be evolved by all the concerned departments like DWMA, IWMP, departments of micro irrigation, state department of agriculture etc to work collectively and cooperatively and with more co-ordination to guide the farmers effectively on water harvesting structures to be taken up in watershed area (73.33%); under socio-economic category, the suggestions explained are low cost water harvesting structures like farm pond, check dam, percolation pit etc should be designed and advised to the farmer (80.00%) and the WCs working in different watersheds should be entrusted with financial and legal powers to take up water harvesting structures in local area according to the needs of the farmers (65.00%); the suggestions offered under financial category are The members of the watershed user groups should be taken into cognizance while distributing budget to various water harvesting structures (71.66%) and The local bodies should be financially empowered to take up some of the location specific, need based and customized water harvesting structures (61.66%).

Table 4.18. Suggestions elicited by the farmers for better Maintenance of water harvesting structures **n=120**

S. No	Suggestions	F	%	Rank
I	Psychological Suggestions			
1	Efforts must be made to inculcate the spirit of team work among the farmers to attend various water harvesting structure by making the members understanding the objectives of the task, the process involved and benefits accrued to each member	95	79.16	I
2	The farmers of nearby watershed areas should be brought together to exchange the successful interventions of water harvesting structures activities in their own watershed area	76	63.33	III

3	Farmers should be told the importance of attending and participation in various group discussions and interface meetings to unearth the problems mutual understanding, mutual sharing the repairs and mutual benefits in maintenance of water harvesting structures	87	72.5	II
II	Situational Suggestions			
1	Farmers should be motivated to take up water harvesting structures on a community mode in a large area to derive more benefits from implementation of water harvesting structures	95	79.16	I
2	The officials should take up more follow up actions after completion of the construction of water harvesting structures	67	55.83	III
3	More extension activities like training programmes interface meetings/ group discussions/exposure visits, networking of innovate farmers should be organized to disseminate latest information on maintenance of water harvesting structures to the farmers	76	63.33	II
III	Technical Suggestions			
1	Much emphasis should be given to improve the knowledge and skills of the farmers on importance/ relevancy /utilization of various water harvesting structures under watershed area by conducting different kinds of knowledge and skill based training programmes.	103	85.83	I
2	More no. of institutions should be brought under the umbrella of watershed programme to provide much needed technical support to the farmers in maintenance of water harvesting structures	88	73.33	III
3	A mechanism has to be evolved by all the concerned departments like DWMA, IWMP, departments of micro irrigation, state department of agriculture etc to work collectively and cooperatively and with more co-ordination to guide the farmers effectively on water harvesting structures to be taken up in watershed area	74	61.66	II
IV	Socio-economic Suggestions			

1	Low cost water harvesting structures like farm pond, check dam, percolation pit etc should be designed and advised to the farmer	96	80.00	I
2	The WCs working in different watersheds should be entrusted with financial and legal powers to take up water harvesting structures in local area according to the needs of the farmers	78	65.00	II
V	Financial Suggestions			
1	The members of the watershed user groups should be taken into cognizance while distributing budget to various water harvesting structures	86	71.66	I
2	The local bodies should be financially empowered to take up some of the location specific, need based and customized water harvesting structures	74	61.66	II

4.8 A suitable extension strategy for better maintenance of water harvesting structures.

A strategy has been designed for better maintenance of water harvesting structures with the following interventions.

Interventions by the DWMA

1. The Department of micro irrigation, DWMA and IWMP should work in tandem to sensitise the farmers the importance and intricacies involved in the maintenance of water harvesting structures.
2. The perception of the farmers on the water harvesting structures should be improved through conducting training programmes periodically by the concerned departments like DWMA, IWMP etc.
3. Efforts must be made by DWMA to conduct more exposure visits to the farmers to witness the operational procedures of well maintained water harvesting structures.
4. An effective mechanism should be evolved by the officials DWMA and IWMP to monitor the performance of water harvesting structures.
5. The DWMA should allocate substantial financial assistance for the maintenance of water harvesting structures.

Interventions by the farmers

1. There is every need to take up the farming collectively on cooperative mode as the farm size of the selected farmers is very less.
2. The farmers should be inculcated the spirit of group approach and team work in carrying farm operations with the help of the KVKs, DAATTCs, ATMA and agricultural research stations.
3. The farmers should be made to participate in all the stages of orchestration of water harvesting structures.
4. Participation of farmers is immense in deciding the location and design of proposed water harvesting structures like bunds, waterways, farm ponds, nala bunds, check dams, gully checks and percolation tanks etc.,

Interventions by the line departments

1. The line departments of concerned states should be focus on increasing income levels from each farm by creating more infrastructures at the rural areas and also by giving more technical assistance to the farmers as the present income.
2. Efforts must be made by the line departments to make the farmers levels are very poor accessible to different kinds of media like print, electronic and social plat forms to build their capacities in terms of knowledge, skill and perceptions both on crops and environment. These departments should bring awareness among the farmer's about different farmer's portals, toll free numbers and the institutes serving the farmers.
3. The state department of agriculture, KVKs and other extension centres at district level should empower the farmers on importance of community participation and group dynamics in maintenance of water harvesting structures.

Interventions by the local bodies

1. The local bodies should take special interest in improving the education levels of farmers should be improved by conducting more adult education programmes and campaigns on literacy improvement, as majority of the sample of selected farmers are illiterates.
2. The government should involve local bodies in designing, utilisation and maintenance of water harvesting structures.

Interventions by the state agriculture university

1. The low cost water harvesting structures and soil moisture conservation

practices should be developed and popularized by the SAUs.

EMPIRICAL MODEL OF THE STUDY

The conceptual model formulated earlier (Figure 2.1) for the research study was tested based on the results and an empirical model was developed and was presented in Figure 4.17.

1. The model was hopefully conceived to give an objective view on extent of utilisation of water harvesting structures and extent of maintenance of water harvesting structures. This model was tested with the help of correlation coefficient analysis to find out relationship between selected profile characteristics and dependent variables.
2. Extent of utilization was positively and significantly related to farm size, group cohesiveness, team work, socio political participation, farming experience, risk taking ability, and environmental awareness.
3. Extent of maintenance was positively and significantly related to education, annual income, team work, group cohesiveness, socio political participation, farming experience and mass media exposure.

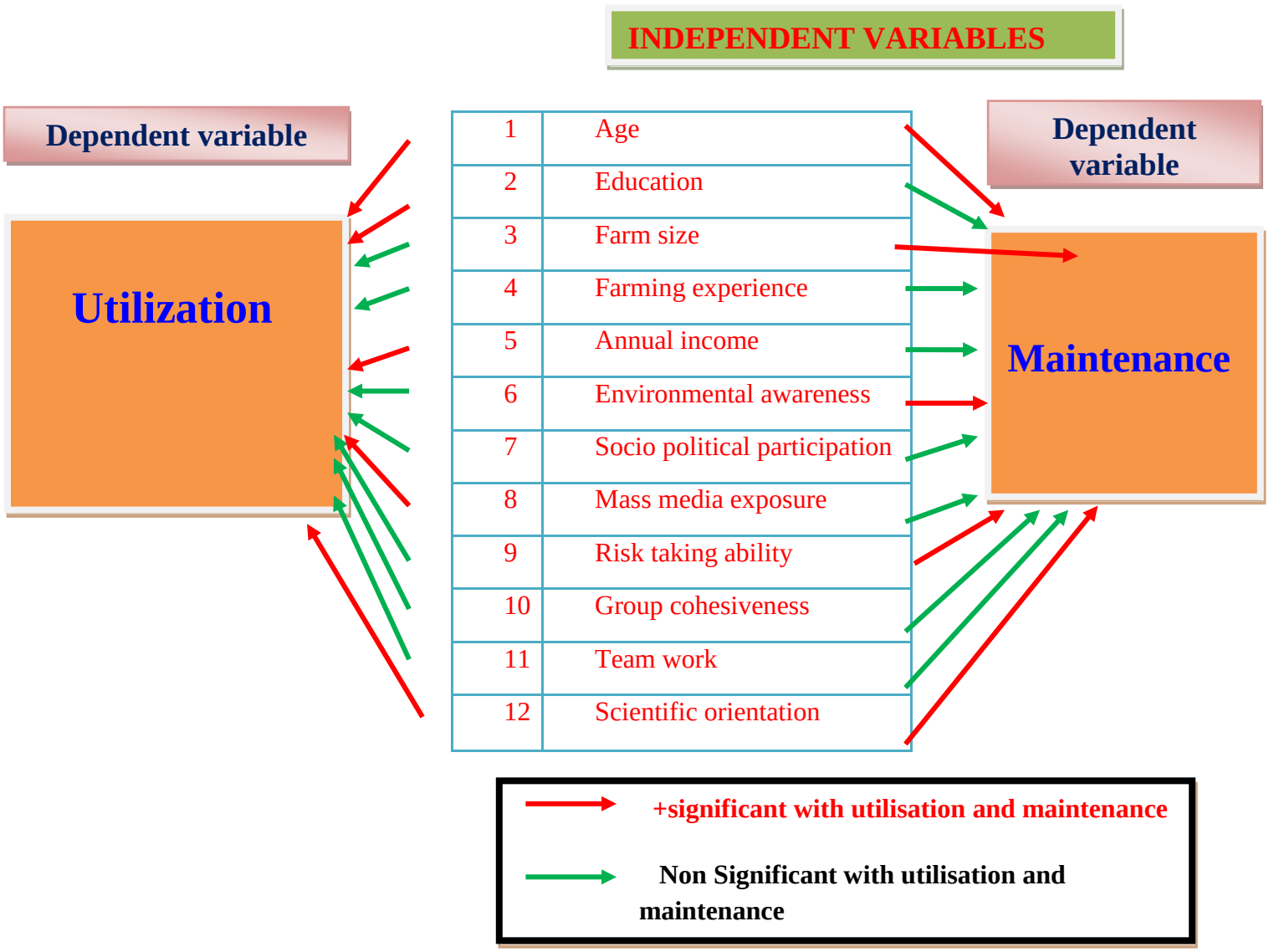

FIGURE 4.17 EMPIRICAL MODEL OF THE STUDY

Chapter V

Summary and Conclusions

CHAPTER V

SUMMARY AND CONCLUSIONS

Water is an important resource in agriculture, Day by day the availability of water is coming down there by there is every need to judiciously utilize the available water in crop production. Over the years it is observed that the amount of rainfall received in various parts of the country is below average. It is high time that the rain fall water should be conserved by using various technologies and structures for increasing the ground water table and also to provide life saving irrigation to the crops. Keeping this in view the present investigation entitled as "A Study on perception, utilization and maintenance of water harvesting structures in Adilabad district of Telangana state" was undertaken with the following objectives.

OBJECTIVES OF THE STUDY

9. To study the selected profile characteristics of watershed farmers.
10. To reveal the perception of farmers on selected water harvesting structures.
11. To unearth the extent of utilisation of water harvesting structures by the farmers.
12. To analyse the extent of maintenance of water harvesting structures by the farmers.
13. To find out the relationship of extent of utilisation and maintenance with the profile characteristics of the farmers.
14. To identify the constraints encountered by the farmers in maintaining water harvesting structures.
15. To elicit suggestions from the farmers for better maintenance of water harvesting structures.
16. To evolve a suitable extension strategy for better maintenance of water harvesting structures.

5.1 RESEARCH DESIGN

Ex-post facto research design was used in the present investigation.

5.2 SAMPLING PROCEDURE

The state of Telangana was chosen purposively for the study as the researcher hails from the same state and is familiar with regional language and cultural patterns, which avoids the problems in rapport development with the respondents. Telangana state is divided into three regions viz., Southern Telangana, Northern Telangana, Central

Telangana. Telangana region was selected purposively as the investigator hails from this region. The Telangana region is comprised of 10 districts namely Nalgonda, Rangareddy, Medak, Warangal, Nizamabad, Karimnagar, Mahaboobnagar, Khammam, Hyderabad and Adilabad. Out of these 10 districts, Adilabad district was selected for the study purposively as highest rainfall of 1157 mm per annum and posses highest area covered under soil and moisture conservation measures. Out of 52 mandals of the district four mandals namely Adilabad, Bela, Jainath, and Thamsi were selected purposively as maximum budget is allotted by the Department of Agriculture for these four mandals for construction of water harvesting structures under Integrated Watershed Management Proramme(IWMP). From each mandal three villages were selected at randomly by following simple random sampling method. Kachkanti , Anukunta and Ankoli villages in Adilabad mandal and Khogdur, Syedpur, Junoni villages in Bela mandal and Deepaiguda, Belluri and Bahadurpura villages in Jainath mandal and Gunjala, Wadgoan and Bheempur villages in Thamsi mandal were selected randomly to make a total sample of 12 villages. From each village 10 farmers were selected purposively to make a total sample of 120 respondents.

3.3 VARIABLES AND THEIR EMPIRICAL MEASUREMENT

5.3.1 Dependent variables

Study of the Perception on water harvesting structures, Extent of utilization of water harvesting structures and Extent of maintenance of water harvesting structures were selected as dependent variables.

5.3.2 Independent variables

The independent variables selected were- Age, Education, Farm size, Farming experience, Annual Income, Environmental Awareness, Socio Political Participation, Mass Media Exposure, Risk Taking Ability, Group Cohesiveness, Team work and Scientific Orientation.

5.4 COLLECTION OF DATA

A structured interview schedule was developed for the study. The data collected through this schedule were analyzed and reported by applying suitable statistical tests.

5. 5 SALIENT FINDINGS OF THE STUDY

5.5.1 Profile characteristics of watershed farmers

The analysis of profile characteristics of watershed farmers indicated that majority of them were illiterates (44.2%) and small farmers (89.2%), whereas majority of them fell under medium category in terms of age (60.9%), farming experience (51.7%), environmental awareness (47.50%), socio political participation (51.7%), risk taking ability (47.5%), scientific orientation (41.7%). Whereas majority of them had low annual income (53.3%), mass media exposure (56.7%), team work (49.2%) and group cohesiveness (39.2%).

5.5.2 Perception of farmers on water harvesting structures

Majority of the watershed farmers had medium level of perception (39.2%) regarding water harvesting structures followed by high (33.3%) and low (27.5%).

5.5.3 Extent of utilization of water harvesting structures

Majority of the watershed farmers had medium level of utilization (54.2%) regarding water harvesting structures followed by low (24.1%) and high (21.7%).

5.5.4 Extent of maintenance of water harvesting structures

Majority of the watershed farmers had low level of maintenance (60.0%) regarding water harvesting structures followed by medium (27.5%) and high (12.5%).

5.5.5 Relationship of extent of utilization and maintenance of water harvesting structures with independent variables.

The results of correlation analysis between profile characteristics revealed that the independent variables *viz.,* group cohesiveness, team work, farm size, environmental awareness, socio political participation, farming experience and risk taking ability were found positively and significantly related with the extent of utilization of water harvesting structures. Where as group cohesiveness, annual income socio political participation, farming experience, education, team work and mass media exposure were found positively and significantly related with extent of maintenance of water harvesting structures. Rest of the independent variables was not significant.

5.5.6 Constraints encountered by the farmers in maintaining water harvesting structures

The major constraints elicited by the watershed farmers were Lack of team spirit among the watershed user groups in maintenance of water harvesting structures

(85.83%), Small and marginal land holdings (81.66%), Poor technical knowledge of watershed farmers both on maintenance and sustainable use of water harvesting structures (87.5%), Low income levels of the farmers to meet the cost of repairs to the water harvesting structures (91.66%), Lack of funds for maintenance of water harvesting structures (79.16%) and Lack of focused group approach in maintenance of water harvesting structures (75.00%).

5.5.7 Suggestions given by the farmers for better Maintenance of water harvesting structures.

The major suggestions expressed by the watershed farmers were efforts must be made to inculcate the spirit of team work among the farmers to attend various water harvesting structure by making the members understanding the objectives of the task, the process involved and benefits accrued to each member (79.16%), farmers should be motivated to take up water harvesting structures on a community mode in a large area to derive more benefits from implementation of water harvesting structures (79.16%), much emphasis should be given to improve the knowledge and skills of the farmers on importance/ relevancy /utilization of various water harvesting structures under watershed area by conducting different kinds of knowledge and skill based training programmes (85.83%), low cost water harvesting structures like farm pond, check dam, percolation pit etc should be designed and advised to the farmer (80.00%), and the members of the watershed user groups should be taken into cognizance while distributing budget to various water harvesting structures (71.66%).

5.5.8 A suitable extension strategy for better maintenance of water harvesting structures.

An effective mechanism should be evolved by the officials DWMA and IWMP to monitor the performance of water harvesting structures. The DWMA should allocate substantial financial assistance for the maintenance of water harvesting structures. There is every need to take up the farming collectively on cooperative mode as the farm size of the selected farmers is very less. Participation of farmers is immense in deciding the location and design of proposed water harvesting structures like bunds, waterways, farm ponds, nala bunds, check dams, gully checks and percolation tanks etc. The line departments of concerned states should be focus on increasing income levels from each farm by creating more infrastructures at the rural areas and also by giving more technical assistance to the farmers as the present income. The local bodies should take special interest in improving the education levels of farmers should be improved by

conducting more adult education programmes and campaigns on literacy improvement, as majority of the sample of selected farmers are illiterates and the low cost water harvesting structures and soil moisture conservation practices should be developed and popularized by the SAUs.

5.6 IMPLICATIONS OF THE STUDY

The implications based on the findings of the current investigation are as follows.

1) The government should allocate more budgets for effective maintenance of water harvesting structures as most of the water harvesting structures were defunct due to ill maintenance.
2) The advisory system on utilization and maintenance of water harvesting structures should be strengthened by deploying more personal of DWMA and IWMP.
3) A close monitoring and supervision should be undertaken by the DWMA, IWMP officials for effective maintenance of water harvesting structures.
4) The local bodies should take active part in identifying, designing, utilization and maintenance of water harvesting structures.
5) The water shed committees should be given financial and legal powers to address the issues related to the water harvesting structures in local area.
6) Farmers should be participated at all stages of the implementation of the water harvesting structures to derive maximum benefits by utilizing these structures.
7) The line departments and departments related to irrigation along with DWMA and IWMP should work in tandem for effective utilization and maintenance of water harvesting structures.
8) The state agriculture university should design low cost water harvesting structures to be implemented indigenously.
9) The need based training programmes should be organised periodically by the DWMA to improve the knowledge and skills of the farmers on utilization and maintenance of water harvesting structures.

5.7 POINTS SUGGESTED FOR FUTURE RESEARCH

1. Sample size may be increased by selecting other districts to generalize the results
2. The water harvesting structures index developed for the present study may be remodified by adding few more indicators

3. A separate study may be taken up to assess the impact of water harvesting structures on crop production.
4. SWOT analysis may be conducted on specific soil and water conservation practices according to the farming situation wise.
5. Role perception and job performance of the watershed officials may be investigated to improve the efficiency of officials under IWMPs.

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Appendices

Interview Schedule on

"A STUDY ON PERCEPTION, UTILISATION AND MAINATENANCE OF WATER HARVESTING STRUCTURES IN ADILABAD DISTRICT OF TELANGANA STATE"

PART-I
GENERAL INFORMATION

Respondent no:
Name of the watershed farmer:
Name of watershed:
District:

PART II
INDEPENDENT VARIABLES

1. Age: …… (Please specify the chronological age)

2. Level of Education

Please specify your formal schooling possessed by you.

S. No	Level of education	response score
1	Illiterate	1
2	Read &write only	2
3	Primary school (up to 5^{th} class)	3
4	Upper primary school(6^{th} to 7^{th} class)	4
5	High school (8,9& 10^{th} class)	5
6	Intermediate	6
7	Under graduation	7
8	Post graduation and above	8

3. Farm size…… acres

4. Farming experience:

Wet..... ac Dry.....ac Total.....ac

5. Annual income

a. Income from main occupation(Agriculture)
b. Income from subsidiary occupation(Agriculture related activities)
c. Income as farm labour
d. Others
e. Total income
f. Expenditure
g. Net income

6. Environmental awareness

Please indicate your response on the following items by indicating yes/no in the tick () mark.

S. No	Statement	response	
		yes	no
1	A minimal change in the ecological balance has a great effect on crop production.		
2	Do you have faith in weather forecasting in increasing crop production?		
3	Are you aware that the ice is being melt due to rapid changes in environment there by raised sea levels?		
4	Extreme changes in temperature are observed in various seasons due to changes in environment at global level?		
5	Are you aware that natural calamities are being observed due to climate change?		
6	Do you agree that soil and water erosion is seen in slopy areas?		
7	Are you aware that abundant vegetation facilitates ecological balance?		

7.Socio-political participation

Please indicate the extent of your participation as not a member, member, active member, committee member and office bearer in the following organizations.

S. No	Organization	not a member	member	active member	committee member	office bearer
1	Village panchayat					
2	Youth club					
3	WUA					
4	SHGs					
5	UGs					
6	VWDC					

8.Mass media exposure

Please indicate how frequently you view the following mass media to acquire information on water harvesting structures on three point continuum i.e. regular (3) occasional (2) and never (1)

S.No	Source	Extent of exposure		
		Regular	Occasional	Never
1	Radio			
2	Television			

3	Education films			
4	News paper			
5	Magazines on agriculture and allied fields			
6	Mobile phones			
7	Interactive videos			

9.Risk taking ability

A set of statements related to risk of watershed farmers are given below. Please state your response to each statement as agree, undecided and disagree.

S. No	Name of the statement	Response		
		Agree	Undecided	Disagree
1	A farmer should grow more number of crops to avoid greater risk involved in growing one or two crops.			
2	A farmer should rather take more of a chance in making a big profit than to be content with a smaller but less risky profits			
3	It is good for farmers to take risk when he/she knows his/her chance of success is high			
4	A farmer has to try new farming methods though less number of farmers have used them with success			
5	Trying an entirely new practice in farming by a farmer involves risk and wasting of resources			
6	Taking more number of water harvesting structures helps to mitigate during the continuous dry spells			

10.Group cohesiveness

Please indicate how frequently true are the following aspects of your group on a five point continuum of very true, true, somewhat true, not true and not at all true

S.NO	Components	very true	true	somewhat true	not true	not at all true
1	Members do not encourage/support each other in the group					
2	I feel this group worked well					

	together					
3	I do not feel comfortable to work with same group members for other activities					
4	The group manages conflicts/disagreements effectively					
5	Members do not rely one another in the group					
6	There is unhealthy competition and criticism among group members					

11.Team work

Following are the statements focus on functioning of a team. Elicit your opinion on the following statements on a three point continuum i.e. agree, undecided and disagree.

S. No	Item	agree	undecided	disagree
1	I feel the task is well accepted by all the members in the team			
2	I consider the working atmosphere is comfortable to all the members in the team			
3	I feel every member is allowed to participate in the discussion on task achievement			
4	I feel most decisions in the team are reached by consensus			
5	I feel the team examine periodically its functioning			
6	I got an opportunity to assess the capabilities of other members in the team			
7	I feel everyone is supportive of each other in the team to accomplish the tasks.			
8	I feel team effectiveness is enhanced when every member has opportunity to contribute			
9	I believe that, the role of every member in the team is well defined			
10	I have been involved at all the stages of team building process.			

12.SCIENTIFIC ORIENTATION

A set of statements related to scientific orientation of watershed farmers are given below. Please state your response to each statement as agree, undecided and disagree.

	Agree (A)	Undecided (UD)	Disagree(DA)
New method of farming gives better results to farmer than old methods			
The way farming practiced by the fore fathers is still the best way			
Even a farmer with lot of experience should use new methods of farming			
Though it takes time for a farmer to learn new technologies in farming it is worth the efforts			
A progressive farmer experiments with new ideas of farming			
Increasing the ground water table and conserving the soil is possible through water harvesting structures			

Dependent variables

Perception on water harvesting structures

Please indicate the response on the following items by marking () in yes / no columns.

S.NO	STATEMENTS	YES	NO
1	Do you believe that the water harvesting structures facilitate to reduce the run off of rainwater		
2	Do you feel that the water harvesting structures prevents the soil erosion		
3	Do you feel that the water harvesting structures changes the cropping systems		
4	Do you believe that the water harvesting structures increases the ground table in the surrounding areas		
5	Do you believe that the water harvesting structures gives life saving irrigation to the crops		
6	Do you believe that the water harvesting structures increases the crop yield		
7	Do you feel that the annual income increases through using of water harvesting structures		
8	Do you feel that the water harvesting structures are good source of drinking water for cattle		
9	Do you believe that the water harvesting structures helps to mitigate the mid season drought conditions		
10	Do you believe that the construction of water harvesting structures gives employment to the local people		
11	Do you feel that the waste land brought under cultivation because of these water harvesting structures		
12	Do you believe that the water harvesting structures establishes the allied enterprises		
13	Do you believe that the water harvesting structures facilitate to farmers to grow high value commercial crops		
14	Do you believe that the using of water harvesting structures increases crop production and productivity		

EXTENT OF UTILISATION OF WATER HARVESTING STRUCTURES

Please elicit the response in terms of degree of usage of water harvesting structures for the following purpose by indicating () mark.

S.NO	Purpose of usage of water harvesting structures	Frequently (4)	Occasional (3)	Rarely (2)	Never (1)
1	Soil conservation				
2	Rain water saving				
3	Life saving irrigation				
4	Drought mitigation				
5	Drinking for live stock				
6	Increases crop yield				
7	establishing the allied enterprises				
8	Mitigate the mid season drought conditions				
9	To grow high value commercial crops				
10	increases crop production and productivity				
11	to arrest the run off of rainwater				
12	changes to profitable cropping systems				
13	For reducing soil erosion				
14	Increase in agro based industries				
15	Monitoring / reducing soil salinity				

EXTENT OF MAINTENANCE OF WATER HARVESTING STRUCTURES

Following are the statements on extent of maintenance of water harvesting structures. Please indicate your response on these statements on a 3 point continuum

S.NO	STATEMENTS	ALWAYS	OCCASIONAL	NEVER
1	Are you getting assistance from public agencies to attend the repairs for the water harvesting structures			
2	Community as a hole will participate in maintenance of water harvesting structures			
3	It is responsibility of the individual farmer to safeguard the water harvesting structures			
4	How regularly to you attend the repair work to the water harvesting structures			
5	The engineering department provides technical assistance for the maintenance of water harvesting structures			
6	Panchayat raj institutions come to rescue of the farmer in attending the repairs of water harvesting structures			
7	Public private partnership is works well in maintenance of water harvesting structures			
8	Adequate staff is deployed for the maintenance of water harvesting structures			
9	Concerned officials visit the water harvesting structures to generate a comprehensive report on functioning of water harvesting structures			
10	The budget under IWMP is earmarked clearly under recurring and non recurring contingences towords a maintenance of water harvesting structures			
11	During the monthly gramsabhas the maintenance of water harvesting structures in jurisdiction of the village is well discussed			

12	Enough attention is not given by the government in maintenance of water harvesting structures			
13	The success of watershed programme is largely depends on well maintenance of the water harvesting structures			
14	Have you followed vegetation control as a preventive maintenance for the water harvesting structures			
15	Inspection is conducted to assure no unsafe conditions are developing			
16	Written records of all inspections and maintenance activities are undertaken			
17	Insurance coverage is provided to protect from external calamities			
18	Uncontrolled seepage weakens the soil and lead to structural failure			
19	The inadequate spillway size causes surface erosion which reduces earth embankment cross section			
20	How regularly you observe cracking settlement and slides which are common signs of structural failure			
21	How frequently you remove large tree roots which create seepage paths into the water harvesting structures			
22	How regularly you check seepage and leakage outflows for dirty water to reduce formation of sinkholes			
23	Have you noticed the wave action against unprotected areas decreasing embankment width			
24	Have you faced the problem of erosion leading to eventual deterioration of the downstream slope and			

	failure of the structure			
25	Is the erosive action displaces channel lining and washes sediment downstream			
26	Have observed the growth of trees in masonry walls disintegrate wall of water harvesting structures by dislodging rubble stone			