A STUDY ON ADAPTIVE CAPACITY AND TECHNOLOGIES ADOPTED BY FARMERS FOR CLIMATE RESILIENT AGRICULTURE IN DROUGHT PRONE AREAS

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M. Sc. (Ag.)

DOCTORL OF PHILOSOPHY IN AGRICULTURE

(DEPARTMENT OF AGRICULTURAL EXTENSION)

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A Study on Adaptive Capacity and Technologies Adopted by Farmers for Climate Resilient Agriculture in Drought Prone Areas

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2017

DECLARATION

I, Mrs. T. ARCHANA, hereby declare that the thesis entitled "A study on Adaptive capacity and technologies adopted by farmers for Climate Resilient Agriculture in drought prone areas" **submitted to the Professor Jaya Shankar Telangana State Agricultural University** for the Degree of **Doctor of Philosophy 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.

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CERTIFICATE

Mrs. T. ARCHANA has satisfactorily prosecuted the course of research and that the thesis entitled **"A STUDY ON ADAPTIVE CAPACITY AND TECHNOLOGIES ADOPTED BY FARMERS FOR CLIMATE RESILIENT AGRICULTURE IN DROUGHT PRONE AREAS"** 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 her for a degree of any University.

Date:
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Chairperson

CERTIFICATE

This is to certify that the thesis entitled **"A STUDY ON ADAPTIVE CAPACITY AND TECHNOLOGIES ADOPTED BY FARMERS FOR CLIMATE RESILIENT AGRICULTURE IN DROUGHT PRONE AREAS"** submitted in partial fulfillment of the requirement 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 **Mrs. T. ARCHANA** 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 received during the course of the investigation have been duly acknowledged by the author of the thesis.

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LIST OF SYMBOLS AND ABBREVIATIONS

NICRA	National initiative on climate resilient agriculture
CRA	Climate resilient agriculture
PRA	Participatory rural appraisal
WBAAS	Weather based agro advisory services
CHC	Custom hiring centre
IPCC	Intergovernmental panel on climate change
MGNREGS	Mahatma gandhi national rural employment guarantee act
PJTSAU	Professor Jayashankar Telangana state agricultural university
NGOs	Non government organizations
DOA	Department of Agriculture
KVK	Krishi Vignan Kendra
FAO	Food and Agriculture Organization
Fig	Figure
Horti	Horticulture
AG	Agriculture
AH	Animal husbandry
ha	Hectare
i.e	That is
dist	District
Kg	Kilo gram
LLS	Late leaf spot
m	Metre
%	Per cent
F	Frequency
ac	Acre
CR	Coefficient of reproducibility
MMCR	Minimal marginal coefficient of reproducibility
R^2	Coefficient of multiple determination
R	Multiple correlation coefficient
r	Correlation coefficient
PACS	Primary agricultural cooperative societies
V	Village
NHM	National horticultural mission
SHM	State horticultural mission
VCRMC	Village climate risk management committee
YFC	Young farmers club
PPR	Predicted pattern of response
DWMA	District watershed management agency
IWMP	Integrated watershed management programme
IFS	Integrated farming systems
TS	Total score
TE	Total error

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ABSTRACT

The present study entitled "A study on adaptive capacity and technologies adopted by farmers for Climate Resilient Agriculture in drought prone areas" had been initiated focusing on the adaptive capacity of farmers to drought.

Ex-post facto research design was adopted in the present investigation. Nalgonda district from the Telangana state and Anantapur district from the Andhra Pradesh state were selected purposively, as they were covered under NICRA, where the CRA technologies introduced. One mandal was purposively selected from each district for the study. Two NICRA adopted villages and two non NICRA villages were selected from each mandal. Thus total four NICRA villages and four non NICRA villages were selected the study. 30 farmers from each village were selected at random to make a sample of 120 respondents from NICRA adopted villages and 120 respondents from non NICRA villages for the study.

The analysis of profile characteristics of farmers indicates that in NICRA group majority of them had medium age, illiterates, medium farming experience, semi medium farm size, rainfed farmers among them most of the members giving irrigation to the fields only in critical stages by using mostly bore wells, occurrence of drought once in three years, Ag crops + Horticultural crops + AH/poultry / goat farming systems, medium socio economic status, high social affiliation, undergone training programmes, medium sources of information utilisation, received average number of loans, medium food security, low traditionalism, high risk taking ability, medium Weather based Agro Advisory services, medium community infrastructural facilities.

In non NICRA group majority of them had medium age, illiterates, medium farming experience, medium farm size, rainfed farmers among them only few farmers were giving irrigation to the fields only in critical stages by using mostly bore wells,

occurrence of drought once in two years, Ag crops + Horticultural crops + AH/poultry / goat farming systems, low socio economic status, medium social affiliation, not undergone any training programme, low sources of information utilisation, received less number of loans, medium food security, medium traditionalism, medium risk taking ability, low Weather based Agro Advisory services, low community infrastructural facilities.

The gathered information from PRA techniques which have conducted in two NICRA adopted villages in Ananthapur district was, these farmers excavated more number of percolation tanks, constructed check dams. Farmers had sown ground nut crop in first fortnight of July with 20 mm rainfall only. Some farmers had sown sorghum, green gram, korra and guar crop in the month of second fortnight of August, as contingent crops. Farmers were also cultivating on the slopes using with stone bunds and contour cultivation and dug out contour trenches on hills. And also one solar plant was present in the village. In case of NICRA villages of Nalgonda, farmers were excavated farm pond and constructed check dams. Some farmers had sown sorghum as contingency crop in the month of September, crop diversification through vegetables. Fodder (APBN-1) cultivation with supplemental irrigation with drips and also azolla rings were present in some areas. The community farmers of Nandyala Gudem village shifted their paddy cultivation to mulberry by giving irrigation through drip system. And also one chawki center was present for rearing the sericulture worms, KVK office with CHC was located to hire the farm implements. One mineral water plant, resources like azolla rings, vermi compost units and farm implements were present.

The gathered information from triangulation of PRA techniques which have conducted in four non NICRA villages of Anantapur was these farmers had done NRM practices but they did not renovate and repair. In these villages rainfed crop (ground nut) failure was the common phenomenon due to occurrence of dry spell. In the month of September some farmers had sown sorghum as contingency crop. In these villages sweet orange, sapota, watermelon and vegetables were grown by giving supplemental irrigation. In case of Nalgonda, famers had poor infra structural facilities. Only Water tanks and one Sarva Shiksha Abhiyan school were present in these Thanda areas. They were cultivating cotton and chilli crop under rainfed only. Due to low rainfall their bore wells also dried up. In the month of September some farmers had sown sorghum as contingency crop for grain and fodder purpose.

Majority of the NICRA farmers had very high (49.17%) Adaptive capacity. In case of non NICRA majority of them had low (50.83%) Adaptive capacity. There was significant difference between NICRA and non NICRA farmers in their adaptive capacity at $p<0.01$ level of significance. Majority of the NICRA farmers were belonged to high (70.00%) overall adoption of CRA technologies and coping mechanism, whereas in non NICRA majority (71.67%) of farmers were belonged to low adoption of CRA technologies and coping mechanism. There was significant difference between the overall level of adoption of CRA technologies and coping mechanism among NICRA and Non NICRA at $p<0.01$ level of significance.

In overall NICRA, out of 17 independent variables availability of water resources , frequency of occurrence of drought, social affiliation and training undergone on CRA had positive and significant relation with the adoption at $p<0.05$ level of significance. In overall non NICRA out of 17 independent variables farming experience, availability of water resources, farming systems had positive and significant relation with adoption at $p<0.05$ level of significance.

Major problem elicited by the NICRA farmers were poor renovation of soil and water conservation structures due to lack of rain fall, poor availability of required inputs to all the farmers, political interference in NRM and inadequate financial support. Major suggestions expressed by the NICRA farmers were regular de siltation activity should

be done by the government to enhance the water storage capacity, use of high yielding verities in drought conditions. Major problem elicited by the non NICRA farmers were lack of more number of need based training on CRA technologies, more crop loss from drought resistant short duration verities due to moisture stress. Major suggestions expressed by non NICRA farmers were farmers participation in deciding the location of NRM activities and contribution of their resources for NRM.

Suggested strategy to transfer of technologies to the NICRA villages include village school for five villages, ICT initiative with interactive portal in village school, computer with one computer operator, computerized data related to five villages action plan, farmer profile, linkage of these computerized data to the all SAU, institutions, developmental programmes, projects, PACS, banks etc. and these all should be maintained strong linkage, web conference, monitoring and evaluations, linkage of weather based agro advisory services with the climate prediction by the farmers, farmer should share the ITKs of CRA to the officials, farmer groups should use the social media, speed up the MGNREGS, IWMP etc., and merge these programmes with the NICRA, Government has to do online marketing through licensed middle man by fixing the minimum support price after consultation with the farmers.

Suggested strategy to transfer of technologies to the non NICRA villages include encouraging exposure visits for non NICRA villagers to the project intervention sites, sensitization campaign for judicious use of natural/community resources, farmer-farmer extension strategy, FFS to promote faster learning by farmers, Youth should be encouraged by providing large area with license to cultivate and also providing facilities like modern new farm implement/machinery and free seeds, advisory services to them by the scientist, Government has to develop an ICT named “e-insure farmer” and merge with weather based crop insurance scheme for proper implementation.

Chapter I
INTRODUCTION

Climate is continually changing and with projected changes in rainfall patterns and temperature range are expected to affect many biological systems including agriculture. Climate related events such as droughts, cyclones, hailstorm, snowfall, erratic rainfall and fluctuations in temperature badly contributing to world food production and overall economy. The atmosphere is one of the principal components in determining weather and climate of the earth. The inter-governmental Panel on Climate Change (IPCC) defined climate in a narrow sense the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period ranging from months to thousand or millions of years. The classical period is 30 years, as defined by the World Meteorological Organization (WMO). These quantities are most often surface variables such as temperature, precipitation and wind.

Today, Climate change has been recognized globally as the most pressing critical issue affecting the mankind survival in the 21st century. No one can deny it any longer. You can feel it in heat, you can see it in ice and you can observe it in storms. Climate change without doubt became the critical environmental issue of present decade. While the policy makers, academicians and activists are engaged in mounting debate about North-South divide over sharing the major responsibility for factors leading to climate change, scientists have given a clarion call for adoption of local action of corrective measures at once to save the planet from catastrophe.

1.1 Climate variability and Indian agriculture

Agriculture is the backbone sector of Indian economy. It contributes 13.9 per cent to GDP (Economic Survey, 2014-2015). This sector is providing sustenance and livelihood for 600 million people and more than 70 per cent people living in rural areas depend on agriculture (census, 2011). In developing countries like India, climate change would represent an additional stress on ecological, cultural, political and socioeconomic systems that are already facing tremendous pressures due to rapid urbanization, industrialization, privatisation, globalisation and economic development. Agricultural activities are among those sectors which are very sensitive to climate and weather conditions. Most interestingly climate change affects the agriculture sectors to a great extent and in turn it contributes to climate change. So, there is a reciprocal relationship between them. Further, this climate change induced effects would accelerate the existing stresses due to non-climate factors, such as changes in land use pattern and the unsustainable use of natural resources.

Singh (2008) said that different estimates by environmentalists indicate location specific uncertainties in the minimum and maximum temperatures which may have adverse impact on agricultural productivity in different agro climatic regions of the country. Such calculations for trends in monthly rainfall may be more during December, January and February in case of West Rajasthan, Punjab, and Haryana. However, there may be slight decrease in October-November rainfall in several locations of the country. The analysis about trends of annual rainfall for the period 1871 to 1999 indicates that there is a shift in

the surplus rainfall from western part of country to east. Lal (2001) reported an annual mean area averaged surface warming over the Indian subcontinent to range between 3.5 and 5.5^{o}c over the region by 2080. The projection indicates more warming in winter season over summer season. Surface temperature in North India probably rises by 3°c or more by 2050 and a marginal increase of 7 to 10% in rainfall is likely to occur over the subcontinent by 2080. Further, the study reported a fall in rainfall by 5 to 25% in winter months and an increase by 10 to 15% in summer monsoon rainfall across the India. These projected changes have both beneficial and adverse effects on agriculture, environment and socio-economic set-up. The projection predicts that mountain glaciers in the Himalayas are melting and could deprive the major rivers of India.

Rainfall is the key variable influencing crop productivity in rainfed farming. Intermittent and prolonged droughts are a major cause of yield reduction in most crops. Long term data for India indicates that rainfed areas witness 3-4 drought years in every 10-year period. However, no definite trend is seen on the frequency of droughts as a result of climate change so far. For any R&D and policy initiatives, it is important to know the spatial distribution of drought events in the country. Along term analysis by CRIDA of rainfall trends in India (1901 to 2004) using Mann Kendall test of significance indicate significant increase in rainfall trends in West Bengal, central India, coastal regions, south western Andhra Pradesh and central Tamil Nadu. Significant decreasing trend was observed in central part of Jammu Kashmir, northern MP, central and western part of UP, northern and central part of Chattisgarh. Analysis of number of rainy days based on the IMD grid data from 1957 to 2007 showed declining trends in Chattisgarh, Madhya Pradesh, and Jammu Kashmir. In Chattisgarh and eastern Madhya Pradesh, both rainfall and number of rainy days are declining which is a cause for concern as this is a rainfed rice production system supporting large tribal population who has poor coping capabilities (Rao, 2013).

1.2 Rainfed Agriculture

Out of an estimated 143 million hectares of cultivated area in India about 24 per cent is under Dryland agriculture. Rainfed agriculture occupies a prominent place in Indian economy and rural livelihoods. It is spread over 55% of net cultivated area, contributing over 40% to the national agricultural production. Rainfed areas support 40% of India's population of over a billion, and play a vital role in food security. Over 87% of coarse cereals and pulses, 55% of upland rice, 77% of oilseeds and 65% of cotton are cultivated under rainfed farming. It is estimated that even after achieving the full irrigation potential, barring for successful completion of river linking project, nearly 45 to 50% of the total cultivated area will remain dependent on rain. Undoubtedly, the rainfed agriculture would continue to occupy a prominent place in Indian agriculture for a long time to come (Venkateswarlu *et al.,* 2011). Despite the progress made so far, rainfed agriculture in India encounters multiple risks and constraints relating to biophysical and socio-economic issues. Agricultural productivity in rainfed areas continues to remain low and unstable due to weather aberrations, nutrient disorder and poor socio-economic status of farmers. Recurrent droughts undermine the food, fodder and livelihood security of the rural mass and force them to migrate in search of work. Rainfed agriculture, which suffers from moisture

shortages, frequent dry spells or drought like situations, should imbibe the technologies that conserve the soil and moisture effectively.

1.3 Climate resilience

Resilience is the ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions (IPCC, 2012). It is the ability of a system to absorb shocks and recover as quickly as possible to normal conditions when external environment improves. Planned adaptation is essential to increase the resilience of agricultural production to climate change. Several improved agricultural practices evolved overcome for diverse agro-ecological regions in India have potential to enhance climate change adaptation, if deployed prudently. Management practices that increase agricultural production under adverse climatic conditions also tend to support climate change adaptation because they increase resilience and reduce yield variability under variable climate and extreme events. Some practices that help adapt to climate change in Indian agriculture are soil organic carbon build up, *in-situ* moisture conservation, residue incorporation instead of burning, conservation agriculture, zero tillage (ZT), laser assisted precision land leveling, direct drilling into the residues, direct seeding of rice, brown manuring with sesbania, unpuddled mechanical transplantation of rice, raised bed planting, crop diversification, water harvesting and recycling for supplemental irrigation, growing drought and flood tolerant varies, water saving technologies, location specific agronomic and nutrient management, crop insurance, improved weather-based agro-advisory, improved livestock feed and feeding methods. Institutional interventions promote collective action and build resilience among communities.

1.4 National Initiative on Climate Resilient Agriculture (NICRA)

The Government of India has accorded high priority to R&D for coping with climate change in agriculture sector. The Prime Minister's National Action Plan on Climate Change has identified agriculture as one of the eight National Missions. Indian Council of Agricultural Research (1CAR), New Delhi has launched a major network project entitled, National Initiative on Climate Resilient Agriculture (NICRA) during 2010-11, focusing on the process of developing district level contingency plans for all the rural districts of country with Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad as the nodal agency with an outlay of Rs.350 crores for the XI Plan. The project is being implemented at large number of research institutes of ICAR, State Agricultural Universities and 100 KVKs. The project is implemented in one representative gram panchayat in each of the 100 districts selected based on major climatic vulnerability viz. drought, floods, heat wave, cold wave, frost and cyclones. The project is implemented by Krishi Vigyan Kendra’s (KVKs) at district level, regionally coordinated by the Zonal Project Directorates (ZPDs) with overall planning, monitoring and coordination by CRIDA, Hyderabad. The project has four components viz., (i) Strategic research on adaptation and mitigation; (ii) Technology demonstration on farmers' fields to cope up with current climate variability; (iii) Sponsored and competitive research grants to fill critical research gaps and (iv) Capacity building of different stake holders.

NICRA has three major objectives, to enhance the resilience of Indian agriculture covering crops, livestock and fisheries to climatic variability and climate change through development and application of improved production and risk management technologies; to demonstrate site specific technology packages on farmers' fields for adapting to current climate risks; and to enhance the capacity building of scientists and other stakeholders in climate resilient agricultural research and its application.

1.5 Village Climate Risk Management Committee (VCRMC)

With approval of gram sabha, VCRMCs were founded in each village constituting representatives from all farmers' categories. VCRMC was involved in all activities for finalizing NICRA interventions, target farmer selection, target area selection, in liaison with gram panchayat and local elected representatives. VCRMC maintained bank account for all its financial transactions under NICRA embracing farmers contribution for different activities, handling of payments recovered from CHC. Bank account was opened in the name of VCRMC and was operated by any two signatories. For ensuring post-project sustainability extensive capacity building was organized by VCRMC. A sub-committee within the VCRMC was entrusted with the ration and management of the CHC. The revenue generated by way of hiring machines was deposited in a bank account managed by VCRMC and the revenue so generated was mostly used for the maintenance, upkeep and repair of machines. The organizational structures of both Nandayalagudem and Boring thanda VCRMCs were consisting of 15 villagers with nominated members as president, vice president, secretary and members.

The mandates of VCRMC are to conduct meeting every month and discuss about programme and climate resilient intervention, send notice in advance to members and farmers to attend the meeting, direct the community in all stages of development and to take responsibility for the improvement of the committee, maintain bank account of the VCRMC under the supervision of principle investigator and nodal officer and maintain village seed bank.

Timeliness of agricultural operations is crucial to cope with climatic variability, especially sowing and intercultural operations. This include limited sowing period available due to delayed monsoon or long dry spells between rainfall events to complete farm operations. Keeping this limitation, NICRA established the CHC in Andhra Pradesh and Telangana sates from 2011 onwards.

CHC is innovative institutional mechanism for providing timely access to farm machinery for sowing, harvesting etc., which are imperative elements of adaptation strategy. CHC emerged as a solution for prevalent problems in rainfed areas like very short sowing window and poor accessibility of small farmers to farm machinery. Activities of CHC resulted in avoidance of miseries due to inability to sow the crop timely. it also include promotion and strengthening of agricultural mechanization through training, testing and demonstrations. The center was established in Nandyalagudem and Boring thanda villages in Atmakoor Mandal of Nalgonda district during 2011-2012. About 6.71 lakh rupees were invested in establishment of the center. The amount taken as loan from the bank for support of the center was 44000. About 12 members were engaged to run this center. Some of the perceived advantages of the CHC were; ensured timely operations in

field preparations. Rotavator was best used among the provided services. It was observed that these implements and accessories contributed towards saving more than 80 per cent of labour cost. Rotavator was best used among the provided services.

1.6 Need for the study:

Drought is one of the most frequently occurring national disasters in India. With its increased frequency and expanded coverage in the recent years, about one third of the country is either drought prone or under desert areas. These areas are lagging behind in agriculture and also in overall economic growth. They experience wide year-to-year fluctuations in agricultural production and incomes and have a relatively high incidence of poverty. The poor in these regions are highly vulnerable to a variety of risks due to their low and fluctuating incomes, high indebtedness and low human development. Helping the poor to come out of vulnerability and poverty and integrating the drought prone areas into the mainstream of development is a serious challenge faced by policy makers at present. Keeping this in view the present investigation entitled as "A study on Adaptive capacity and technologies adopted by farmers for Climate Resilient Agriculture in drought prone areas" was undertaken.

1.7 Statement of problem

Several global studies have indicated that India is particularly vulnerable to climate change; Practices imparting climate resilience are the best adaptation option available. Readiness to the climate vagaries and better incorporation of people from various strata can catapult adoption of these practices. NICRA has been implemented its interventions across the country. Technology demonstration component and capacity building component of NICRA has paved the way to climate resilience in 100 districts. The adaptive capacity and extent of adoption of climate resilient technologies in these areas is to be analyzed to find out the extent to which these technologies could induce resilience of stakeholders for sustainable livelihood and development.

1.8 SCOPE AND IMPORTANCE OF THE STUDY

Delineation of status of farmers' adaptive capacity and it provided a reasonable understanding on level of adoption of climate resilient technologies among farming community, and to isolate factors promoting adoption and those hinder, base through the study will be of immense help in drawing a roadmap and extension strategy for capacity building of farmers towards adaptation and mitigation of adverse effects. And also the results of participatory rural approaches manifest itself the needy areas in the villages, these needy areas support the researchers and extension workers to further dissemination of the need based technologies. Suggestions to offset the discrepancies in initial stages of implementation are being sought from farmers. Incorporating critical points from these, some potential suggestion are put forward in this study. The study is expected to be very relevant for the National level organizations, NICRA, planners, policy makers, SAU and researchers to identify points of success and failures, thus to reshape further step of their action. Relevance of the study has been enriched by some proposals for upscaling these technologies to more compatible, convenient but advanced levels. Further, the study offers few recommendations to facilitate replication of CRA technologies in other parts of the country.

1.9 OBJECTIVES OF THE STUDY

1.9.1 General objective

A study on Adaptive capacity and technologies adopted by farmers for Climate Resilient Agriculture in drought prone areas.

1.9.2 Specific objectives

1. To study profile characteristics of respondents.
2. To analyze the rural settings on changing climate through participatory approaches.
3. To assess the adaptive capacity of farmers in terms of their climate readiness and attitude of respondents towards Climate Resilient Agriculture technologies.
4. To find out the respondents level of adoption of Climate Resilient Agriculture technologies and coping mechanisms for Climate Resilient Agriculture.
5. To study the relationship between profile characteristics of respondents and level of adoption of Climate Resilient Agriculture technologies.
6. To study the problems and suggestions elicited by the respondents in adoption of technologies for Climate Resilient Agriculture.
7. To suggest strategies for transfer of technologies for Climate Resilient Agriculture.

1.10 LIMITATIONS OF THE STUDY

Since all the social science researchers were subjected to certain limitations, the present study was no exception. As such, the study had certain limitations as indicated below:

- Since the study area was limited to two districts, Ananthapur district of Andhra Pradesh and Nalgonda district of Telangana, generalization of the findings to whole rainfed agro-ecosystem will be a difficult task.
- The findings of the study were based on expressed opinion of the respondents. Hence, the objectivity would be limited to the extent of the respondents' honest opinion.
- Even if the data were cross checked to minimize the error, it is a fact that the results of the study may be apt only for the area where the study had been conducted.
- Like any other single student research, time frame available for the study also appeared as limiting factor. Some aspects, which require longitudinal studies and observations that are time dependent, could not be studied.
- In spite of the above limitations, no effort was spared to make the study as objective and systematic as possible.

1.11 PRESENTATION OF THE STUDY

This study was presented in six chapters as follows;

Chapter I: Deals with 'INTRODUCTION' which gave a brief account of the need and importance of the study, objectives, the scope as well as limitations of the study.

Chapter II: Deals with 'REVIEW OF LITERATURE' with extensive literature survey of the past related to the present study.

Chapter III: Devoted for describing the 'MATERIAL AND METHODS' of the study including statistical tools.

Chapter IV: Dealt with 'RESULTS AND DISCUSSION' of the study.

Chapter V: Dealt with 'SUMMARY AND CONCLUSION' consisting implications of the findings and suggestions for future research.

The literature cited and appendices were given at the end.

CHAPTER II
REVIEW OF LITERATURE

A Comprehensive review of literature is crucial to any research study. The main objectives of review of literature are: to find out what work, both theoretical and empirical has been done before; assist in delineation of the problem area; provides insight into methods and procedures; provide a basis for theoretical framework; suggest operational definitions of major concepts and provide a basis for interpretation of findings.

The present study has been restrained by required number of studies as climate resilience is relatively new topic for research. This chapter has attempted to find out relevant studies done previously in this area of research and the same has been arranged chronologically in the following subheads:

2.1 Profile characteristics of respondents.

2.2 Rural settings on changing climate through participatory approaches

2.3 Adaptive capacity of farmers in terms of their climate readiness and attitude of respondents towards Climate Resilient Agriculture technologies

2.4 Level of adoption of technologies and coping mechanisms for Climate Resilient Agriculture

2.5 Relationship between profile characteristics of respondents and level of adoption of technologies

2.6 Problems and suggestions elicited by the respondents in adoption of technologies for Climate Resilient Agriculture

2.7 Strategies for transfer of technologies for Climate Resilient Agriculture

PROFILE CHARACTERISTICS OF THE WATERSHED FARMERS

2.1.1 Age

Sridhar (2002) in his study concluded that concluded 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 farmers belonged to the middle age group, followed by old age (36.25%) and young age group (18.75 %), repectively.

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

Chinnam Naidu (2012) reported that majority (51.11%) of the sugarcane farmers belonged to middle age group followed by old age (31.11%) and young age (17.78%) categories respectively.

Omid *et al.* (2012) revealed that majority of (35.30%) farmers were up to 43 years of age followed by 57 and above (34.30%) and 43-57 years of age (29.80%).

Sharma *et al.* (2012) found that maximum number of respondents (45.33%) belonged to middle age (35-45 years) followed by young (25-35 years) age 34.60 per cent, whereas, twenty per cent belonged to old age (>45 years).

2.1.2 Education

Reddy (2005) identified 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.

Chinnam Naidu (2012) revealed that 51.11 per cent of the sugarcane farmers were educated up to middle school level followed by high school (26.11%), college level (12.22%), graduation (6.67%), illiterate (2.78%) and (1.11%) post graduate level of education.

Omid *et al.* (2012) found that majority (27.70%) of farmers were grouped under reading and writing, followed by graduation (26.60%), elementary education (17.60%), high school (15.60%) and illiteracy (12.50%).

Sharma *et al.* (2012) revealed that maximum number of respondents (74.44%) had education upto graduate level. 16 per cent were post graduates. A limited number of respondents (9.33%) had education upto intermediate level.

Lokhande (2013) disclosed that majority of the respondents i.e. 85.47 per cent were literate whereas 14.53 per cent respondents were illiterate. However, just 5.50 per cent respondents had completed graduation.

Prabhavathi (2013) revealed that nearly 31.80 per cent of the respondents had middle level of education followed by primary education (29.40%), secondary education (27.10%), collegiate education (8.20%) and functional literate (3.50%).

Swetha (2013) revealed that majority of the respondents had primary school education (35.83%), followed by high school (33.33%), illiterate (22.50%), intermediate (5.00%), under graduation (1.67%) and post-graduation (1.67%).

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) concluded 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.

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.

Palanisami *et al.* (2011) found that majority of (70.67%) micro irrigation farmers were belonged to small followed by large (23.33%) and marginal (6.00%) level holding.

Savita (2011) revealed that, 40.67 per cent of the beneficiaries belonged to medium category followed by small (30.67%), large (20.66%) and marginal farmers (8.00%) category.

Chinnam Naidu (2012) opined that 37.78 per cent of the respondents were under medium farm size category followed by small farm size (33.89%) and big farm size (21.11%) categories respectively. Only 7.22 per cent of the respondents were under marginal farm size category.

2.1.4 Availability of water resources

Satish Kumar (1998) conducted an analytical study on factors responsible for crisis situation and reported that 51.42 per cent of the respondents irrigated the cotton fields through bore wells, while the fields of rest of the respondents (48.58 per cent) were rainfed.

Kruparkar (2001) concluded that 52.50 per cent of the farmers cultivated cotton under wells, followed by 47.5 per cent who cultivated cotton under rainfed and none under canals.

Subramanyam (2003) reported that surface waters like hill streams, tanks, ponds and reservoirs are the major sources of water supply to the tribal people in the agency areas of Eastern Ghats. The other ground water resources are the springs and wells. Among these two sources of water supply, the spring water is largely used for drinking and terrace cultivation purposes.

He further reported that tribals construct the bunds on the four sides of each field and made holes two inches above the bottom most bund of each field. Like thus the springs over flow water reaches from the top most field to the bottom most one. This kind of irrigation technology is very commonly found in terrace cultivation throughout the agency tracts of Eastern Ghats.

Shiv kumar (2009) reported that in tribal areas, most popular scheme under the NREGS sub sector "Kapil Dahra" is impacting well on increasing the irrigation area. 34.00 per cent of the area is fully irrigated, while 11.00 percent is partially irrigated and 55.00 percent un-irrigated.

Praveena (2010) reported that majority of the respondents (61.66 per cent) were rainfed farmers while 23.33 per cent could irrigate the fields to an extent of 25 per cent and rest 15.00 per cent irrigated the fields to an extent of 25.00 to 50.00 per cent. The respondents who had irrigation facility to some extent irrigated their fields through bore wells and some of the farmers (13.33 per cent) from Kadapa used sprinklers to irrigate the vegetable fields.

2.1.5 Frequency of occurrence of drought

Mortimore (1998) stated that the frequency of these droughts have been on the increase over the last 100 years. The most prominent of these droughts was that of the early 1970s during which 100s of 1000s of people and millions of animals died.

Hulme *et al.* (2001) revealed that drought has been a recurrent feature, with early records dating back to the 1680s, the magnitude and intensity of these droughts have been on the increase over the last 100 years and consequently in the destruction caused by it.

Tarhule and Lamb (2003) found that the magnitude and intensity of these droughts have been on the increase over the last 100 years.

Anil Kumar and Indira (2007) stated that frequency of occurrence of drought during the last 3 decades in Gujarat; there were nine major droughts during these periods with coverage of state's total areas ranging from 23.00 percent to almost 90.00 percent.

Srinivasa Rao *et al.* (2013) stated that long term rainfall data for India indicate that rainfed areas experience 3-4 drought years in every 10 year period. Of these, two to three are in moderate and one or two may be of savior intensity.

Srinivasa Rao and Gopinath (2016) found that the cultivation of crops depends on the nature of drought (chronic and contingent), its probable duration and frequency of occurrence within the season.

2.1.6 Farming systems

Devendra (2000) reported that recycling of wastes in a crop-livestock integration contributing to enhance the soil fertility through nutrient recycling and organic enrichment of soil in dry land and rainfed environments.

Alam *et al.* (2000) stated that the manure availability of 12 tonnes from a pair of draught cattle integrated in the farm was diverted to crop area to maintain soil fertility.

Vairavan *et al.* (2000) observed that in an integrated Silvipasture based farming system for dry land, among the annual components, rearing goat recorded higher income followed by milch cows.

Radhamani (2001) reported that integration of crop + tree + goat system provided higher net return than cropping alone for Western Zone of Tamil Nadu under rainfed situation.

Das (2001) reported that small breeds of livestock and poultry with cereal and grain legume crop formed an integral part of the farming system.

Radhamani (2001) observed that predominance of milch cows, goats and buffaloes along with cropping in dry land for Western Zone of Tamil Nadu. For one hectare area of dry land, integration of sorghum + cowpea (grain), sorghum + cowpea (fodder) and *Cenchrus glaucus* each in 0.33 ha intercropped in *Emblica officinalis* with tellicherry goat (5+1) in 0.01 ha could be recommended against raising sole sorghum crop alone.

Thanrongwarangkul (2001) found that diversification of farming activities improved the utilization of labour; reduced unemployment in areas where there was a surplus of underutilized labour and provided a source of living for those households that operated their farm as a full time occupation.

Sivamurugan (2001) stated that integration of cropping with dairy + biogas + mushroom generated the highest employment of 875 mandays.

Schierre *et al.* (2002) found that animals on a farm provided inputs to other enterprises and constituted a source of meat and milk, a means of savings and a source of social states.

Thirukumaram (2002) stated that integration of goat (11+1), rabbit (7+1) and pigeon (10 pairs) with crop component cumbu (G) + soybean (G), maize (F) + cowpea (F), Cenchrus ciliaris -+ Siylontanthes scabrawas identified as the best model for one hectare dry land area of Western Zone of Tamil Nadu.

Van Biakel *et al.* (2003) reported that diversification of farming activities improved the utilization of labour; reduced unemployment in areas where there was a surplus of underutilized labour and provided a source of living for those households that operated their farm as a full time occupation

Jayanthi *et al.* (2003) reported the effect of integration of dairy and goat components along with cropping for better utilization of resources. Crops and crop wastes were used as a feed resource for animals and the manure from the livestock enterprises were recycled as a source of nutrients to the crop, thereby supplying the nutrients harvested back to the soil.

Ravi (2004) stated that agriculture with poultry, agriculture with sheep rearing and agriculture with sericulture were the important farming systems identified in the study area. The relative profitability of the selected farming systems both in small and medium farms was studied and it revealed that the farming system, agriculture + sheep was most profitable among the selected farming systems with an annual net returns of 0.43 Lakhs/farmer and 0.76 lakhs/farmer in small and medium fanners, respectively.

Esther Shekinah *et al.* (2005) observed that in an integrated fanning system along with crop components, goat, pigeon, buffalo, agroforestry system and farm pond were integrated. Tellicherry breeds were maintained for meat purpose. Buffaloes were maintained solely for milk. The farm pond was dug for collecting the runoff to be used m

times of moisture stress and silt collection. Through the quantification of physical indicators, the studyled to the conclusion that farming systems with enterprise combination of cropping (fertilized with composted buffalo manure), pigeon (10 pairs), goat +buffaloes (two milking buffaloes tone calf), agroforestry and farm pond could be recommended for the dry land tractsof Western Zone of Tamil Nadu.

Benhin (2006) found that among the farming systems of marginal farmers, integrated farming system involving crop production (cotton + pigeonpea intercropping) and livestock rearing (4 bullocks, 3 desicows and 1 buffalo) gave higher net return (`40,180/year) compared to other farming systems. Similarly, among the three farming systems of small farmers, integrated farming system involving crop production (cotton + pigeonpea intercropping) and livestock rearing (2 bullocks, 1 desicow and 40 goats) performed better with a net return of 89,937/year compared to other farming systems.

Ramrao *et al.* (2006) revealed that integrated farming system with two bullocks + one cow + one buffalo + 10 goats along with poultry and duck was the most beneficial system for the marginal farmers in rainfed regions of Chhattisgarh in Central India

Jayanthi *et al.* (2007) found that recycling of crop residues and animal manure from integrated farming system components about 5.3 tonnes of compost was obtained with 1.6 tonnes as vermicompost and 3.7 tonnes as biocompost. This could supply 26.0, 22.3 and 26.0 kg NPK to field and fodder crops through biocompost and 39.4, 10.5 and 18.0 kg NPK to vegetable crops as vermicompost in one acre of land area.

Shivani *et al.* (2010) reported that integration of seasonal vegetable (bitter gourd - tomato - bottle gourd) with food crop (rice - potato- onion), goat and vermicompost resulted in higher productivity than cropping alone under irrigated upland condition. Recycling of vermicompost and goat manure in the system not only reduced the cost of cultivation by saving fertilizer but also improved the soil health.

Barik *et al.* (2010) found that integrated farming system approach with combination of crops (rice, off-season tomato, cauliflower) and non-crop enterprises like poultry + paddy straw mushroom production + vermicomposting was sustainable system giving maximum net return and additional employment under rainfed risk prone situations in Deogarh district of Orissa.

Policy note (2010) stated that red loamy soil predominates in dry land of Tamil Nadu, with some sandy alluvium and red sandy soil. The red loam soil type contains

bunker gravel and this type is the best land for retiring livestock. The soil is rich in calcium and phosphorus. Crops grown in dry land of Tamil Nadu are cotton, finger millet and sorghum. During the monsoon season, millet and sorghum is grown

Ugmimba *et al.* (2010) identified that the integrated farming systems adopted by farmers were crop-livestock (47.62%), crop-fish (9.52%), crop-fish-livestock (29.76%), livestock-fish (11.90%) and crop-livestock-agro processing (1.19%).

Magombo *et al.* (2012) found that farmers have tended to move towards mixed crop-livestock farming.

2.1.7 Socio Economic Status

Jeyamissie (2000) reported that majority of Toda tribal farmers belonged to medium family size (66.00%) and 34.00 per cent of the tribal farmers belonged to small family size.

Manay and Farzana (2000) in their study on socio economic characteristics of rural families reported that 89.4 per cent of the rural respondents belonged to nuclear families and 10.6 per cent of the rural respondents belonged to joint families, 65.2 percent of the families had three to seven members in their families and 25.8 per cent of the families had less than three members and 9.0 per cent of the families had more than seven members in their family. Majority (87.5%) of the farmers families possessed less than 5 acres of land and 6.1 per cent and 6.1 per cent of the families possess more than 5 acres and no land respectively. 81.2 per cent of the families possessed dairy and 25.8 per cent of the families possessed poultry. 15 per cent of the families possessed energy saving assests such as Kerosene stove or pressure cooker. Entertainment assets such as Radio and Television were possessesed by 59 per cent of them. Seventy four per cent of the families possessed furniture and 57.6 per cent of them had cycle or moped. About 50 per cent of the families had farm implements such as kurpi, spade and desi plough. Eighty eight per cent of the families had their own house and twelve per cent of the families lived in rented house.

Manakar *et.al*. (2000) in their study on Socio-economic and Psychological Profile of Fishermen reported that majority (43.33%) of the respondents had medium level of socio-economic status followed by low (20.00%) and high (6.67%) level of socio-economic status.

Shinde *et.al.* (2000) in their study on Identification and Adoption of Indigenous Agricultural Practices by Dryland Farmers reported that majority of the farmers had moderate levels of socio-economic status.

Kumar (2000) in her study on Nutritional Status of Scheduled Caste lactating Mothers in Rural Area reported that 61 per cent of the respondents had medium family followed by small (32.00%) and large (7.00%) families respectively. 60 per cent of the respondents are illiterates and 60 per cent of the respondents had nuclear family and 75 per cent of the respondents occupation is labour.

Kumari (2004) reported that majority (55%) of the tribal women belonged to medium socio-economic status group followed by low (30.56%) and high (14.44%) levels of socio-economic status respectively.

Krishnaprasad (2005) inferred that 67.08 per cent of farm families under below poverty line were under medium family size category followed by 17.50 per cent small family size and high family size (15.42%).

Chandrashekhar (2007) suggested that majority of the respondents (58.34%) had no membership in any organization, whereas 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.

Malik (2007) observed that 40.00 per cent of tribal communities belonged to low income category followed by medium (38.33%) and large income category (21.67%).

Sharma (2007) revealed that 60.00 per cent of the tribal farmers belonged to low income category followed by 36.67 per cent of the respondents belonged to medium income category while only 3.33 per cent were under high income category.

Awais (2007) reported that majority (77.21%) of tribal farmers were illiterate. A very small proportion of farms (20% tribal farms) have members who are engaged in non-agricultural occupations.

Antara *et al.* (2009) reported that 41.9 per cent of the tribes are labour, 48.77 per cent of the tribes house is hut, 56.57 per cent of the tribes have family size upto 5 members, 71.57 per cent of the tribes were illiterates

Kiran and Kanani (2010) revealed that 39.00 per cent of the SHG women were found to be the daily labourers and 31.00 per cent had been involved in agriculture and allied activities.

Rao *et al*. (2010) reported that 59.40 per cent of the tribal respondents had semi pucca house, 90.4 per cent of the tribal respondents had nuclear family, 48.20 per cent of the tribal respondents were cultivators and 52.10 per cent of the tribal respondents have family size of 1-4 members.

Meenakshi (2011) observed that the majority (58.33%) of the respondents were wage earners. Less than one-fifth of the respondents (16.67%) were observed to be farmers cum wage earners. Less than one-tenth (7.50%) of the respondents were found engaged in farming alone. Further it is reported that 11.67 per cent of the respondents were found without any employment. Only 5.83 per cent of the respondents were doing their own business.

Chinnam Naidu (2012) revealed that majority of the sugarcane farmers (69.44%) were under medium annual income group followed by 17.78 per cent under high annual income group and 12.78% farmers were in low annual income group.

Mohan and Ramesh (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.

Swati *et al.* (2013) revealed that annual income of overall category of member households was Rs 1,31,598. Rich households had significantly higher income (Rs 1,86,069) as compared to poor households (Rs 94, 086).

Osondu and Ibezim (2013) found in their study that 55.0 per cent the respondents earned monthly income of between Rs 5,000 and Rs 30,000, a total of 45.0 per cent of them earned Rs 31,000 and above in spite of the fact that they were small scale farmers. The farm income they earned may have been augmented by remittances from their children and relations abroad.

Santosh (2014) found that majority (64%) of the respondents annual family income was between Rs.30.000 -40.000 while 30 per cent of the respondent's annual income between Rs.40.000-50.000, remaining 6 per cent respondent's annual income more than Rs.50.000.

2.1.8 Farming experience

Raju (2002) revealed that majority of watershed farmers (63.00%) had medium level of farming experience (63.00%) 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.

Chidananda (2008) reported that majority (87.50%) of the dryland farmers were under medium annual income group followed by 12.50 per cent under high annual income group and there is no farmer in low income group category.

Prashanth (2011) indicated that, majority of the organic cotton farmers had medium farming experience (45.00%) followed by low (30.00%) and high farming experience (25.00%) whereas, majority of the conventional cotton farmers had medium farming experience (50.00%) and equal percentage of (25.00%) high and low farming experience.

Pynbianglang Kharumnuid (2011) indicated that majority of the potato growers were under medium farming experience (47.50%), followed by high farming experience (28.33%) and low farming experience (24.17%).

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

Chinnam Naidu (2012) reported that majority of the sugarcane farmers were having medium farming experience followed by high (21.67%) and low (20.00%) farming experience categories

2.1.9 Social affiliation

As limited literature was available in this area, results of few relevant studies were presented.

Preethi and Shashikantha (2008) revealed that 50.00 percent of the women entrepreneurs had medium affiliation motivation, followed by other 50.00 percent of the women entrepreneurs had high affiliation motivation.

2.1.10 Trainings undergone on CRA

Raju (2002) revealed that majority of watershed farmers (60.50%) had received medium level of training followed by low (22.00%) and high (17.50%) level of training.

Anitha (2004) concluded that 70.00 per cent of the farm women were not undergone any training and remaining 30.00 per cent of the respondents were undergone training for three months on income generating activities.

Doli (2006) found that majority of the respondents were found in low category (83.00%) of organizational and training participation.

Rahman and Yamao (2006) observed that majority (33.70%) of the farmers had received much training followed by less (27.40%), nil (21.40%) and medium (17.50%) levels of training received.

Praveena (2010) found that 48.33 per cent of respondents have not undergone any training programme on pest and disease management while 40.00 per cent of the farmers had undergone 1-4 trainings programmes and 11.67 per cent of the farmers participated in 4-8 training programmes.

2.1.11 Sources of Information Utilisation

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 exposure, 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.

Raju (2002) revealed that majority of the watershed farmers (54.50%) had medium level of extension contact followed by low (24.00%) and high (21.50%).

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

Singh and Kumar (2004) revealed that about two thirds of respondents had low mass media exposure (65.83%) followed by medium (29.17%) and high mass media exposure (5.00%).

Saha (2010) reported that majority of the respondents had medium mass media exposure (57.50%) followed by those having high (23.33%) and low level of mass media exposure (19.17%).

Thaddeus *et al*. (2011) found that Knowledge of climate change impacts is related to availability and accessibility of information on the phenomenon. Farmers received information on climate change from the following three major sources; radio/television (61.0%), newspaper (44.0%) and friends (43.8%). Other sources included internet (18.2%), researchers (14.8%), extension workers (13.8%), farmers' co-operative (10.2%) and politicians (3.5%).

Romashkumar (2012) reported that maximum number of respondents had medium level of extension contact (58.67%) followed by low level of extension contact (24.67%) and high level of extension contact (16.66%).

2.1.12 Credit availability

Food and Agriculture Organization (2008) reported that missing or imperfect rural markets, such as credit and insurance markets in rural areas had an important impact on household agricultural production, investment and labour allocation decisions and migration related decision.

Egyir (2010) found that in his study at Ghana, farmers relied mainly on informal and semi formal financial services prior to the establishment of the formal banking system. The main sources of credit included thrift groups, moneylenders and acquaintances among others.

Idris (2010) observed that small-scale farmers have relatively more access to informal and semiformal credit institutions than to formal credit institutions. In addition, the high repayment rate of loans recorded by informal and semiformal institutions could indicate that the loans were granted at affordable rates to the small-scale farmers and that subsidization might not be necessary.

Todd and Sharma (2010) found that smallholder farmer’s lack of access to production credit is mainly as a result of financial institution’s disinterest in lending to peasant agriculture. Agriculture financing is unattractive because it is perceived to be risky or weather dependent and unprofitable.

Mann *et al.* (2010) observed that formal finance sector is dominated by commercial and rural banks. Whereas commercial banks are normally located within district capitals,

rural banks are usually located in rural areas. The semi-formal financial sector includes microfinance institutions and non-governmental organizations. The informal financial sector consists of moneylender, traders, family, friends, neighbours, and among others.

Etwire *et al.* (2013) revealed that the subsistence nature of farming tends to make farmers unattractive as borrowers whereas farmers or farmer groups who are operating in a value chain were more likely to receive credit.

Kuldip and Anand (2013) revealed that the contribution of formal source of credit in farmer's indebtedness was 67.60 per cent in Haryana and 57.70 per cent in India in 2003.

2.1.13 Food security

Situation Assessment Survey (SAS) of Farmers (2003) revealed that the commercial banks were dominant formal source of credit in Haryana as well as in India, while agriculture professional moneylenders were the dominant informal source of credit in both places. The contribution of commercial banks in total formal debt is 63.01 and 61.69 per cent in Haryana and India, respectively; while in case of informal debt the contribution of agriculture professional moneylenders is 74.38 per cent in Haryana and 60.75 per cent in aggregate India.

Hajjar *et al*. (2008) in addition to enhancing food security and climate resilience, diversity in the field also delivers important ecosystem services. Variety mixtures that are tolerant to drought and flood not only increase productivity, but also prevent soil erosion and desertification, increase soil organic matter and help stabilise slopes. Benefits for farmers include reducing the need for costly pesticides, receiving price premiums for valued traditional varieties and improving their dietary diversity and health.

Food and Agriculture Organization (FAO) (2008) reported that food insecurity and lack of economic opportunities in agriculture and related rural sectors, such as forestry and fisheries can lead to migration to other areas in search of employment, income, or food.

Ramachandran (2008) reported that there has been a decline in the proportion of expenditure on food items in the last three decades in both urban and rural areas. The decline is mainly due to low cost of cereals which are the major source of energy in Indian dietaries, and it was seen in all income groups. The share of cereals in household expenditure has fallen from 41 per cent to 18 per cent in rural India and from 23 per cent to 10 per cent in urban India over the same period. Over this period, the expenditure on pulses has remained more or less the same in all the income groups. However, because of the

soaring cost of pulses, there has been a decline in pulses consumption in all the income groups.

Cumba *et al.* (2009) found that majority of households who live in the uplands, from a food security point of view; coping mechanisms include reducing the number of daily meals, eating less expensive or desirable food and serving smaller portions.

Kumbhare *et al*. (2014) fond that low about 59 per cent followed by very low (20%) medium (16.50%) status of food security. The overall household food security status was found low among BPL house hold as compared to household.

2.1.14 Traditionalism

According to the present study this variable is operationalized in terms of cultural beliefs and religious beliefs that exist in farming. As this variable is used for the first time researcher could not find the exact review for this variable. Hence the review related to cultural belief, religious beliefs were presented.

Ratnakar (1990) found that cent per cent sericulture beneficiaries of ITDA and non-beneficiaries in Khammam district of Andhrapradesh belonged to medium level of religious belief.

Debbarman (1991) reported that all customs and beliefs of Santal tribes were centered around their religion.

Rao (1993) reported that majority (71.43%) of tribal farmers had medium religious belief followed by high (16.07%) and low (12.50%) religious belief.

Putla (1994) reported that majority (80%) of the Lambadi tribes of Andhra Pradesh had medium level of religious belief followed by high level of religious belief (15.8%) and low level of religious belief (4.2%).

Kumar (1994) found that majority of tribal respondents had medium (56.65%) religious belief followed by high (28.4%) and low (14.95%) religious belief.

Sankara Rao (1995) found that majority of tribal respondents had medium (50.0%) religious belief followed by low (26.67%) and high (23.33%) religious belief.

Bindu (2001) reported that majority (71.11%) of the tribal respondents had favourable religious belief followed by unfavourable (22.22%) and neutral (6.67%) level of religious belief respectively.

Raj and Pawan (2008) indicated that almost (99.33) all the respondents still had faith in Kuldevta with a negligible (0.67%) exception. He also observed that 46 per cent respondents had faith in supernatural powers and 54.00 per cent respondents had no faith in

supernatural powers. Regarding the participation of respondents in religious activities, 53.33 per cent respondents observed religious activities daily in the form of prayer and 40 per cent of respondents performed it sometimes and 6.67 per cent respondents never performed.

Kiran (2011) reported that majority of the tribal respondents (73.22%) possess medium level of religious belief, followed by high (16.67%) and low levels (10%) respectively.

2.1.15 Risk taking ability

Singh and Bhagat (2002) indicated that, majority (64.00%) of the respondents has medium risk orientation followed by high (24.00%) and low (12.00%) levels of risk orientation.

Subramaniyam (2003) revealed that 75.00 per cent of the trained farmers had medium risk preference, followed by high (13.34%) and (11.66%) low risk taking ability.

Chidananda (2008) reported that majority (65.83%) of dryland farmers had medium risk taking ability followed by high (20.00%) and low (14.17%) risk taking abilities respectively.

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

2.1.16 Weather based Agro Advisory services

Nagasree *et al*. (2013) suggested that dissemination of weather based information services and advisories through integration of ICT tools like Touch screen information kiosk, Display announcement package, Interactive voice response system (IVRS), Sasyavani mobile based agro advisories, to the farming community and extension functionaries through timely forecasting of information on occurrence of pests and diseases, crop operations to be carried out during weather sensitive crop growth stages plays a pivotal role in reducing weather related risks.

Venkatesh *et al.* (2013) found that the utility varied from cent per cent for spraying in grape gardens to eight per cent for inter-cultivation activities in field crops. Thus, by adopting the weather forecasts for important agricultural operations, the farmers are getting ready to face the adverse effects of climate change.

Ananta Vashisth *et al*. (2013) found that the farmers, who followed the agromet advisories, are able to reduce the input cost and increases in the net profit as compared to the non AAS farmers in wheat, carrot and rice. This profit was due to the crop management done by the farmers according to agromet advisory bulletins. Thus, the application of agromet advisory bulletin, based on current and forecast weather is a useful tool for enhancing the production and income.

Rani Saxena *et al*. (2015) reported that under use of agromet advisory services (AAS), the input cost is reduced and the net profit increased as compared to the non AAS in all the four crops. This economic benefit is attributed to timely and economic management of scarce resources in crops according to weather forecast based agromet advisory. Therefore it can be concluded that the application of weather forecast based agromet advisory bulletin is an important and useful tool for enhancing the production and overall farm income.

2.1.17 Infrastructural facilities

As limited literature was available in this area, results of few relevant studies were presented.

Anil Kumar and Indira (2007) observed that villages in drought and drought prone regions of Gujarat are having sufficient physical infrastructures and facilities, however, educational and health facilities are not so encouraging. The issues of health and drinking water are somehow closely related in drought regions which needs a serious attention. The availability of drinking water and its related issues reveals striking features in these villages.

Chakraborty *et al.* (2012) found that majority (64.00%) of the villages were fell under 'marginally good' infrastructure facilities followed by good infrastructure (25.80 %) than poor (8.70%) and very good (1.50%) infrastructure facilities.

2.2 Rural settings on changing climate through participatory approaches.

Conway (1987) reported the primary purpose of the maps is to delimit the main agro-ecological zones within the village, again chosen subjectively as being distinct agro-ecosystems in terms of one or more ecological, agricultural socio or economic features. Transects also reflect the zones and provide an opportunity to characterise them in terms of the crops and livestock husbandry and the different problems encountered.

Limpinutana (1987) reported mapping of spatial distribution of resources and how they were used for agriculture would help in understanding the possible relationships between various environmental factors and agricultural activities.

He was also reported that crop calendars have been extensively used by various cropping/farming systems projects. They show the earliest and later time of planning and individual cropping pattern and therefore the period and duration of area occupied by that particular crop calendars used for land preparation, weeding, fertilization, harvesting, threshing of grain. Seasonal usage of natural resources, animal feed, availability, drinking water for man and livestock and source of fuel wood etc.

Pretty (1990) reported in rapid catchment analysis in Kenya, when farmers patterns of rain fall differed in six different catchments and also differed from the 'real' data from a nearby rain fall station, this was judged to reflect spatial heterogeneity, without ruling out the possibility that the farmers were wrong.

James and Prem (1991) reported that resource map indicates vegetation (forest trees) land use (cultivated, uncultivated and waste), grazing land, forest land, irrigated land, land ownership patterns, land productivity and cropping patterns.

Ford and Zelo (1991) reported evaluation of PRA activity in Mbusyani, Kakuyuni, Kenya where the community plan included the rehabilitation of two dams and catchments installing a well, erosion control on slopes and water supply development.

Ison and Ampt (1992) reported that PRA, a qualitative survey methodology, was being increasingly utilised in third world situations to better formulate the problems and identify opportunities for agricultural research and development.

He was also suggested that the concepts which underpin PRA and the range and richness of outcomes make it a relevant tool for formulation of problems for agricultural research and development in Australia and other developed countries. A model for future agronomic research which has emerged from the PRA experience and which incorporates PRA is proposed. This model, which focuses on farmer participation in the research process, in seen to offer greater potential for sustainable agricultural development in Australia than the increasingly questionnaire transfer of technology model.

Sam Joseph (1992) reported social map is a very powerful tool; In addition to providing information caste wise location, water resources, education, religious centres etc, this map after marking each home, can be used for generating information like baselines surveys on population, literacy, assets etc.

Ian Scoones (1994) reveled that browse ranking with livestock owners can be a quick and effective way of finding out about fodder preferences and availability in an area.

Neela Mukherjee (1994) observed that the PRA exercise highlighted a range of different aspects of village livestock and livelihood. The issue of livestock was so integral to the village economics that it was referred to time and time again in discussions about different aspects of livelihood. The visual PRA methods brought to the surface hidden problems, priorities, preferences and uses of livestock and helped in deeper probing of issues important to villagers.

Robin Mearns *et al.* (1994) inferred that participatory mapping and transect were used to gain a general introduction to each brigade and to begin to identify grazing and other key resources, patterns of seasonal mobility etc.

Swift and Uman (1994) reported that the groups were entirety free to select their own problems and opportunities and also allocate their own priorities to them Nevertheless a high degree of consensus emerged, based not on the difference between production system of geographic areas, but on differences in wealth.

Bhardwaj *et al.* (1995) utilised PRA as an important tool for evaluation of watershed programmes, using resource map in developing participatory environment in the village. It also helped to understand the diversity of the somaghatta village resources. It also helped to locate the different soil and water conservation structures.

Sabarathnam (1996) facilitated resource map in Kalehelli village with orchid, water channel, sandy loan, waste land, fallow land, wells, crops like spinach, cabbage, tomato, garlic, wheat, maize, etc, and transformer, tea shop, government depot, private clinic and processing unit.

Nirmala (1998) observed that the mapping techniques that measured pattern analysis of space social map, resource map, Agro-ecology map, mobility map and these system properties namely productivity, security, sustainability assessed through sustainability analysis and innovation assessment technique were found to have high reliability and

validity and therefore, could be successfully employed for planning, implementation of projects and identification of priorities for agriculture development.

Lammerink (1999) reported that the participatory method, helps the community to describe and analysis their water supply system and to identify their problems and opportunities in community management.

Jost (2012) reported that in village resource use map infrastructure (roads, bridges, houses, buildings), water sources (drinking water, water bodies, irrigation sources, rivers, boreholes), agricultural lands (crop varieties and location), health clinics, schools and religious facilities, shops, markets, small industries , special use places (bus stops, cemeteries, shrines, waste sites) agro-ecological zones were documented.

2.3 Adaptive capacity of farmers in terms of their climate readiness and attitude of respondents towards Climate Resilient Agriculture technologies

Adaptation refers to the adjustment made by the people in their behavior or economic and livelihood patterns that reduce their vulnerability to climate change induced stresses.

Intergovernmental Panel on Climate Change (2001) defined adaptive capacity as the ability of a system to adjust to climate change, to moderate potential damages, to take advantage of opportunities or to cope with the consequences.

Maddison (2006) argued that adaptation to climate change requires that farmers first notice that the climate has changed, and then identify useful adaptations and implement them.

Joyce *et al.* (2009) stressed that climate readiness is an important element in reducing the potential impacts of extreme events on individuals, communities, and the environment. Development or refinement of plans that incorporate preparedness, mitigation, and response efforts would address current stresses as well as begin to address potential adaptations to likely future events associated with the current stressors and climate change.

Gowda (1996) stated that most of the farmers possessed a favorable (67.77%) attitude towards sustainable farming.

Padmavathi (1996) observed that 65.56 per cent of the mitrakisans had favourable attitude followed by 18.88 per cent and 15.56 per cent with high and less favourable attitude towards National Watershed Development Project in Rainfed Area (NWDPRA).

Rahman *et al.* (1999) revealed that most of the farmers possessed a highly favourable attitude towards environment and sustainability issues of agricultural development.

Rahman and Milkuni (1999) stated that half of the farmers in the study area possessed a less than favourable attitude towards sustainability issues of agricultural development. Only 6.00 per cent of them expressed a highly favourable attitude and 44.00 per cent expressed a moderate attitude.

Chataway *et al.* (2003) showed that 40.00 per cent of the respondents had favourable attitude towards agronomic and resource management issues.

Rahman and Yamao (2006) observed that 53.80 per cent of the farmers had moderate attitude towards agro-environment issues compared to 41.20 per cent highly favourable and 5.00 per cent unfavourable attitude towards agro-environment issues.

Fakoya *et al.* (2007) revealed that 64.00 per cent of the respondents showed neutral attitude towards sustainable soil management practices.

Khalkheili and Zamani (2008) found that majority of the farmers had positive attitude towards participation in irrigation management.

Takon *et al.* (2013) showed that a greater proportion of the people agreed that only very few people should take the responsibility of conserving natural resources (78.40%).

2.4 Level of adoption of technologies and coping mechanisms for Climate Resilient Agriculture

Bhaskaram and Praveena (1982) indicated that 65.00 per cent of the respondents had adopted the general recommended dry land agricultural practices namely, off season tillage, soil mulching and mid-season correction.

Jaiswal *et al*. (1985) reported that the adoption of improved dry land farming practices by small and marginal farmers of watershed areas was not to the extent expected, whereas the use of fertilizer and pesticides were confined only to big farmers.

Lal (1987) reported that conservation tillage practices can increase farm system resilience and improve the capacity of formers to adapt to climate change. At the same time, such practices may reduce carbon tosses that occur with ploughing and also further sequester carbon via residue incorporation and reduced erosion.

Reddy and Walker (1987) found that 58.00 per cent of the respondents belonged to high adoption category in case of soil and water conservation and dry land cultivation practices, while 61.00 per cent of the respondents were in low level of adoption with regard to improved dry land farming technology. In case of non-arable land development practices, majority of the respondents exhibited high level of adoption. Further, the study revealed that the adoption level of big farmers was significantly higher than that of small farmers with respect to watershed management practices.

Rao (1988) reported that majority of marginal (83.00%), small (78.00%) and medium (54.00%) farmers were not adopting any of the soil and moisture conservation practices. However, a good number of (about 60.00%) large farmers had adopted all the soil and moisture conservation practices. Regarding crop production technology, the study indicated that majority of respondents of all farm size groups adopted most of the practices recommended for intercrop jowar+redgram at 2:1 ratio and majority of marginal and medium farmers had medium level of adoption of improved implements as compared to small and large farmers. The study also indicated that only 19.00 per cent of the respondents were adopting the suggested alternate land use measures like farm forestry, social forestry and pasture development, while a large majority (81.00%) was not at all adopting any of them.

Prasad (1990) stated that majority (53.34%) of the respondents had medium level of adoption of recommended watershed management practices.

Eswarappa (1991) revealed that the adoption level was high in case of land treatment practices, alternate land use and use of improved implements, while medium in crop production and agro forestry practices and low in case of horticultural practices.

Iqbal (1991) observed that majority (67.80%) of the beneficiaries had high level of adoption of dry land farming technology, but their adoption rate was low in case of horticultural practices, pasture land development and social forestry.

Krishnamurty (1993) revealed that majority (60.00%) of the respondents had medium level of adoption of recommended watershed management practices followed by high (20.84%) adoption and low (19.16%) adoption.

Pathak and Laryea (1995) reported the furrow irrigated raised bed system (FIRBS) of wheat cultivation could provide savings in seed by 25-40 per cent, water by 25-40 per cent and nutrients by 25 per cent, without affecting the grata yield production.

Reddy (1996) revealed that a great majority (67.11%) of sample respondents had medium level followed by 18.22 per cent with high and 14.67 per cent of respondents with low level of adoption of watershed technology.

Kadam *et al*. (2001) concluded that majority (68.00%) of the beneficiaries had adopted only one practice, namely, 'dividing fields with small bunds'. The practices namely, 'stubble and agro waste plucking' (38.66%) and 'small earthen bunds' (23.33%) were also adopted by a considerable number of the beneficiaries.

Raju (2002) revealed that majority of the respondents (57.50%) had medium level of adoption of eco-friendly farming practices followed by 22.50 per cent with low level of adoption and remaining 20.00 per cent with high level of adoption.

Baethgen *et al* (2003) found that availability of better climate and agricultural information helped farmers to make comparative decisions among alternative crop management practices and this allows them to better choose strategies that make them cope well with changes in climatic conditions.

Tompkins and Adger (2003) found that adaptive ecosystem management overturns some major tenets of traditional management styles which have in many cases operated through exclusion of users and the top-down application of scientific knowledge rigid programmes.

Bradshaw *et al.* (2004) stated that the individual farms have become more specialised in their cropping patterns 1994-2002 of crop diversification in Canadian prairie agriculture and this trend is unlikely to change in the immediate future, notwithstanding anticipated climate change and the known risk reducing benefits of crop diversification.

Kurukulasuriya and Mendelson (2006) used multinomial logit models to analyze crop and livestock choices was adaptation options. It showed that crop choice is climate sensitive and farmers adapt to changes in climate by switching crops. The results from choice models from the livestock study showed that farmers in warmer temperatures tend to choose goats and sheep as opposed to beef, cattle and chicken. Goats and sheep can do better in dry and harsher conditions than beef and cattle.

Nhemachena and Hassan (2007) indicated that less than 40 per cent of the respondent did not adopt any adaptation strategies in Southern Africa. Female headed households were more likely to take up adaptation options.

Blanco and Lai (2008) identified that soil and water conservation structures can provide benefits by reducing water erosion, improving water quality, and promoting the formation of natural terraces over time, all of which should lead to higher and less variable yields, such structures also often provide benefits to neighbors and downstream water users by mitigating flooding, reducing sedimentation of water ways, structures including contour bunds either earth or stone to reduce runoff velocity and soil loss are appropriate for permeable soils on gentle to moderately sloping lands. It may form the basis for terraces on steeply sloped land, and may reduce further gully erosion when built above across gullies.

Deressa *et al.* (2008) found that the adaptation methods are; changing planting dates, using different crop varieties, planting tree crops, irrigation, soil conservation and not adapting. Among these the use of different crop varieties was the most common adaptation method, while irrigation was the least common.

Yesuf *et al.* (2008) analysed that changing crop variety, soil and water conservation, water harvesting, planting of trees and changing planting and harvesting dates are the choices of adaptation measures adopted by the farmers. Among these methods of adaptation, planting trees was the measure adopted by most farmers. However, about 42 per cent of the farmers did not use any adaptation method for climate change impacts.

Food and Agricultural Organisation (2009) reported that livestock keeping is an important component of coping mechanism under drought conditions in all the rural communities of Chicualacuala Although there is great potential to strengthen the livestock industry, this is only sustainable under conditions of climate change with the concomitant development of infrastructure (e.g. watering points to allow for rotational grazing, slaughterhouse), livestock health services, and sustainable rangeland management practices. In the absence of such development, increasing animal numbers as an adaptation could lead to longer term environmental degradation and erosion of productive natural capital.

Gbetibouo (2009) reported that the eight adaptation measures adapted by the farmers in the Limpopo River Basin to tackle the increased temperature were: planted different crops (6.86 %), changed crop variety (3.00 %), changed planting dates (3.69 %),

increased irrigation (3.96 %), used crop diversification (1.00 %), changed the amount of land under cultivation or grazed (3.43 %) and invested in livestock by buying feed supplements (3.69 %). Other adaptation measures were cited by 5 per cent of farmers.

Gilier *et al.* (2009) stated that though sustainable land management activities increase productivity in the medium to long run through improved soil characteristics and water retention, but in the short run, cultivation intensities and yields can decline.

Gwimbi (2009) reported that the cotton farmers were of the view that their solution to climate change depended on the use of irrigation (31.00%), diversification into cotton varieties that were more drought-resistant ones (10.00%), diversifying into other crops (11.00%), or alternatively, timing the planting period to coincide with the onset of the rains (14.00%). Majority of the respondents (71.00%) opted for short-season hybrid varieties because the growing season was getting shorter. Farmers noted that rainfall patterns had hindered the growing of long-season cotton varieties.

Mertz *et al.* (2009) revealed that farmers in the Sahel have adopted the coping and adaptation strategies which included traditional crop diversification, mobility, livelihood diversification and migration.

Tabi *et al.* (2002) expressed that farmers use a combination of adaptation strategies from the five different choices recorded in the region. The most frequently used strategy is varying time of planting (81.00%) and the least, water management control practice (43.00%). Use of fertilizers (70.00%), choice of variety (65.00%) and use of herbicide (62.00%) were the second, third and fourth adaptation choices.

Akponikpe *et al.* (2010) reported that the farmers have adopted water and soil conservation strategies to deal with the prolonged lack of rain. Most farmers also delay planting to adapt to the delayed rains.

Anil *et al.* (2010) observed that 51.25 per cent, 35.00 per cent and 13.75 per cent of the respondents had medium, high and low extent of adoption of cultural practices for water and soil conservation respectively. As regard to mechanical practices, majority (46.25%) of the respondents had medium, 36.25 per cent and 17.50 per cent had low and high extent of adoption of mechanical practices for water and soil conservation. In case of horticultural practices, 38.75 per cent respondents showed high level of adoption, while 36.25 and 25.00 per cent respondents had medium and low level of adoption of horticultural practices. In case of vegetative practices, majority of the respondents i.e. 48.75

per cent had medium extent of adoption of vegetative practices for water and soil conservation. Thus, there was a considerable variation in the extent of adoption of various watershed development practices. The extent of adoption of vegetative practices by the respondents was low followed by mechanical practices as compared to rest of the selected practices.

Fosu-Mensah *et al.* (2010) found that main adaptation strategies reported by farmers are crop diversification and changing planting dates.

Acquah de Graft (2011) assessed that the farmers' level of adaptation was found to be relatively high with majority of the farmers' stating that: planting different varieties of crops, changing planting dates, and soil and water conservation are the main adaptation measures taken to cope with climate change.

Branca *et al.* (2011) undertook a comprehensive meta-analysis of SLM practices and found that improved agronomic practices such as cover crops, crop rotations (especially with legumes) and improved varieties have increased cereal productivity by 116 per cent on average whereas agroforestry is associated with a 69 per cent increase. Tillage management and agroforestry were found to be particularly beneficial in dry agricultural areas.

James *et al*. (2013) stated that the majority of farmers in Sub-Sahara Africa have adopted crop diversification, planting different crop varieties, changing planting and harvesting dates to correspond to the changing pattern of precipitation, irrigation, planting tree crops, water and soil conservation techniques and switching to non-farm income activities.

Nyanga *et al.* (2011) revealed that crop diversification, conservation agriculture and gardening are the common adaptation measures used by farmers, while increasing livestock diversity and seeking support from veterinary officers are the measures taken by pastoral farmers.

Nzeadibe *et al.* (2011) found that the varying strategies have been adopted by farmers in the Niger Delta for climate change adaptation were 80.20 per cent planted with early rainfall followed by 77.20 per cent adopted mixed farming, 75.80 used proper preservation of seeds as an adaptive strategy. Similarly, 74.20 per cent adopted use of inorganic manure; 72.00 per cent utilized organic manure, cover cropping was used by 71.80 per cent, increase number of weeding of cropped land accounted for 67.50 per cent

used by farmers. Other noteworthy adaptive measures reported included protection of water sheds/mulching (64.50%), listening to information on climate change (59.20%), use of minimum/zero tillage (57.20%) and afforestation (56.00%) in cushioning the effects of climate change.

Pynbianglang Kharumnuid (2011) indicated that majority of the potato growers had medium adaptation to climate change (42.50%), followed by high (30.00%) and low (27.50%) adaptation to climate change.

Thaddeus Chidi Nzeadible *et al*. (2011) reported that 77.20 per cent of farmers adopted mixed farming; 75.80 per cent used proper preservation of seeds as an adaptive strategy, 74.20 per cent adopted use of inorganic manure, 80.20 per cent of farmers planted with early rain fall in the Nigeria delta region of Nigeria.

Sofoluwe *et al.* (2011) stated that late planting, irrigation, soil conservation, planting different crop varieties are the common adaptation strategies used by the farmers.

Pathak *et al.* (2012) identified ten adaptations option having the highest priority in mitigating climatic vulnerability flowing experts ranking. These options were climate ready crop varieties, water-saving technologies, changing planting dates, fanning system, growing different crops, integrated pest management, crop insurance, conservation agriculture, improved weather-based agro-advisory and improved nutrient management.

Yadav *et al.* (2012) reported that drip irrigation technologies were essential to generate income and alleviate poverty of the small farmers. Drip irrigation mechanisms water loss due to run-off and deep percolation and water savings of 50-80 per cent were achieved when compared with most traditional surface irrigation methods.

Hussain *et al.* (2013) found that Crop adaptation strategies viz., changes from long to short duration varieties (75%), changes in planting dates (85%), changes in quantity of seeds, fertilizer application, number of irrigation and spacing was adopted by majority (73%) of the farmers.

Kesava Rao *et al.*(2013) found that the Breeding of varieties tolerant to higher temperature and adoption of better water management (both in-situ and ex-situ) practices achieved through integrated watershed approach could play a major role in sustaining pigeon pea productivity under future climate scenarios.

James *et al.* (2013) stated that the farmers have adopted crop diversification, planting different crop varieties, changing planting and harvesting dates to correspond to the changing pattern of precipitation, irrigation, planting tree crops, water and soil conservation techniques, and switching to non-farm income activities.

Nagaraj *et al.*(2013) found that with diffusion of innovations, provision of quality seeds, efficient input delivery and market linkage, more than 75 per cent of the farmers benefitted through bridging the productivity gaps and there by enhanced income in both crop and livestock sectors. The welfare gains accrued to the farming community are evident due to cost effective technologies in harsh agro climatic conditions.

Rajkumar *et al.* (2013) found that the temporal trends in phenology parameters are showing an early shift in kharif season as well as a general reduction in its duration. Partly these trends could be the result of adaptation to increasing rainfall deficit with time.

Srinivasarao *et al.*(2013a) found that the strategies are crop residue recycling, farmyard manure (FYM) additions, inclusion of legumes in the system, legume cover crops, growing green manure crops (dhaincha, sunhemp), green leaf manures (gliricidia), composting, vermin composting and tank silt application. Crop residues of rainfed crops such as cotton, castor, pigeon pea, maize etc were chopped and left on the surface of soil to act as a mulch-cum-manuring. Soil organic carbon (SOC) improvement in farmer's fields registered with continuous carbon management practices, resulted in increase available soil moisture retention by 2-3 percent in the soil. Thus, improved SOC mediated in higher water retention.

Gry Synnevag *et al.*(2014) found that Coping and adaptation mechanisms to which farmers have resorted include selling labor, land leasing, shifts in crop and livestock systems, use of early maturing, drought and disease resistant varieties, small scale irrigation systems, gardening, increased use of crop residues as animal feed, diversification to off farm activities, and petty trade.

Philip *et al.* (2014) stated that the Small holder households use stone/grass/mud bonding, organic manure application as indigenous coping strategies.

Sujit (2014) found that the adaptive capacities of the farmers were enhanced through different technological interventions and through capacity building Programme of NICRA.

Simpson and Burpee (2014) reported that the positive benefits of most NRM changes took time to manifest and were easily masked by seasonal stresses.

Khorshed (2015) stated that the farmers' alternative adaptation choices were sustainable irrigation practices and an understanding of the characteristics of farms and farming households to frame better strategies to cope with water-stressed regimes in drought-prone environments.

Jasna (2015) found that the soil health cards, farm ponds, check dams and its renovation, red gram verities BRG1 and BRG2, ragi- redgram cropping system, preventive vaccination of animals were the most adopted interventions under various categories recommended by NICRA.

2.5 Relationship between profile characteristics of respondents and level of adoption of technologies

Waman *et al.*(1998) found that the level of education, size of family, interest in modern farming and sources of information were the main factors, which significantly influenced behavior of the small farmers regarding new farm technology.

Soni *et al.* (2000) stated that there was a positive association between the socio-economic characteristics of farmers and the extent of adoption of modern technologies. The findings also showed that lack of knowledge was major obstacles in adopting improved varieties of crops and plant protection. Moreover, high fertilizer's cost was also one of the reasons for non-adoption of farm technology.

Antle and Diagana (2003) reported that scarcity of information and thin credit and insurance market reduce adoption incentives.

Rahman and Yamao (2006) expressed that farmers' education is significantly positively related to their attitude towards participatory resource management.

Marenya and Barrett (2007) revealed that the size of the farm owned by a household, the value of its livestock, off-farm income, family labour supply and the educational attainment and gender of the household head all had a significant positive effect on the likelihood of adoption of NRM activities.

Nhemachena and Hassan (2007) revealed that years of farming experience, access to extension services, access to credit facilities and markets are the significant determinants of adaptations to climate change in the region.

Deressa *et al.* (2008) found that the level of education, age, sex and household size of farmers were found to be significant determinants of adaptation to climate change in the

study area. Also farmers in different agroecological settings employ different adaptation methods.

Sitaula (2008) revealed that training and capacity building lead to better participation of the stakeholders in NRM.

Apata *et al.* (2009) analysed that farming experience and access to education were found to promote adaptation. This implies that educating farmers to improve their awareness of potential benefits of adaptation is an important policy measure.

Gbetibouo (2009) argues that farmers with access to extension services in South Africa are likely to perceive changes in the climate because extension services provide information about climate and weather. Consequently, awareness and perceptions of changes in climatic conditions shape action or inaction on the problem of climate change.

Fosu-Mensah *et al.* (2010) found that land tenure, soil fertility levels, access to extension services, access to credit and the community in which the farmers lived were found to be the significant determinants of their choice of adaptation measures farmers took.

Acquah-de Graft and Onumah (2011) found that the significant determinants of adaptation to climate change are age, gender, years of education, years of farming experience, own farm land and other income generating activities.

Sofoluwe *et al.* (2011) stated that the regression results showed that livestock ownership, access to loans, off farm income generation, gender and household size are the significant determinants of adapting to climate change impacts.

Anil *et al.* (2010) revealed that extent of adoption showed positive correlation with education, size of family, size of land holding, annual income, occupation, attitude towards watershed programme, irrigation facilities, credit facilities, agricultural innovations and communicational sources at 1.00 per cent level of significance, while its association with age was found negative and highly significant. Caste and possession of agricultural assets did not show significant relationship with overall adoption of watershed technologies. It indicated that respondent's education, size of family, land holding size, annual income, occupation, attitude, irrigation and credit facilities, agricultural innovations and communication sources did positively affected the respondent's adoption of watershed technologies while the remaining variables did not effect.

Latha *et al.* (2012) concluded that the small and medium rained farmer wen highly vulnerable to ell mute change and to a larger extent the small and medium rainfed farmers adopted coping mechanism for climate change compared to large farmer.

Ahmed (2013) revealed that the distribution of adopter household is not uniform across the size group of farm household. It was observed that there were some factors, which were mainly responsible for the adoption of new technology in agriculture, these factors were: farm size, income, risk taking ability, irrigation facility, use of fertilizers, credit facility, education, market price, age and information accessibility, (negatively related with adoption)

James *et al.* (2013) stated that the years of farming experience, household size, years of education, access to credit facilities, access to extension services and off-farm income are among the significant determinants of adopting climate change adaptation measures.

Tagel Gebrehiwot and Anne van der Veen (2013) stated that level of education, age and wealth of the head of the household; access to credit and agricultural services; information on climate and temperature all influence farmers' choices of adaptation.

Khorshed (2015) stated that farmers with more experience of farming, better schooling, more secure tenure rights, better access to electricity and institutional facilities were more likely to adopt alternative adaptation strategies.

Jasna (2015) found that the most important factors responsible for adoption of climate resilient technologies among farmers were experience in farming and leased-in land area.

She further reported that a considerable significance in difference of crop diversification, land area irrigated during kharif, rabi and summer irrigation frequency achieved between NICRA and non NICRA farmers.

2.6 Problems and suggestions elicited by the respondents in adoption of technologies for Climate Resilient Agriculture

Singh (1991) communicated that unless the programme clientele that is beneficiary farmers are convinced that it is in their own personal interest to protect their soil erosion and to harvest, store and conserve rain-water and spend their energy and money in construction, repair and maintenance of necessary soil and water conservation structures, can the soil and water conservation programme succeed.

Kulkarni and Sangle (1993) examined the constraints in execution of the Phuldhaba watershed project activities. The major economic constraints as expressed by farmers were untimely credit, insufficient credit and high rate of interest and rigidity of loan norms.

Eswarappa (1991) revealed that the major constraints expressed by the beneficiaries of watershed were marginal productivity of the dry lands, undulating topography and poor soil fertility, poor resource base of the farmers, requirement of high level management for the adoption of dry land technologies. Therefore, administration and implementing workers must take care of these problems by a strong technical support and integration of other input and credit institutions at grass root level so that more and more voluntary participation of farmers in watershed activities can be encouraged.

Raju (2002) revealed that the most important constraints encountered by the respondents in adoption of sustainable farming were appearance of periodical drought spells during cultivation (bio-physical), poor economic status of the farmers (micro level), lack of pest and disease resistant varieties (technical), high cost of neem related products, inadequate and untimely supply of agricultural inputs and lack of training facilities (extension).

Raju (2002) revealed that the most important suggestions given by the respondents were sound research on ecological farming practices, made available the biofertlizer and neem based products on subsidized rates by government, establishment of bio-gas plants for getting more organic manure, strengthening of the extension system to immediate dissemination of proven sustainable farming.

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 are the major suggestions offered by the farmers for effective implementation of NWDPRA in rainfed areas.

Nhemachena and Hassan (2007) found that lack of credit facilities and information on adaptation options and insufficient inputs are the main barriers to adopting any climate change adaptation options.

Deressa *et al.* (2008) reported that the reasons for not adapting are lack of information on climate change impacts and adaptation technologies, lack of financial resources, labour constraints and land shortages.

Anil *et al.* (2010) revealed that illiteracy (71.25%), lack of capital (65.00%), complexity of loan procedures (62.50%), high cost of fertilizer and seed (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.

Tschopp *et al.* (2010) revealed that less than 2.00 per cent of the respondents perceived and understood land degradation and subsequent reduced land fertility were constraints for sustainable food production under dry land area.

Acquah-de Graft (2011) identified that lack of information on climate change impacts and adaptation options, lack of access to credit, access to water, high cost of adaptation, insecure property rights and lack of access to sufficient farm inputs as the main barriers to the adoption of any adaptation measure.

Sofoluwe *et al.* (2011) stated that lack of information on climate change impacts and access to credit, labour shortages, shortage of land and poor potential for irrigation are the barriers to adapting to the perceived changes in climatic conditions.

Nzeadibe *et al.* (2011) stated that the main factors that prevent farmers from adapting to climate change impacts were found to include: information asymmetry, irregularities of extension services, poor government attention to climate problems, inability to access available information and improved crop varieties/seeds, ineffectiveness of indigenous methods, no subsidies on planting materials, limited knowledge on adaptation measures, low institutional capacity, and absence of government policy on climate change.

Gandure *et al.* (2012) investigated that the barriers to adaptations to climate change included lack of access to early warning information and unreliability of seasonal forecast. Farmers also reported that lack of access to adequate cropland was a barrier to adapting to climate change.

Ahmed (2013) documented the constraints of adoption of new technology in agriculture. Most of the farmers were well informed about the new development in agriculture and they were ready to adopt the new farming technology but were not in a position to adopt the improved technology at full scale due to certain constraints faced by them in day-to-day life. The constraints mentioned by farmers were classified into the economic constraints, input constraints, guidance and training constraints, and general constraints.

1. Economic constraints comprises the following items
    a. Lack of own capital
    b. Inadequate institutional credit
    c. High rate of interest of non-institutional credit
    d. Lack of collateral of farmers and complex procedure in obtaining credit
2. Input constraints comprise the following items:
    a. Impurity of seeds
    b. High cost of HYV seeds
    c. High cost of fertilizers
    d. Inadequate irrigation facilities
    e. High rate irrigation charge of private pumping sets
    f. Erratic supply of electricity
    g. Insufficient availability of effective and pure chemicals, pesticides insecticides etc
3. Guidance and training constraints consists of the following items:
    a. Lack of information about new technology
    b. Lesser contact with extension agencies
    c. Lack of knowledge of various development programmes to uplift the poor farmers

4. General constraints comprise the following issues:

a. Low price of agricultural produce
b. More proneness of HYV seeds to diseases
d. Lack of cold storage
e. Transport problem
f. Problem of regulated market
g. Lack of education
h. Problems of soil testing, water testing, soil salinity etc
i. Environmental problem

Hussain *et al*. (2013) found that farmers (>90 numbers) have stressed on provision for early warning system, awareness creation among farmers about climate change, timely supply of inputs and provision of financial support for soil nutrient enrichment.

Nzeadibe *et al.* (2011) found that farmers have stressed on the involvement of the state through legislature is very important in aiding climate change adaptation.

Tagel Gebrehiwot and Anne van der Veen (2013) stated that Moreover, lack of information on adaptation measures and lack of finance are seen as the main factors inhibiting adaptation to climate change.

Philip *et al.* (2014) stated that the problem was more acute for the poor, landless, women, large sized families, un affordability of agricultural inputs, and water shortage. The study suggests further studies should be conducted to identify, scientifically proof and document the available coping mechanisms, indigenous knowledge/ and innovation.

2.7 Strategies for transfer of technologies for Climate Resilient Agriculture

Kumar (2000) reported that there is a need for ensuring peoples participation in terms of their choices and preferences they could be brought into decision making process from the stages of research to technology diffusion and its adaptation or we can say that scientific technology should be blended with knowledge of the peoples.

Samantha (2001) suggested that participation of farmers, extension workers and research scientists in technology development and its dissemination processes not only help to develop feasible, economically viable and appropriate technology but also creates an environment where all these actors help each other mutually for the development of agriculture in totality. In the process research scientists are tremendously benefited by evolving technologies in consultation with the farmers and extension workers, which help to earn recognition and credit in the scientific community. The extension workers may be able to disseminate the technological information to the farmers which are easily acceptable.

Lyamchai *et al.* (2005) suggested that integration of farmers' knowledge with the scientific knowledge has shown to increase productivity in Lushoto. Capturing local innovations and integrating them in research, extension and development activities, adoptable and sustainable solutions can be found and scaled up. However, the majority of R & D staff is yet convinced that farmers are full conversant of their environment and have immense local knowledge which when tapped and complemented with the scientific knowledge, can revolutionize agriculture of the rural poor communities.

Florent and Paul (2006) reported that giving recognition and value to local innovations is crucial to institutionalise them in the formal research and development system, in order to contribute to community empowerment and rural development. To achieve this, a validation or screening process is an important intermediary step. At this stage of the Participatory Adaptation and Diffusion of Technologies for Rice-Based Systems project, we cannot pin down best-bet methodological steps. However, we have learnt that the validation process is context-specific, based on project objectives and largely influenced by the participants' background and perceptions. Abroad stakeholder representation and good facilitation will add to the quality of the process and will avoid any inappropriate local innovations being scaled up.

Agwu *et al*. (2008) suggested that government should encourage and promote farmers and private sector innovation by enacting favourable policies (patenting, reward

system), while extension administrators should be trained to build capabilities to facilitate, analyze and promote farmer innovations.

James *et al*. (2013) suggested that to enable Sub-Sahara African farmers to develop more effective climate change adaptation strategies, there is the need for African governments to support farmers by providing the necessary resources such as credit, information and extension workers to train farmers on climate change adaptation strategies and technologies, and investing in climate resilient projects like, improving on existing or building new water infrastructure and building climate change monitoring and reporting stations.

Sreenivasarao and Sireesha (2013) suggested a comprehensive strategy involving all the stakeholders (ICAR,SAUs, Scientists & Extension personnel) for scaling up of farmers innovations which include documentation, participatory research, separate cell for business, extension activities, Agritourism, networking of farmer innovators etc.

Praveen (2014) suggested a comprehensive strategy for effective promotion of ITKs in dissemination through documentation of ITKs, test verification of scientific rational of ITKs, Validation of rational ITKs, Documentation of valid ITK, Establishment of separate cell and fund for protection of ITKs, IPR/GI issues, Market intelligence cells and incubators for commercialisation of ITKs, networking of tribal potential farmer leaders and potential farmers are potential disseminators.

Justice and Tobias (2014) emphasised that our findings do not imply the promotion of farmer innovation at the neglect of modern agricultural technologies. Farmer innovation cannot replace formal research. The findings on the heterogeneous welfare effects for non-innovators even suggest that farm households engage in other important activities which contribute to well-being; hence, the focus should not be solely on farmer innovation. Our results only strengthen arguments for better support for farmer innovation as a complement to externally promoted technologies in efforts to reduce poverty and attain food security.

2.8. CONCEPTUAL FRAME WORK AND DERIVATION OF HYPOTHESES

A conceptual frame work or schematic model is a diagrammatic representation outlining the dominant elements of a system, and their inter relationship with respective criterion variable. In the light of the inference derived from evidence in the literature, conceptual frame work was thus established (Figure 2.1.)This represents the important dimensions and postulated relationship among the variables. Seventeen independent

variables related characteristics of the rainfed farmer'swere chosen based on the review of literature and in consultation with experts to examine the nature and extent of relationships. These are represented in a conceptual model which helped to derive hypothesis for empirical testing.

2.8.1 Hypotheses

The study deals with the factors contributing to the extent of adoption of farmers towards climate resilient agriculture.

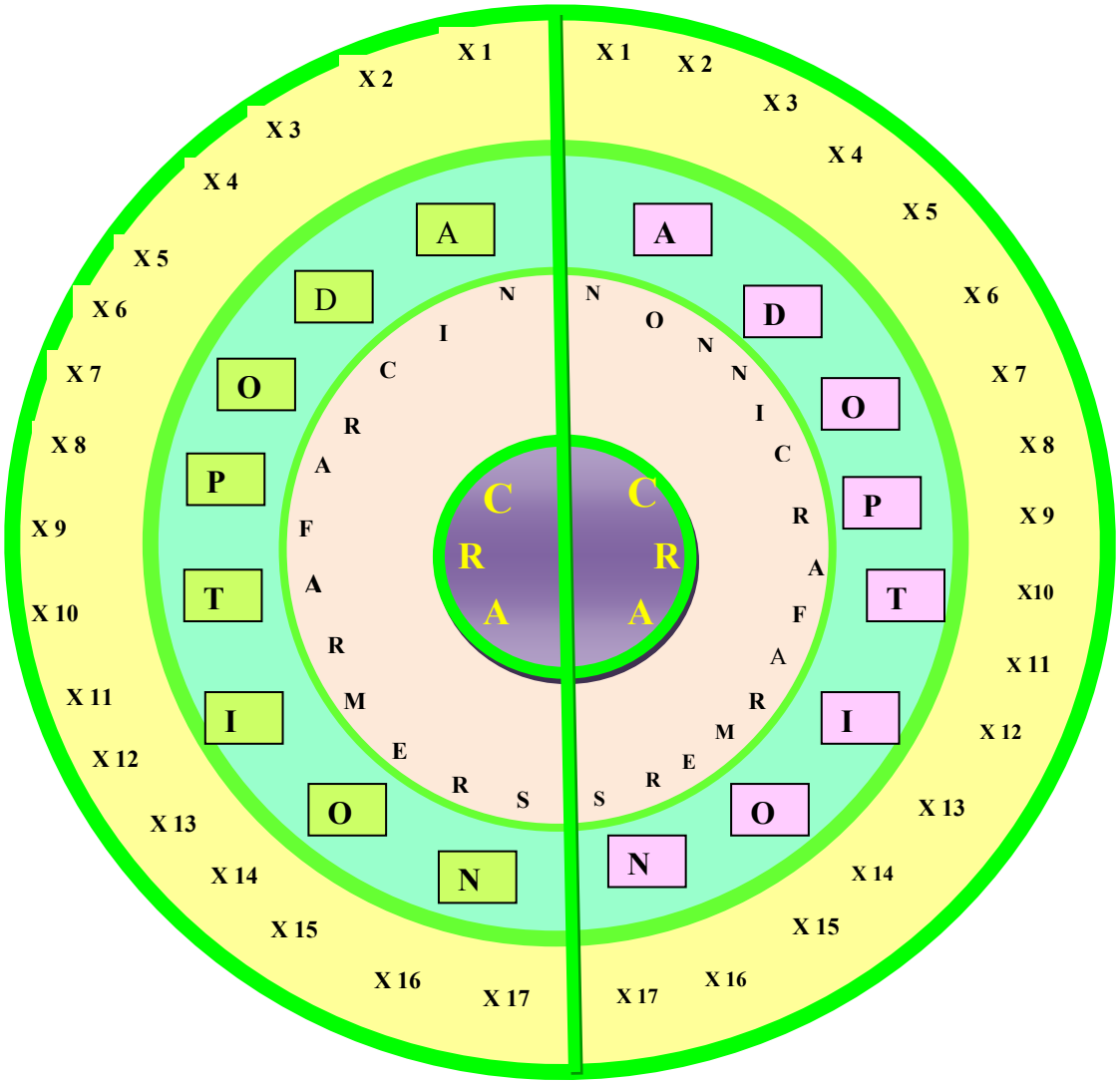


Fig.2.1Conceptual model of the study

Profile Characteristics	
Age	X1
Education	X2
Farming experience	X3
Farm size	X4
Availability of water resources	X5
Frequency of occurrence of drought	X6
Farming systems	X7
Socio Economic Status	X8
Social affiliation	X9
Trainings undergone on CRA.	X10
Sources of Information Utilisation	X11
Credit availability	X12
Food security	X13
Traditionalism	X14
Risk taking ability	X15
Weather based Agro Advisory services	X16
Community Infrastructural facilities	X17

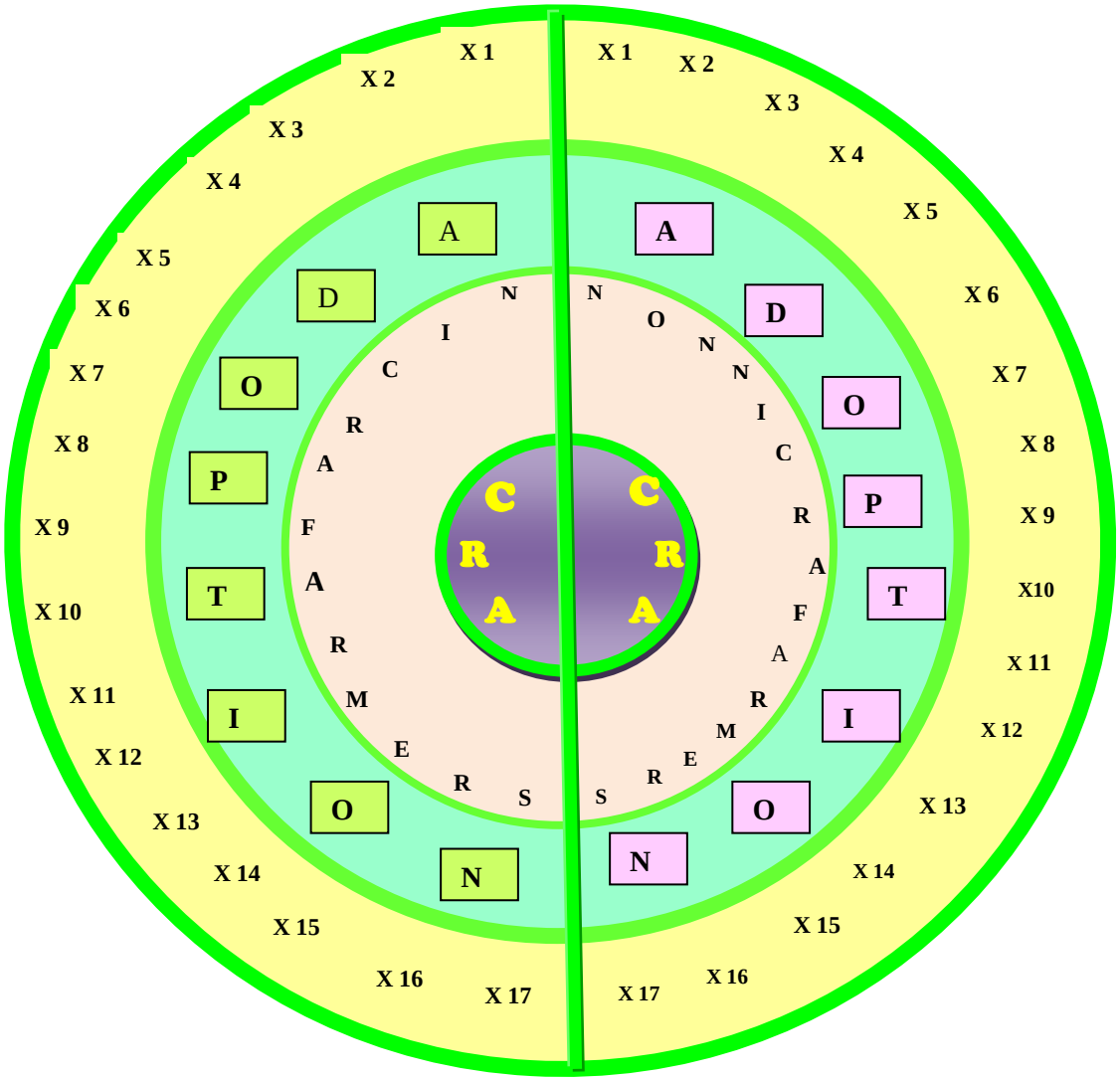


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Trainings undergone on CRA.	X10
Sources of Information Utilisation	X11
Credit availability	X12
Food security	X13
Traditionalism	X14
Risk taking ability	X15
Weather based Agro Advisory services	X16
Community Infrastructural facilities	X17

Chapter III

MATERIAL AND METHODS

This chapter deals with research design, sampling procedure, variables and their measurement, tools of data collection, statistical tests used and analytical procedures followed to interpret the data of the present study. The details of the methodology followed in the present investigation were presented under the following heads.

3.1 Research design

3.2 Sampling procedure

3.3 PRA tolls used

3.4 Variables and their empirical measurement

3.5 Collection of data

3.6 Statistical tools used

3.7 Preparation of report

3.1 RESEARCH DESIGN

Ex post facto research design was followed for carrying out the study, as the variables selected for the study have already occurred. *Ex post facto* research design is systematic empirical enquiry in which the independent variables are not directly manipulated because they have already occurred or they are inherently not manipulatable. Keeping in view the type of variables under consideration, size of respondents and phenomenon to be studied, the ex-post facto research design was selected as an appropriate research design.

3.2 SAMPLING PROCEDURE

3.2.1 Locale of the study

The States of Telangana and Andhra Pradesh were selected purposively for the study. As the investigator was familiar with the local language, which would help to build up quick rapport and also enable in-depth study combined with personal observation.

3.2.2 Selection of the District

Nalgonda district from the Telangana state and Anantapur from the Andhra Pradesh were selected purposively, as they were covered under NICRA where the CRA technologies introduced.

3.2.3 Selection of mandals

One mandal was purposively selected from each district for the study.

3.2.4 Selection of villages

Two NICRA adopted villages and two non NICRA villages were selected from each mandal. Thus total four NICRA villages and four NON NICRA villages were selected the study.

3.2.5 Selection of respondents

From each village 30 farmers were selected at random to make a sample of 120 respondents from NICRA adopted villages and 120 respondents from non NICRA villages for the study.

3.3 VARIABLES AND THEIR EMPIRICAL MEASUREMENT

Relevant variables were identified in consultation with experts, and also based on extensive review of related literature. The Table 3.1 shows the different variables selected for the study.

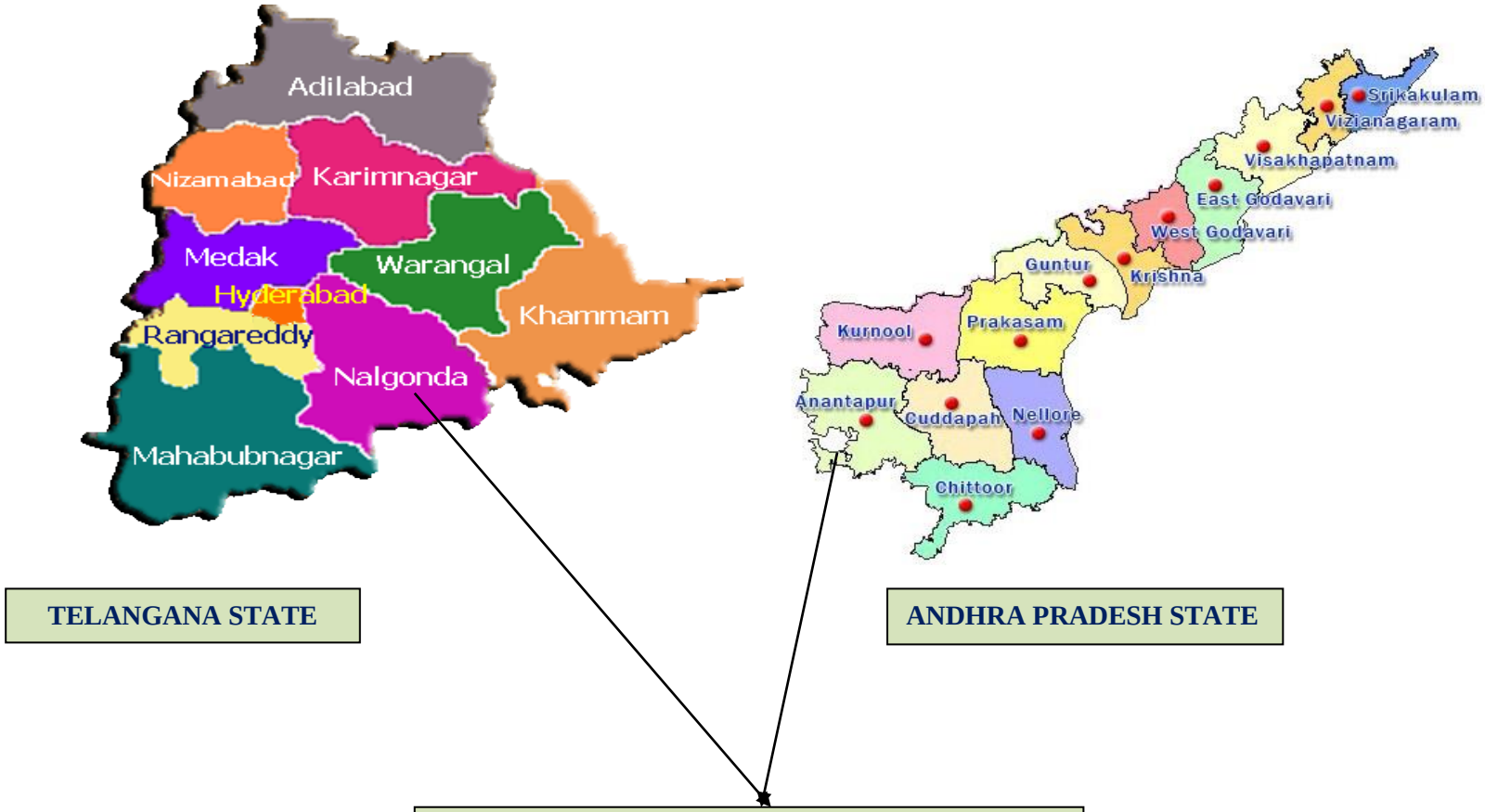


Fig. 3.1 Regions covered under study



Fig: 3.2. Geographical location of the study in Telangana region

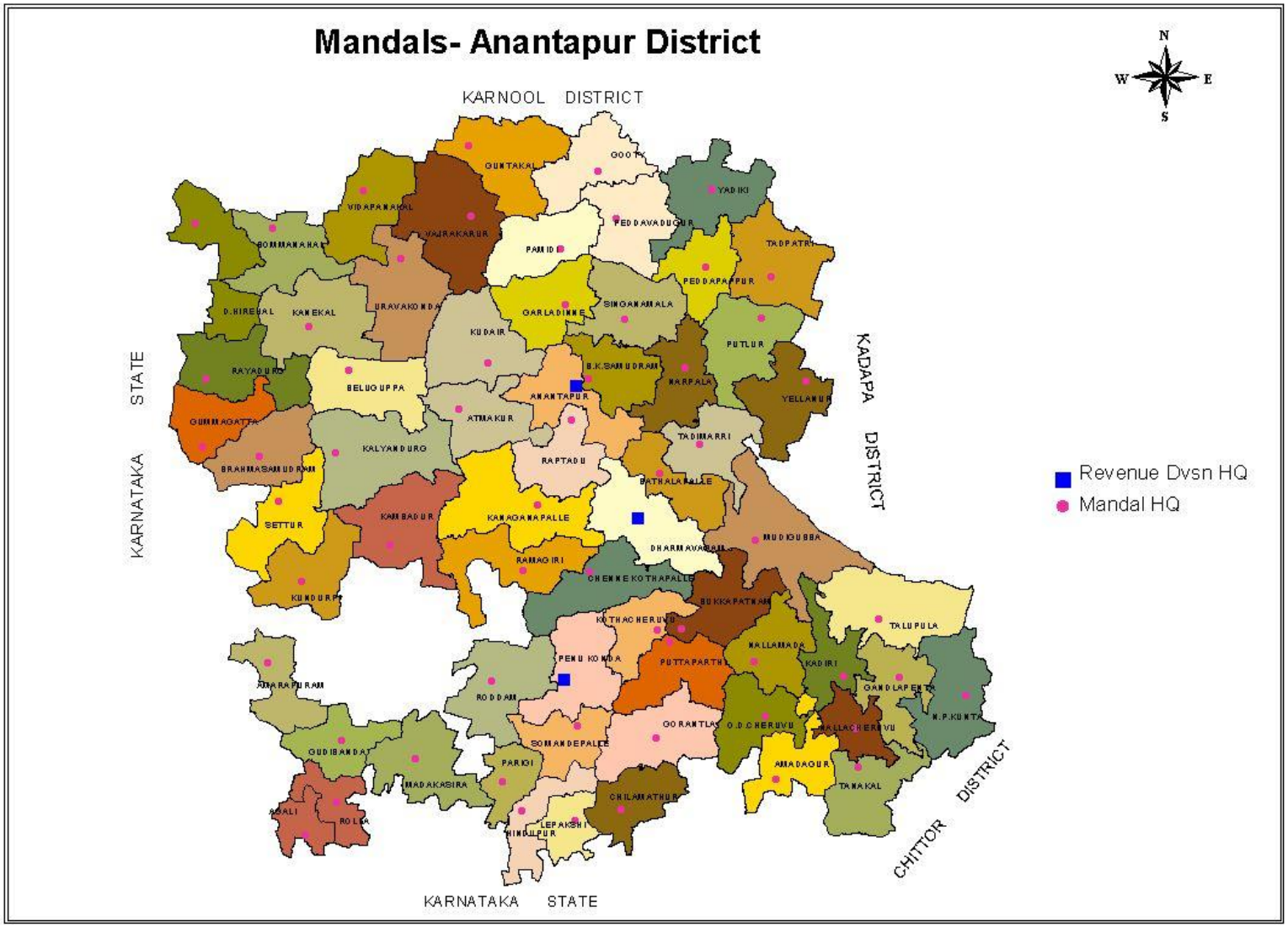

Mandals- Anantapur District
KARNOOL DISTRICT
KARNATAKA STATE
KADAPA DISTRICT
CHITTOR DISTRICT
KARNATAKA STATE
N
W
E
S
Revenue Dvsn HQ
Mandal HQ
GUNTAKAL
GOOTY
YADIKI
VIDAPANAKAL
VAJRAKARUR
PAMIDI
PEDDAVADUGUR
TADPATRI
BOMMANAHAL
PEDDAPAPPUR
D.HIREHAL
KAMEKAL
URAVAKONDA
GARLADINNE
SINGANAMALA
KUDAIR
PUTLUR
RAYADURG
B.K.SAMUDRAM
NARPALA
BELUGUPPA
ANANTAPUR
YELLANUR
GUMMAGATTA
ATMAKUR
TADIMARRI
KALYANDURG
RAPTADU
BRAHMASAMUDRAM
BATHALAPALLE
SETTUR
KAMBADUR
KANAGANAPALLE
MUDIGUBBA
DHARMAVARAM
RAMAGIRI
CHENNEKOTHAPALLE
KUNDURPI
BUKKAPATNAM
KOTHACHERUVU
TALUPULA
PENUKONDA
PUTTAPARTHI
KADIRI
AMARAPURAM
RODDAM
GORANTLA
O.D.CHERUVU
GUDIBANDA
SOMANDEPALLE
AMADAGUR
PARIGI
MADAKASIRA
TANAKAL
CHILAMATHUR
AGALI
ROLLA
LEPAKSHI
HINDUPUR

Fig: 3.3. Geographical location of the study in Andhra region

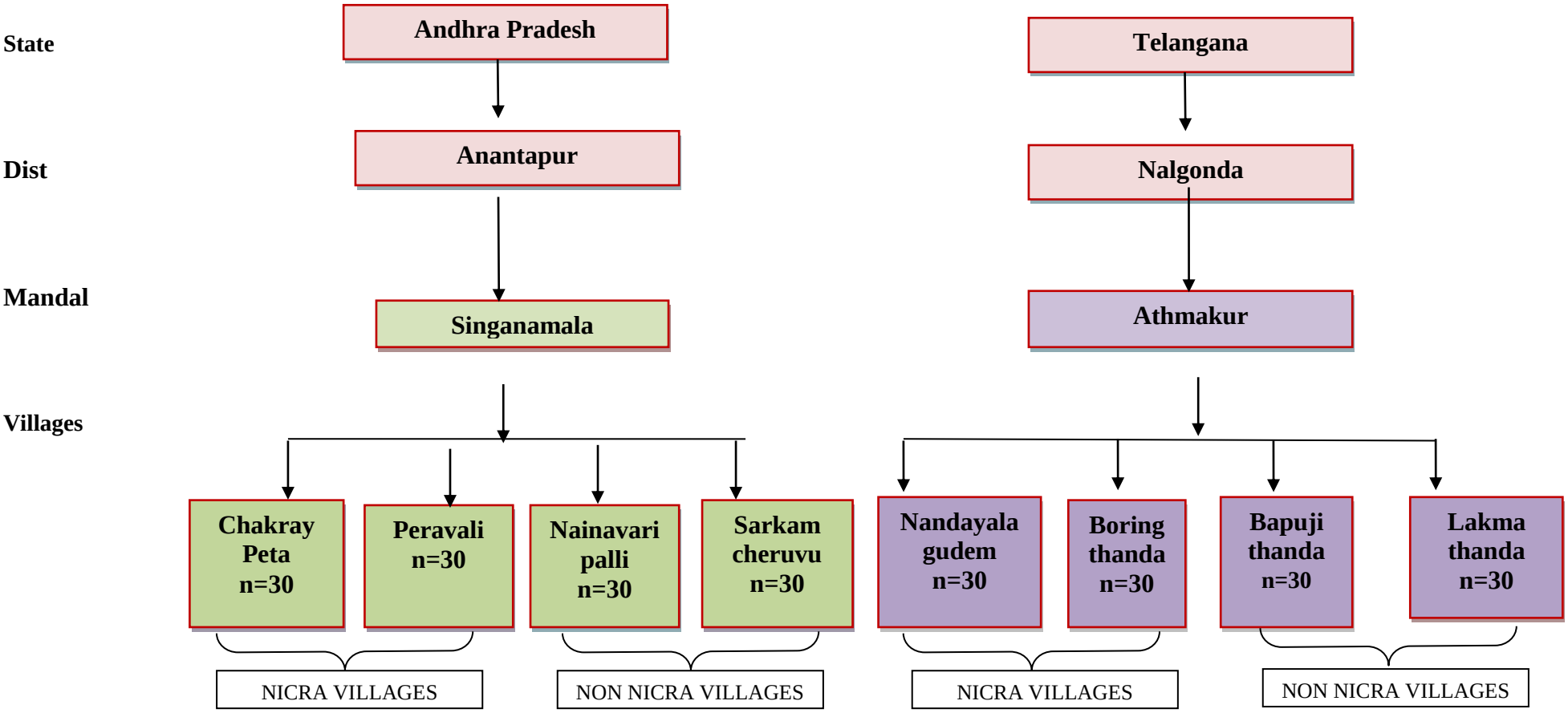


Fig. 3.4 Sampling procedure followed in the study

Table 3.1. Variables and their empirical measurement

S. No	Variables	Measurement
I	**Dependent variables**	
A.	Adaptive Capacity 1) Climate readiness 2) Attitude towards Climate resilient agriculture	 Schedule developed for the study Scale developed for the study
B.	Level of adoption of Climate resilient agriculture technologies and Coping mechanisms	Schedule developed for the study
II	**Independent variables (Socio economic and Personal variables)**	
1	Age	Chronological Age
2	Education	Number of years of formal education
3	Farm size	Schedule used by Agricultural census (2010-11) adopted for the study
4	Availability of water resources	Schedule developed for the study
5	Frequency of occurrence of drought	Schedule developed for the study
6	Farming systems	Schedule developed by Chitra (2010) adopted for the study with suitable modifications
7	Socio Economic Status	Schedule developed by Swathi (2012) adopted for the study with suitable modifications
8	Farming experience	Schedule developed for the study
9	Social affiliation	Schedule developed by Swetha (2013) adopted for the study with suitable modifications
10	Trainings undergone on CRA.	Schedule developed for the study
11	Sources of Information Utilisation	Schedule developed for the study
12	Credit availability	Schedule developed for the study
13	Food security	Household Food Insecurity Access Scale (HFIAS) used by Jennifer *et al.*(2007) adopted for the study with suitable modifications

14	Traditionalism	Scale developed by Swathi (2012) adopted for the study with suitable modifications
15	Risk taking ability	Schedule developed by Archana (2012) adopted for the study with suitable modifications
16	Weather based Agro Advisory services	Schedule developed for the study
17	Community Infrastructural facilities	Schedule developed for the study
III.	**Participatory approaches**	PRA techniques were used

3.3.1 Dependent variables

3.3.1.1 Adaptive capacity: It is defined as the ability of the farmer to adjust to climate change with special focus on drought, to take advantage of opportunities, or to cope with the consequences or that enhance their adaptive capacity to CRA.

This Adaptive capacity for the purpose of the study was measured was divided into two different sub headings, first one climate readiness and other one was attitude of respondents. Thus Adaptive capacity was operationally defined for the purpose of present study as respondent's climate readiness and attitude towards CRA.

The description and details of variables and their measurement are given under the following subheads:

3.3.1.1.1 Climate Readiness: It was operationalized as "the extent to which a respondent is ready to face the effects of climate change especially drought".

For measuring this variable, with extensive review of literature and consultation of experts a set of statements were prepared. After pre testing very easy, very difficult and ambiguous questions were removed. Finally, under this variable 10 statements were included in the schedule. For all the statements included in this variable, respondent's responses were elicited on a four point continuum of always, sometimes, rarely and never. A score of three, two, one and zero were assigned these categories respectively. The maximum and minimum possible scores were 30 and 0 respectively. The total score of a respondent is computed by summing up the scores he/she has obtained for each and every statement of the variable. Based on the actual scores, the highest (39) and lowest scores (5)

were considered and range was calculated, then the respondents were grouped into five categories of very low, low, medium, high and very high based on the inclusive class interval technique. The results were expressed in the form of frequencies and percentages.

Categorization: The respondents were grouped into following five categories i.e. Very low, low, medium, high and very high for managing drought based on inclusive class interval technique.

S. No.	Category	Class interval
1.	Very low	5-11
2.	Low	12-18
3.	Medium	19-25
4.	High	26-32
5.	Very high	33-39

3.3.1.1.2 Attitude towards different CRA

Attitude: It was operationally defined as the degree of positive or negative feeling of respondents towards CRA.

Development and standardization of attitude scale:

ATTITUDE

Attitude is the positive or negative feeling associated with a psychological object as suggested by Edwards and Kilpatrick (1948). Katz (1960); Katz and Stotland (1959); Sarnoff and Katz (1954) and Smith *et al.* (1956) reported that people hold and express a particular attitude because they derive psychological benefit by doing so.

Edwards (1957) defined attitude as the degree of positive or negative affect associated with some psychological object.

Attitude strength is an important determinant of the attitude-behavior relationship. Strong attitudes are based on past knowledge and may be retrieved, whereas weak attitude is often constructed on the spot. Strong attitudes have more impact on behavior, are less susceptible to self-perception effects and are more stable over time (Holland *et al.,* 2002). Attitudes are relatively stable and once formed, provide a long-term positive effect (Olgyaiova *et al.,* 2005). Attitude of an individual varies significantly when working in a group.

Attitude in the study operationally defined as the degree of positive or negative feeling of farmers towards the CRA and specific CRA technologies of Nalgonda and Anantapur districts. A scale was developed to appraise the attitude.

3.3.1.1.2.1 Choice of Technique for Measurement

In order to develop a scale to measure the attitude Scalogram analysis was chosen which is popularly known as Guttman Scale or a Cumulative scale.

Guttman Scale was chosen because the psychological object being studied here is about the unidimensional in nature of attitude and the Guttman scale is unidimensional scale. When the human beings can be ordered on a single continuum from the least to the most favorable attitude with regard to a psychological object, then the psychological continuum is regarded as a unidimensional in nature. Thus attitude is unidimensional. Scalogram analysis is a unidimensional scale (Edwards,1969). Hence it is possible to develop a scale for attitude through Guttman's Scalogram analysis.

There is no scale developed to measure the attitude of farmers towards CRA and specific CRA technologies together and also use of this technique was found to be very limited. As it is respondents based technique, it needs less number of statements (7-12) and it is more appropriate technique for this psychological object. Through this scale we can identify error of the statement, by eliminating the errors we can improve the Coefficient of reproducibility. By drawing the cutting points we can minimize the errors. Hence there is no need to do the reliability and validity again. Scalogram analysis is evaluative attitude construction technique. Hence Guttman scale procedure was chosen to construct attitude scale.

Venkata Ramana Reddy (1971) used Guttman Scale for measuring creativity of Agricultural Scientists. Sabaratnam (1987) used Guttman for constructing progressiveness scale. Greg Guest (2000) used this scale for constructing scale on wealth status of fishing community. Manasa (2016) used this scale for measuring attitude of women towards SHGs.

3.3.1.1.2.2 Procedure for Constructing Guttman Scale

The following steps were involved in construction of the scale through Scalogram analysis.

3.3.1.1.2.2.1 Definition of Universe

Here the universe is the attitude of the respondents towards the CRA and specific CRA technologies.

3.3.1.1.2.2.2 Collection of Statements

A number of 120 statements relating to the universe i.e., attitude of farmers towards the general concept of CRA and specific CRA technologies were collected representing the universe initially from various sources and then edited based on the review of literature and discussion with the experts on the basis of criteria suggested by Edward. Finally 50 statements were selected after the editing.

Contrary to Guttmann's early advice, it may be desirable to select the relevant statements relating to the given area of content prior to testing for scalability (Edwards, 1957). There is some reason to believe that the statements selected should be based on intuition and experience and should have homogenous content, for example, that statements that have been found to meet an internal consistency test are more apt to meet the requirements of a cumulative scale than of unselected statements (Edwards and Kilpatrick, 1948). However the item analysis procedure is not necessary part of scale analysis. (Guttman, 1944).

The 50 statements on two aspects of attitude towards CRA were given to the 100 experts in this area of different institutes for judging the relevancy of the each statement with the study on a 3 point continuum (3=Most relevant, 2=Relevant, 1=Irrelevant). Data were collected both directly and through mail. Based on the scores assigned by the judges mean was calculated. The statements with mean less than grand total mean were removed

and the first twelve statements of highest mean were selected under each category. Finally 24 statements were considered for the construction of the attitude scale.

3.3.1.1.2.2.3 Preparation of Draft Scale

All the 24 statements arranged in a random way in two categories as in 12 under each head and was furnished in appendix –II.

3.3.1.1.2.2.4 Administration of Scale

After taking necessary copies of the draft scale, the statements were given to 100 respondents other than the final sample. Respondents were asked to state their agreement on each statement with yes or no response categories. The scores for positive statements were assigned as 1 and 0 for yes and no, it was reversed for negative statements. A score was obtained for each subject by summing the weights assigned to the response categories the respondents has selected. The respondents are then arranged in rank order of scores from high to low.

3.3.1.1.2.2.5 Scalability of the statements

a. Cornell technique

The first method of measuring scalability is Cornell technique**.** Scalability of the statements was tested in terms of reproducibility. When all the statements selected to constitute scale are scalable on a single continuum from most to least favorable. When statements arranged in a order of importance it should be possible to get the responses from the respondents from most to least favorable on the basis of their score alone. This is called perfect reproducibility and this is expressed as coefficient of reproducibility (Venkata ramana Reddy, 1971). But since the perfect reproducibility is not to be expected in practice, it becomes a matter of importance to measure the degree of reproducibility present for any given set of attitude statements. This can be accomplished by placing the cutting points.

Under this method a table is constructed with one column for each response category for each statement and one row for each subject were drawn. Starting with the person having highest score, the responses of each subject to each statement are recorded by placing a checkmark (1 for the correct answer, 0 for the wrong answer) in the appropriate cell of the table provides a record of all the available data. Then a cutting point is placed for the response categories of each statement. A Cutting point is the point that

marks the place in the rank order of subjects where the most common response shifts from one category to the other. Guttman (1947) offers two rules in placing the cutting points. The first one is that cutting should be located so as to minimize the error, second is no category should have more error in it than non error. Cutting points are presented in the table by the horizontal bold line. Keeping these criteria in mind cutting points was placed for the twelve statements in two categories. Now errors for each response category were calculated in each statement were recorded. Errors are the responses falling outside the category to which they theoretically belong (Edwards 1957). The errors for each response category of a statement were calculated and were recorded at the bottom of the table in the row ‘e', in the same way errors were calculated for the all the statements in each of the two categories and were summed up.

$$\text{Coefficient of reproducibility (CR)} = 1 - \frac{\text{Sum of Errors}}{n \times C}$$

Where ‘n’ is number of respondents/subjects

C is number of statements.

Coefficient of reproducibility varies from 0 to 1. If the CR is below 0.85, it represents a spurious degree of accuracy. This can be improved by eliminating the statements which constitutes more errors and then reconsidering and rescaling the remaining items for improved C.R.

The obtained CR values of cornel technique for both the sets were more than 0.85. For the first set it was 0.891 and for the second set it was 0.892 for the score matrix presented in Table 3.2 and 3.3.

Table 3.2 Score matrix of the respondents on attitude of farmers towards general concept of CRA Cornell Technique

	Statements																								
	1		2		3		4		5		6		7		8		9		10		11		12		
Respondents	Yes (1)	No (0)	Yes (0)	No (1)	Yes (0)	No (1)	Yes (1)	No (0)	Yes (0)	No (1)	Yes (1)	No (0)	Yes (0)	No (1)	Yes (1)	No (0)	Yes (0)	No (1)	Yes (1)	No (0)	Yes (1)	No (0)	Yes (0)	No (1)	S
1	1			1		1	1			1	1			1	1			1	1		1			1	12
2	1			1		1	1			1	1			1	1			1	1		1			1	12
3	1			1		1	1			1	1			1	1			1	1		1			1	12
4	1			1		1	1			1	1			1	1			1	1		1			1	12
5	1			1		1	1			1	1			1	1			1	1		1			1	12
6	1			1		1	1			1	1			1	1			1	1		1			1	12
7	1			1		1	1			1	1			1	1			1	1		1			1	12
8	1			1		1	1			1	1			1	1			1	1		1			1	12
9	1			1		1	1			1	1			1	1			1	1		1			1	12
10	1			1		1	1			1	1			1	1			1	1		1			1	12
11	1			1		1	1			1	1			1	1			1	1		1			1	12
12	1			1		1	1			1	1			1	1			1	1		1			1	12
13	1			1		1	1			1	1			1	1			1	1		1			1	12
14	1			1		1	1			1	1			1	1			1	1		1			1	12
15	1			1		1	1			1	1			1	1			1	1		1			1	12
16	1			1		1	1			1	1			1	1			1	1		1			1	12
17	1			1		1	1			1	1			1	1			1	1		1			1	12
18	1			1		1	1			1	1			1	1			1	1		1			1	12
19	1			1		1	1			1	1			1	1			1	1		1			1	12
20	1			1		1	1			1	1			1	1			1	1		1			1	12
21	1			1		1	1			1	1			1	1			1	1		1			1	12
22	1			1		1	1			1	1			1	1			1	1		1			1	12
23	1			1		1	1			1	1			1	1			1	1		1			1	12
24	1			1		1	1			1	1			1	1			1	1		1			1	12
25	1			1		1	1			1	1			1	1			1	1		1			1	12
26	1			1		1	1			1	1			1	1			1	1		1			1	12
27	1			1		1	1			1	1			1	1			1	1		1			1	12
28	1			1		1	1			1	1			1	1			1	1		1			1	12
29	1			1	0		1			1	1			1	1			1	1		1			1	11
30	1			1		1	1		0		1			1	1			1	1		1			1	11
31	1			1		1	1			1	1		0		1			1	1		1			1	11
32	1			1		1	1			1	1			1	1			1	1			0		1	11
33	1			1		1	1			1		0		1	1			1	1		1			1	11
34	1			1		1	1			1		0		1	1			1	1		1			1	11
35	1			1		1	1			1		0		1	1			1	1		1			1	11
36	1			1		1	1		0		1			1	1			1	1		1			1	11
37		0		1		1	1			1	1			1	1			1	1		1			1	11
38	1			1		1	1			1	1			1	1		0		1		1			1	11
39	1			1		1	1			1	1			1	1		0		1		1			1	11
40	1			1		1	1			1	1			1	1			1	1			0		1	11
41	1			1		1	1			1	1			1	1		0		1			0		1	10
42	1			1	0		1			1	1			1	1			1	1		1		0		10
43	1			1		1	1			1		0		1	1		0		1		1			1	10
44	1			1		1	1			1		0		1	1		0		1		1			1	10
45	1			1		1	1			1	1			1	1		0		1			0		1	10
46	1			1	0		1			1	1			1	1			1	1		1		0		10
47		0		1		1	1			1	1			1	1			1	1		1		0		10
48	1			1		1	1			1	1			1	1		0		1			0		1	10
49	1			1		1	1		0		1			1	1			1	1			0		1	10
50	1			1		1	1			1	1		0		1			1	1		1		0		10
51	1			1		1	1			1	1		0		1			1	1		1		0		10
52	1			1		1	1			1	1			1	1		0		1			0		1	10
53	1			1		1	1			1		0		1	1			1	1		1		0		10
54	1			1		1	1			1		0		1	1			1	1		1		0		10

55	1			1		1	1			1	1		0		1			1		0		0		1	9
56	1			1		1	1		0		1			1	1			1		0	1		0		9
57	1		0		0		1			1	1			1	1			1	1		1		0		9
58	1			1		1	1			1	1			1	1		0		1			0	0		9
59	1			1		1	1			1	1			1	1		0		1			0	0		9
60	1			1		1	1			1		0	0		1			1		0	1			1	9
61	1			1		1	1		0		1		0		1			1	1			0	0		8
62	1			1		1	1			1		0		1	1		0		1			0	0		8
63	1			1		1	1		0		1		0		1			1	1			0	0		8
64	1			1		1	1		0		1		0		1			1	1			0	0		8
65	1			1		1		0	0		1			1	1			1	1			0	0		8
66	1			1		1	1		0		1		0		1			1	1			0	0		8
67	1			1		1	1			1		0	0		1			1		0		0		1	8
68	1			1		1	1		0		1		0		1			1	1			0	0		8
69		0		1		1	1			1		0		1	1		0		1		1		0			8
70		0		1		1	1			1		0		1	1		0		1			0	0			7
71		0		1		1	1			1		0		1	1		0		1			0	0			7
72	1			1		1	1			1		0		1	1		0		1			0	0			7
73	1			1		1	1			1		0		1	1		0		1			0	0			7
74	1			1		1	1			1		0		1	1		0		1		1		0			7
75		0		1		1	1			1		0		1	1		0			0	1		0			7
76		0		1		1		0	0			0	0			0		1	1		1			1		6
77		0		1		1		0	0			0	0			0		1	1		1			1		6
78		0		1		1	1			1		0		1	1		0			0		0	0			6
79		0		1	0		1		0			0	0		1		0			0	1			1		5
80	1		0		0		1		0			0		1	1		0		1			0	0			5
81	1			1	0			0	0			0		1	1		0		1			0	0			5
82	1			1	0			0	0			0		1	1		0		1			0	0			5
83		0	0			1	1		0			0		1	1		0		1			0	0			5
84	1		0		0		1		0		1		0		1		0		1			0	0			5
85	1		0		0		1		0			0		1	1		0			0		0	0			4
86		0	0			1	1		0			0		1	1		0			0		0	0			4
87	1		0		0		1		0		1		0			0	0			0	1		0			4
88		0	0			1	1			1		0	0		1		0			0		0	0			4
89		0	0			1	1			1		0	0		1		0			0		0	0			4
90	1		0		0		1		0			0	0			0	0			0	1		0			3
91		0	0			1	1		0			0	0		1		0			0		0	0			3
92		0	0			1	1		0			0	0		1		0			0		0	0			3
93		0	0			1		0	0		1		0			0	0		1			0	0			3
94		0	0		0		1		0			0	0		1		0			0		0	0			2
95		0	0			1		0	0			0	0		1					0		0	0			2
96		0	0		0			0	0			0		1		0	0			0		0	0			1
97		0	0		0			0	0		1		0			0	0			0		0	0			1
98		0	0		0			0	0			0	0			0	0			0		0		1		1
99		0	0		0			0	0			0	0			0	0			0		0	0			0
100		0	0		0			0	0			0	0			0	0			0		0	0			0
f	76	24	20	80	18	82	88	12	32	68	62	38	28	72	90	10	41	59	78	22	58	42	46	54		
p	0.76			0.8		0.82	0.88			0.68	0.62			0.72	0.9			0.59	0.78		0.58			0.54		
q		0.24	0.2		0.18			0.12	0.32			0.38	0.28			0.1	0.41			0.22		0.42	0.46			
e	7	5	2	0	4	8	0	6	12	2	4	10	15	1	0	5	11	2	1	5	8	10	7	6		
TE	12		2		12		6		14		14		16		5		13		6		18		13		131	

Coefficient of reproducibility (CR) **= 1- proportion of errors**

Proportion of errors = 131/1200 = 0.109

Coefficient of reproducibility (CR) = 1-0.109

CR = 0.891

The obtained CR values of cornel technique for both the sets were more than 0.85. For the first set it was 0.891 and for the second set it was 0.892 for the score matrix presented in Table 3.2 and 3.3.

Table 3.3 Score matrix of the respondents on attitude farmers towards specific CRA technologies - Cornell Technique

sub	STATEMENTS																								
	1		2		3		4		5		6		7		8		9		10		11		12		
	0	1	1	0	1	0	0	1	1	0	1	0	1	0	1	0	0	1	0	1	0	1	1	0	TS
1		1	1		1			1	1		1		1		1			1		1		1	1		12
2		1	1		1			1	1		1		1		1			1		1		1	1		12
3		1	1		1			1	1		1		1		1			1		1		1	1		12
4		1	1		1			1	1		1		1		1			1		1		1	1		12
5		1	1		1			1	1		1		1		1			1		1		1	1		12
6		1	1		1			1	1		1		1		1			1		1		1	1		12
7		1	1		1			1	1		1		1		1			1		1		1	1		12
8		1	1		1			1	1		1		1		1			1		1		1	1		12
9		1	1		1			1	1		1		1		1			1		1		1	1		12
10		1	1		1			1	1		1		1		1			1		1		1	1		12
11		1	1		1			1	1		1		1		1			1		1		1	1		12
12		1	1		1			1	1		1		1		1			1		1		1	1		12
13		1	1		1			1	1		1		1		1			1		1		1	1		12
14		1	1		1			1	1		1		1		1			1		1		1	1		12
15		1	1		1			1	1		1		1		1			1		1		1	1		12
16		1	1		1			1	1		1		1		1			1		1		1	1		12
17		1	1		1			1	1		1		1		1			1		1		1	1		12
18		1	1		1			1	1		1		1		1			1		1		1	1		12
19		1	1		1			1	1		1		1		1			1		1		1	1		12
20		1	1		1			1	1		1		1		1			1		1		1	1		12
21		1	1		1			1	1		1		1		1			1		1		1	1		12
22		1	1		1			1	1		1		1		1			1		1		1	1		12
23		1	1		1			1	1		1		1		1			1		1		1	1		12
24		1	1		1			1	1		1		1		1			1		1		1	1		12
25		1	1		1			1	1		1		1		1			1		1		1	1		12
26		1	1		1			1	1		1		1		1			1		1		1	1		12
27		1	1		1			1	1		1		1		1			1		1		1	1		12
28		1	1		1			1	1		1		1		1			1		1		1	1		12
29		1	1		1			1	1		1		1		1			1		1		1	1		12
30		1	1		1			1	1		1		1		1			1		1		1	1		12
31		1	1		1			1	1		1		1		1			1		1		1	1		12
32		1	1		1			1	1		1		1		1			1		1		1	1		12
33		1	1		1			1	1		1		1		1			1		1		1	1		12
34		1	1		1			1	1		1		1		1			1		1		1	1		12
35		1	1		1			1	1		1		1		1			1		1		1	1		12
36		1	1		1			1	1		1		1		1			1		1		1	1		12
37		1	1		1			1	1		1		1		1			1		1		1		0	11
38		1	1		1			1	1		1		1		1			1		1		1		0	11
39		1	1		1			1		0	1		1		1			1		1		1	1		11
40		1	1		1		0		1		1		1		1			1		1		1	1		11
41		1	1		1		0		1		1		1		1			1		1		1	1		11
42		1	1		1			1	1		1		1			0		1		1		1	1		11
43		1	1		1			1	1		1		1		1			1	0			1	1		11
44		1	1		1			1	1		1		1			0		1		1		1	1		11
45		1	1			0		1	1		1		1		1			1		1		1	1		11
46		1	1		1			1	1		1		1		1			1		1	0		1		11
47		1	1			0		1	1		1		1		1			1		1		1	1		11
48		1	1		1			1	1		1		1		1		0			1		1	1		11
49		1	1			0		1	1		1		1		1			1		1		1	1		11
50		1	1		1			1	1		1		1		1			1		1	0		1		11
51		1	1			0		1	1		1		1		1			1		1		1	1		11
52		1	1			0		1	1		1		1		1			1		1		1	1		11
53		1	1		1			1	1		1		1		1			1		1	0		1		11
54		1	1			0		1	1		1		1		1			1		1		1	1		11
55		1	1			0		1	1		1		1		1			1		1		1	1		11

56		1	1			0		1	1		1		1			1		1		1		1	1		11
57		1	1			0		1	1		1		1			1		1		1		1		0	10
58		1	1			0		1	1		1		1			1		1		1		1		0	10
59	0		1			0		1	1		1		1			1		1		1		1	1		10
60		1	1		1		0		1		1			0		1		1		1		1		10
61		1		0	1			1		0	1		1			1		1		1		1		10
62		1	1		1		0		1		1			0		1		1		1		1		10
63	0		1			0		1	1		1		1			1		1		1		1		10
64		1	1		1			1	1		1			0		1	0			1		1		10
65	0	1	1			0		1	1		1			0		1	0			1		1		9
66		1	1			0		1		0	1		1			1		1	0			1		9
67		1	1			0		1	1		1		1			1		1	0				0	9
68		1	1			0		1		0	1		1			1		1	0			1		9
69		1	1			0		1		0	1		1			1		1	0			1		9
70	0		1		1			1	1		1		1			1	0		0			1		9
71	0		1		1			1		0	1			0		1		1	0			1		8
72		1	1			0		1	1		1			0	1		1		0			1		8
73		1	1			0	0		1		1			0		1		1		1			0	8
74		1	1			0		1	1			0	1		1			1	0		0			8
75		1	1		1		0		1		1		1			0		1	0		0			8
76		1	1		1		0		1			0	1		1			1	0			1		8
77		1		0	1		0			0	1		1			0		1		1	0			7
78		1		0		0	0			0	1		1		1		0			1		1		7
79	0		1			0	0		1		1		1			0		1		1	0			7
80	0		1		1		0		1		1			0	1			1	0		0			7
81	0		1			0	0		1		1		1		1			1	0		0		0	6
82	0		1		1		0			0	1		1		1		0		0			1	0	6
83	0		1			0	0			0	1		1		1			1	0		0		1	6
84	0			0		0	0			0	1		1		1		0			1		1	1	6
85		1		0	1			1		0		0	1		1		0			1	0			0	6
86	0			0	1		0		1		1			0	1		0			1	0		1		6
87	0			0	1			1		0	1			0	1		0			1		1	0		6
88		1		0		0	0		1			0		0	1			1	0		0		1		5
89	0		1			0	0		1			0		0	1			1	0			1		0	5
90		1	1		1			1		0		0		0	1		0		0		0			0	5
91		1	1			0	0		1		1			0		0	0		0		0			0	4
92	0			0	1			1		0		0		0		0	0			1		1		0	4
93	0		1			0	0			0		0		0		0	0			1	0		1		3
94	0		1			0	0			0		0		0	1			1	0		0			0	3
95		1		0		0		1	1			0		0		0	0			0	0			0	3
96	0			0	1		0			0		0	1			0	0			0	0			0	2
97		1		0		0		1		0		0		0		0	0			0	0			0	2
98	0		1			0	0		1			0		0		0	0			0	0			0	2
99	0			0		0	0			0		0		0	1		0			0	0			0	1
100	0			0	1		0			0		0		0		0	0			0	0			0	1
f	20	80	86	14	66	34	25	75	79	21	85	15	84	16	81	19	17	83	23	77	30	70	78	16	130
p		0.8	0.86		0.66			0.75	0.79		0.85		0.84		0.81			0.83		0.77		0.7	0.78		
q	0.2			0.14		0.34	0.25			0.21		0.15		0.16		0.19	0.17		0.23		0.3			0.16	
e	4	6	6	3	18	5	5	6	6	8	1	3	1	2	2	11	3	3	8	6	3	8	1	11	
TE	10		9		23		11		14		4		3		13		6		14		11		12		

Coefficient of reproducibility (CR) **= 1- proportion of errors**

Proportion of errors = 108/1200 = 0.108

Coefficient of reproducibility (CR) = 1-0.108

CR = 0.892

The obtained CR values of cornel technique for both the sets were more than 0.85. For the first set it was 0.891 and for the second set it was 0.892 for the score matrix presented in Table 3.2 and 3.3.

b. GOOD ENOUGH TECHNIQUE

Good enough technique is another technique that is available to test the scalability of the statements under Scalogram. This method was suggested by Good enough (1944), Edwards and Kilpatrick (1948) has shown, enable us to determine the coefficient of reproducibility in such a way that the coefficient does accurately represent the degree of accuracy with which we can reproduce the responses to statements from total scores alone. A score matrix for 12 statements of two subset was prepared with rows corresponding to the subjects and columns to the statements. This matrix will be in the order of n x'C' where n is the number of the respondents i.e., 100 in this study while 'C' is number of statements in the scale, this is same for all the two subsets. The responses of the respondents to the statements were recorded in the row wise in matrix in terms of 0 and 1. Starting with the person having highest score, the responses of each subject to the statements are recorded in each row. The response pattern is recorded with the highest score in the first row. The second row was corresponding to the subjects of next highest score and thus data was arranged in the descending order of scores. Sum of scores of the each subject was placed at right side of last statement column. The sum of columns is equal to the sum of scores of all subjects, represented at the bottom of the Table. 3.4 and 3.5. The sum for each column of the score matrix is divided by the total number of subjects to obtain the proportions p of the 1 response to each statement. The proportions of zero response will be 1- p = q. These values of p and q were represented at the bottom of the Tables 3.4 and 3.5.

Table 3.4 Scores of the respondents in descending order on attitude of general concept of CRA - Good enough Technique

Respondents	Statements												S	E
	1	2	3	4	5	6	7	8	9	10	11	12		
1	1	1	1	1	1	1	1	1	1	1	1	1	12	0
2	1	1	1	1	1	1	1	1	1	1	1	1	12	0
3	1	1	1	1	1	1	1	1	1	1	1	1	12	0
4	1	1	1	1	1	1	1	1	1	1	1	1	12	0
5	1	1	1	1	1	1	1	1	1	1	1	1	12	0
6	1	1	1	1	1	1	1	1	1	1	1	1	12	0
7	1	1	1	1	1	1	1	1	1	1	1	1	12	0
8	1	1	1	1	1	1	1	1	1	1	1	1	12	0
9	1	1	1	1	1	1	1	1	1	1	1	1	12	0
10	1	1	1	1	1	1	1	1	1	1	1	1	12	0
11	1	1	1	1	1	1	1	1	1	1	1	1	12	0
12	1	1	1	1	1	1	1	1	1	1	1	1	12	0
13	1	1	1	1	1	1	1	1	1	1	1	1	12	0
14	1	1	1	1	1	1	1	1	1	1	1	1	12	0
15	1	1	1	1	1	1	1	1	1	1	1	1	12	0
16	1	1	1	1	1	1	1	1	1	1	1	1	12	0
17	1	1	1	1	1	1	1	1	1	1	1	1	12	0
18	1	1	1	1	1	1	1	1	1	1	1	1	12	0
19	1	1	1	1	1	1	1	1	1	1	1	1	12	0
20	1	1	1	1	1	1	1	1	1	1	1	1	12	0
21	1	1	1	1	1	1	1	1	1	1	1	1	12	0
22	1	1	1	1	1	1	1	1	1	1	1	1	12	0
23	1	1	1	1	1	1	1	1	1	1	1	1	12	0
24	1	1	1	1	1	1	1	1	1	1	1	1	12	0
25	1	1	1	1	1	1	1	1	1	1	1	1	12	0
26	1	1	1	1	1	1	1	1	1	1	1	1	12	0
27	1	1	1	1	1	1	1	1	1	1	1	1	12	0
28	1	1	1	1	1	1	1	1	1	1	1	1	12	0
29	1	1	0	1	1	1	1	1	1	1	1	1	11	2
30	1	1	1	1	0	1	1	1	1	1	1	1	11	2
31	1	1	1	1	1	1	0	1	1	1	1	1	11	2
32	1	1	1	1	1	1	1	1	1	1	0	1	11	2
33	1	1	1	1	1	0	1	1	1	1	1	1	11	2
34	1	1	1	1	1	0	1	1	1	1	1	1	11	2
35	1	1	1	1	1	0	1	1	1	1	1	1	11	2
36	1	1	1	1	0	1	1	1	1	1	1	1	11	2
37	0	1	1	1	1	1	1	1	1	1	1	1	11	2
38	1	1	1	1	1	1	1	1	0	1	1	1	11	2
39	1	1	1	1	1	1	1	1	0	1	1	1	11	2
40	1	1	1	1	1	1	1	1	1	1	0	1	11	2
41	1	1	1	1	1	1	1	1	0	1	0	1	10	2
42	1	1	0	1	1	1	1	1	1	1	1	0	10	2
43	1	1	1	1	1	0	1	1	0	1	1	1	10	4
44	1	1	1	1	1	0	1	1	0	1	1	1	10	4
45	1	1	1	1	1	1	1	1	0	1	0	1	10	2
46	1	1	0	1	1	1	1	1	1	1	1	0	10	2
47	0	1	1	1	1	1	1	1	1	1	1	0	10	2
48	1	1	1	1	1	1	1	1	0	1	0	1	10	2
49	1	1	1	1	0	1	1	1	1	1	0	1	10	2
50	1	1	1	1	1	1	0	1	1	1	1	0	10	2
51	1	1	1	1	1	1	0	1	1	1	1	0	10	2
52	1	1	1	1	1	1	1	1	0	1	0	1	10	2
53	1	1	1	1	1	0	1	1	1	1	1	0	10	2
54	1	1	1	1	1	0	1	1	1	1	1	0	10	2
55	1	1	1	1	1	1	0	1	1	0	0	1	9	3

56	1	1	1	1	0	1	1	1	1	0	1	0	9	3
57	1	0	0	1	1	1	1	1	1	1	1	0	9	4
58	1	1	1	1	1	1	1	1	0	1	0	0	9	0
59	1	1	1	1	1	1	1	1	0	1	0	0	9	0
60	1	1	1	1	1	0	0	1	1	0	1	1	9	6
61	1	1	1	1	0	1	0	1	1	1	0	0	8	4
62	1	1	1	1	1	0	1	1	0	1	0	0	8	0
63	1	1	1	1	0	1	0	1	1	1	0	0	8	4
64	1	1	1	1	0	1	0	1	1	1	0	0	8	4
65	1	1	1	0	0	1	1	1	1	1	0	0	8	4
66	1	1	1	1	0	1	0	1	1	1	0	0	8	4
67	1	1	1	1	1	0	0	1	1	0	0	1	8	4
68	1	1	1	1	0	1	0	1	1	1	0	0	8	4
69	0	1	1	1	1	0	1	1	0	1	1	0	8	2
70	0	1	1	1	1	0	1	1	0	1	0	0	7	2
71	0	1	1	1	1	0	1	1	0	1	0	0	7	2
72	1	1	1	1	1	0	1	1	0	1	0	0	7	1
73	1	1	1	1	1	0	1	1	0	1	0	0	7	1
74	1	1	1	1	1	0	1	1	0	1	1	0	7	2
75	0	1	1	1	1	0	1	1	0	0	1	0	7	4
76	0	1	1	0	0	0	0	0	1	1	1	1	6	6
77	0	1	1	0	0	0	0	0	1	1	1	1	6	6
78	0	1	1	1	1	0	1	1	0	0	0	0	6	4
79	0	1	0	1	0	0	0	1	0	0	1	1	5	4
80	1	0	0	1	0	0	1	1	0	1	0	0	5	4
81	1	1	0	0	0	0	1	1	0	1	0	0	5	4
82	1	1	0	0	0	0	1	1	0	1	0	0	5	4
83	0	0	1	1	0	0	1	1	0	1	0	0	5	2
84	1	0	0	1	0	1	0	1	0	1	0	0	5	4
85	1	0	0	1	0	0	1	1	0	0	0	0	4	4
86	0	0	1	1	0	0	1	1	0	0	0	0	4	2
87	1	0	0	1	0	1	0	0	0	0	1	0	4	6
88	0	0	1	1	1	0	0	1	0	0	0	0	4	2
89	0	0	1	1	1	0	0	1	0	0	0	0	4	2
90	1	0	0	1	0	0	0	0	0	0	1	0	3	4
91	0	0	1	1	0	0	0	1	0	0	0	0	3	0
92	0	0	1	1	0	0	0	1	0	0	0	0	3	0
93	0	0	1	0	0	1	0	0	0	1	0	0	3	4
94	0	0	0	1	0	0	0	1	0	0	0	0	2	0
95	0	0	1	0	0	0	0	1	0	0	0	0	2	2
96	0	0	0	0	0	0	1	0	0	0	0	0	1	1
97	0	0	0	0	0	1	0	0	0	0	0	0	1	2
98	0	0	0	0	0	0	0	0	0	0	0	1	1	2
99	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0
f	76	80	82	88	68	62	72	90	59	78	58	54		
p	0.76	0.8	0.82	0.88	0.68	0.62	0.72	0.9	0.59	0.78	0.58	0.54	863	**183**
q	0.24	0.2	0.18	0.12	0.32	0.38	0.28	0.1	0.41	0.22	0.42	0.46		

Table 3.5 Scores of the respondents in descending order on attitude of specific CRA technologies - Good enough Technique

sub	STATEMENTS													
	1	2	3	4	5	6	7	8	9	10	11	12	T	TE
1	1	1	1	1	1	1	1	1	1	1	1	1	12	0
2	1	1	1	1	1	1	1	1	1	1	1	1	12	0
3	1	1	1	1	1	1	1	1	1	1	1	1	12	0
4	1	1	1	1	1	1	1	1	1	1	1	1	12	0
5	1	1	1	1	1	1	1	1	1	1	1	1	12	0
6	1	1	1	1	1	1	1	1	1	1	1	1	12	0
7	1	1	1	1	1	1	1	1	1	1	1	1	12	0
8	1	1	1	1	1	1	1	1	1	1	1	1	12	0
9	1	1	1	1	1	1	1	1	1	1	1	1	12	0
10	1	1	1	1	1	1	1	1	1	1	1	1	12	0
11	1	1	1	1	1	1	1	1	1	1	1	1	12	0
12	1	1	1	1	1	1	1	1	1	1	1	1	12	0
13	1	1	1	1	1	1	1	1	1	1	1	1	12	0
14	1	1	1	1	1	1	1	1	1	1	1	1	12	0
15	1	1	1	1	1	1	1	1	1	1	1	1	12	0
16	1	1	1	1	1	1	1	1	1	1	1	1	12	0
17	1	1	1	1	1	1	1	1	1	1	1	1	12	0
18	1	1	1	1	1	1	1	1	1	1	1	1	12	0
19	1	1	1	1	1	1	1	1	1	1	1	1	12	0
20	1	1	1	1	1	1	1	1	1	1	1	1	12	0
21	1	1	1	1	1	1	1	1	1	1	1	1	12	0
22	1	1	1	1	1	1	1	1	1	1	1	1	12	0
23	1	1	1	1	1	1	1	1	1	1	1	1	12	0
24	1	1	1	1	1	1	1	1	1	1	1	1	12	0
25	1	1	1	1	1	1	1	1	1	1	1	1	12	0
26	1	1	1	1	1	1	1	1	1	1	1	1	12	0
27	1	1	1	1	1	1	1	1	1	1	1	1	12	0
28	1	1	1	1	1	1	1	1	1	1	1	1	12	0
29	1	1	1	1	1	1	1	1	1	1	1	1	12	0
30	1	1	1	1	1	1	1	1	1	1	1	1	12	0
31	1	1	1	1	1	1	1	1	1	1	1	1	12	0
32	1	1	1	1	1	1	1	1	1	1	1	1	12	0
33	1	1	1	1	1	1	1	1	1	1	1	1	12	0
34	1	1	1	1	1	1	1	1	1	1	1	1	12	0
35	1	1	1	1	1	1	1	1	1	1	1	1	12	0
36	1	1	1	1	1	1	1	1	1	1	1	1	12	0
37	1	1	1	1	1	1	1	1	1	1	1	0	11	2
38	1	1	1	1	1	1	1	1	1	1	1	0	11	2
39	1	1	1	1	0	1	1	1	1	1	1	1	11	2
40	1	1	1	0	1	1	1	1	1	1	1	1	11	0
41	1	1	1	0	1	1	1	1	1	1	1	1	11	0
42	1	1	1	1	1	1	1	0	1	1	1	1	11	2
43	1	1	1	1	1	1	1	1	1	0	1	1	11	2
44	1	1	1	1	1	1	1	0	1	1	1	1	11	2
45	1	1	0	1	1	1	1	1	1	1	1	1	11	2
46	1	1	1	1	1	1	1	1	1	1	0	1	11	2
47	1	1	0	1	1	1	1	1	1	1	1	1	11	2
48	1	1	1	1	1	1	1	1	0	1	1	1	11	2
49	1	1	0	1	1	1	1	1	1	1	1	1	11	2
50	1	1	1	1	1	1	1	1	1	1	0	1	11	2
51	1	1	0	1	1	1	1	1	1	1	1	1	11	2
52	1	1	0	1	1	1	1	1	1	1	1	1	11	2
53	1	1	1	1	1	1	1	1	1	1	0	1	11	2
54	1	1	0	1	1	1	1	1	1	1	1	1	11	2
55	1	1	0	1	1	1	1	1	1	1	1	1	11	2
56	1	1	0	1	1	1	1	1	1	1	1	1	11	2
57	1	1	0	1	1	1	1	1	1	1	1	0	10	2

58	1	1	0	1	1	1	1	1	1	1	1	0	10	2
59	0	1	0	1	1	1	1	1	1	1	1	1	10	2
60	1	1	1	0	1	1	1	0	1	1	1	1	10	2
61	1	0	1	1	0	1	1	1	1	1	1	1	10	3
62	1	1	1	0	1	1	1	0	1	1	1	1	10	2
63	0	1	0	1	1	1	1	1	1	1	1	1	10	2
64	1	1	1	1	1	1	1	0	1	0	1	1	10	4
65	1	1	0	1	1	1	1	0	1	0	1	1	9	4
66	1	1	0	1	0	1	1	1	1	1	0	1	9	2
67	1	1	0	1	1	1	1	1	1	1	0	0	9	2
68	1	1	0	1	0	1	1	1	1	1	0	1	9	2
69	1	1	0	1	0	1	1	1	1	1	0	1	9	2
70	0	1	1	1	1	1	1	1	1	0	0	1	9	4
71	0	1	1	1	0	1	1	0	1	1	0	1	8	6
72	1	1	0	1	1	1	0	1	1	0	0	1	8	2
73	1	1	0	0	1	1	1	0	1	1	1	0	8	4
74	1	1	0	1	1	0	1	1	1	0	0	1	8	2
75	1	1	1	0	1	1	1	0	1	0	0	1	8	2
76	1	1	1	0	1	0	1	1	1	0	1	0	8	4
77	1	0	1	0	0	1	1	0	1	1	0	1	7	6
78	1	0	0	0	0	1	1	1	0	1	1	1	7	6
79	0	1	0	0	1	1	1	0	1	1	0	1	7	4
80	0	1	1	0	1	1	0	1	1	0	0	1	7	4
81	0	1	0	0	1	1	1	1	1	0	0	0	6	2
82	0	1	1	0	0	1	1	1	0	0	1	0	6	4
83	0	1	0	0	0	1	1	1	1	0	0	1	6	2
84	0	0	0	0	0	1	1	1	0	1	1	1	6	6
85	1	0	1	1	0	0	1	1	0	1	0	0	6	6
86	0	0	1	0	1	1	0	1	0	1	0	1	6	8
87	0	0	1	1	0	1	0	1	0	1	1	0	6	8
88	1	0	0	0	1	0	0	1	1	0	0	1	5	6
89	0	1	0	0	1	0	0	1	1	0	1	0	5	4
90	1	1	1	1	0	0	0	1	0	0	0	0	5	6
91	1	1	0	0	1	1	0	0	0	0	0	0	4	4
92	0	0	1	1	0	0	0	0	0	1	1	0	4	8
93	0	1	0	0	0	0	0	0	0	1	0	1	3	4
94	0	1	0	0	0	0	0	1	1	0	0	0	3	4
95	1	0	0	1	1	0	0	0	0	0	0	0	3	6
96	0	0	1	0	0	0	1	0	0	0	0	0	2	4
97	1	0	0	1	0	0	0	0	0	0	0	0	2	4
98	0	1	0	0	1	0	0	0	0	0	0	0	2	2
99	0	0	0	0	0	0	0	1	0	0	0	0	1	2
100	0	0	1	0	0	0	0	0	0	0	0	0	1	2
f	80	86	66	75	79	85	84	81	83	77	70	78		203
p	0.8	0.86	0.66	0.75	0.79	0.85	0.84	0.81	0.83	0.77	0.7	0.78		
q	0.2	0.14	0.34	0.25	0.21	0.15	0.16	0.19	0.17	0.23	0.3	0.16		

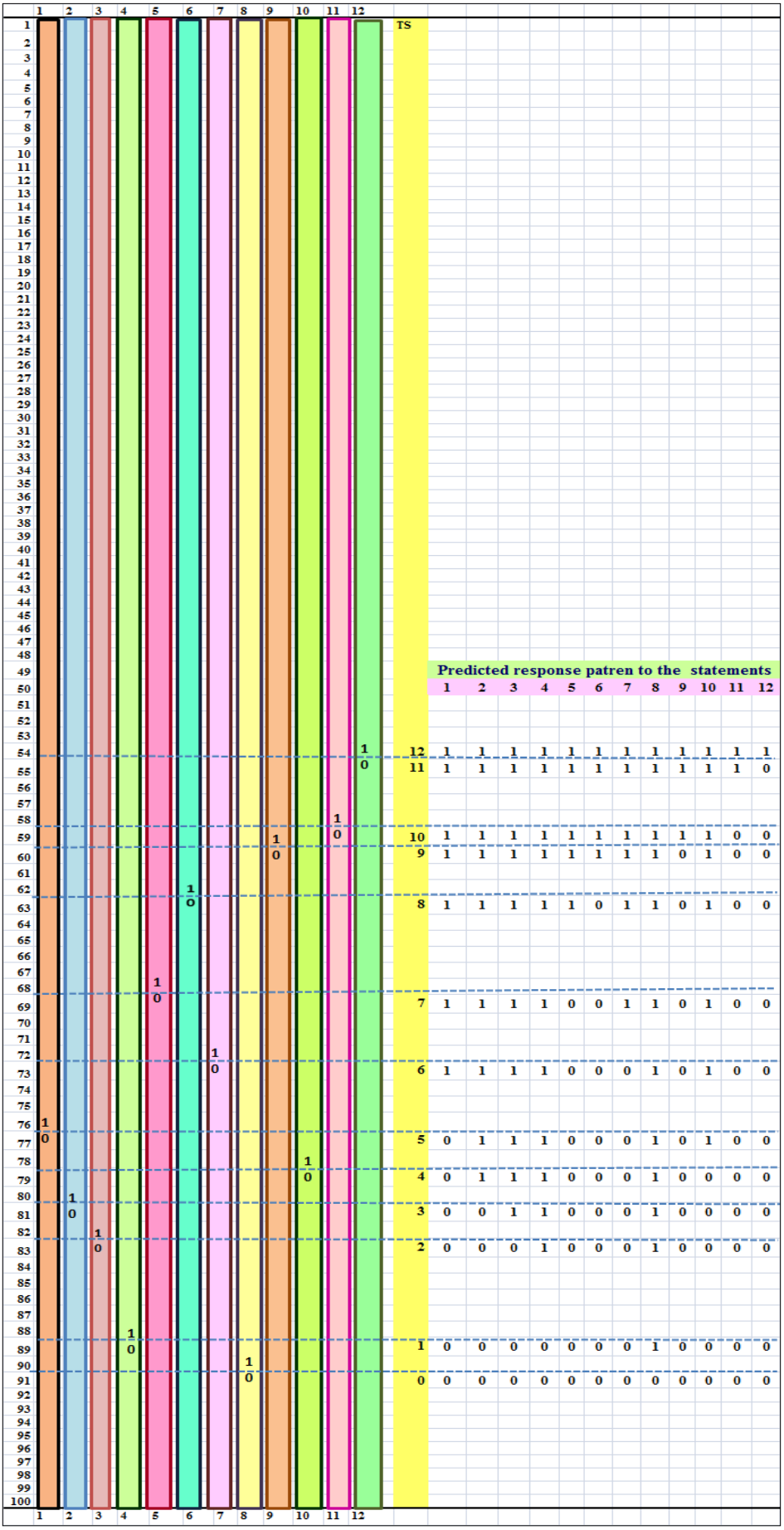


Fig: 3.5 Bar charts used in determining the predicted response patterns corresponding to the score of Table 3.4

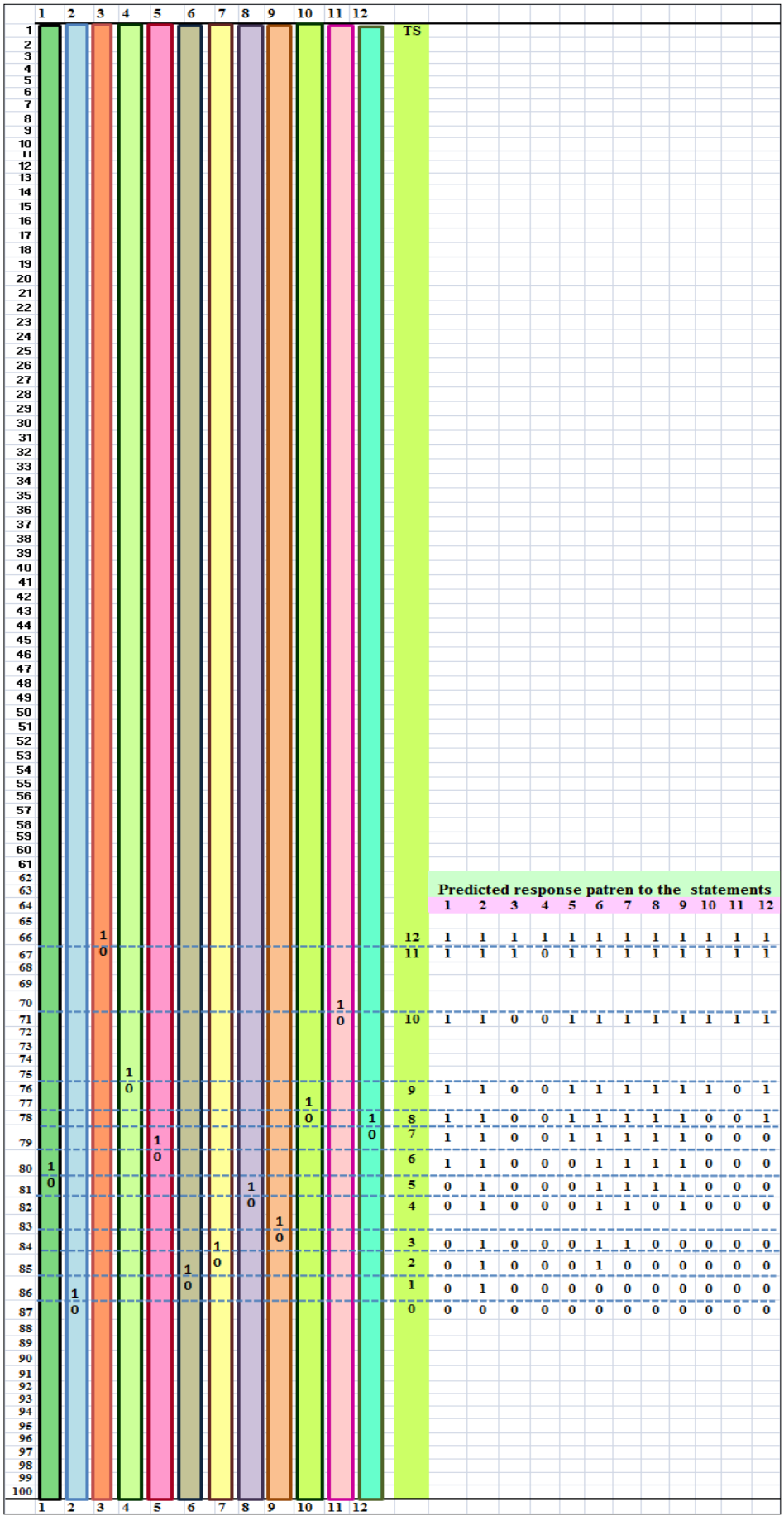


Fig: 3.6 Bar charts used in determining the predicted response patterns corresponding to the score of Table 3.5

In order to find out the predicted response pattern a bar chart was drawn for each statement as shown in the Figure 3.6. The area above the cutting point in the bar chart indicates the proportion giving the response 1 to the statement and the lower part represents the proportion giving the zero response. The points of division are indicated by the solid lines. Each point of the division is extended through other bars in terms of dotted lines. For the twelve statements scale the possible range of score is from 0-12 on the hypothesis that statements constitute a perfect scale, the Predicted Patterns of Response (PPR) to the each score is determined. The PPR are directly obtained from the bar chart as represented in the Fig: 3.6.

The PPR of each score was compared with the observed pattern which was recorded in the original score matrix Table 3.6. Each deviation of an observed response pattern from PPR is counted as error. Likewise errors of each subject were calculated and placed across the last column of the row. For example subject 37 scored 11 and the observed response pattern for this score 1 1 1 1 1 1 1 1 1 1 1 0 and PPR for 11 was 1 1 1 0 1 1 1 1 1 1 1 1 here we noticed the difference in two position hence the error was considered as 2 and this value was recorded in the errors column in the row corresponding to the subject 37.

Once the errors were calculated for all the subjects with PPR, they were summed up and proportion of errors was calculated. After calculating the proportion of errors CR was calculated

Proportion of Errors = Sum of Errors / No of Subjects X Statements

CR= 1- Proportion of Errors

Table 3.6 Proportion of Errors and CR of two subsets

S. No.	Attitude of respondents	Total errors	Proportion of errors e/nxc	Coefficient of reproducibility 1- e/nxc
1	**General concept of CRA**	183	0.1525	0.8475
2	**Specific CRA technologies**	203	0.1692	0.8308

d. Calculation of Minimum Marginal Coefficient of Reproducibility (MMCR)

In order to improve the predictions from the knowledge of total scores, Guttman (1947) developed a measure called Minimum Marginal Coefficient of Reproducibility (MMCR) which can be easily determined from the score matrix of a given set of statements having known frequencies in each categories of response. First, the proportion of the response in the modal category has to be found. Modal categories are those values having the highest proportion (*p/q*) in the total frequency of each statement. If these values were then summed and divided by the number of statement, the resulting value indicated the MMCR. Thus MMCR can be calculated with the formulae.

$$MMCR = \frac{M1+M2+M3.....+M7}{C}$$

M1, M2.... = proportions of responses in the modal category for the 12 statements

C= Number of statements.

Table 3.7 Modal categories and MMCR of the twelve statements

Attitude towards	**Statements**												
	Proportion	1	2	3	4	5	6	7	8	9	10	11	12
General concept of CRA	p	0.76	0.8	0.82	0.88	0.68	0.62	0.72	0.9	0.59	0.78	0.58	0.54
	q	0.24	0.23	0.2	0.12	0.35	0.38	0.31	0.1	0.42	0.2	0.42	0.48
	Modal category	0.76	0.8	0.82	0.88	0.68	0.62	0.72	0.9	0.59	0.78	0.58	0.54
	MMCR=8.67/12=0.7225												
Specific CRA technologies	**Proportion**	1	2	3	4	5	6	7	8	9	10	11	12
	p	0.8	0.86	0.66	0.75	0.79	0.85	0.84	0.81	0.83	0.77	0.7	0.78
	q	0.2	0.14	0.34	0.25	0.21	0.15	0.16	0.19	0.17	0.23	0.3	0.16
	Modal category	0.8	0.86	0.66	0.75	0.79	0.85	0.84	0.81	0.83	0.77	0.7	0.78
	MMCR=9.44/12=0.7866												

The MMCR of the two categories was compared with their coefficient of reproducibility got in the earlier steps. It was observed from the data that there is improvement in our predictions from knowledge of the total scores. CR values should be greater than MMCR for first and second subset of statements but CR values were less than the 0.85 as shown in the Table 3.6. CR value should be more than the 0.85. Hence the scale is not considered to be satisfactory. The CR value is to be improved by reducing the error.

e. Possible Response Patterns

The presence of error may be due to the presence of the second variable, other than the one originally defined. The presence or absence of the second variable is determined by the examination of pattern of the subject to find out whether non –scale type exist (Guttman, 1945). The total number of the possible pattern of responses is a function of the number statements under consideration and the number of the response categories or each statement. Thus, here for 12 statements in each set with two response categories of the number of possible patterns (scale and non- scale) is 2^{12} i.e.; 4096 for each set. By the familiar rules of permutations and combinations, we know that there is only pattern of response that will result in the score 1, while there are 12 different ways of in which the score 1 can be obtained and so on. But by the Guttman's definition a scale should have one and only one pattern of response for each possible score.

f. Number of Scale Types

In general, the number of possible scale types, for any set of the statements may be determined by summing the number of response categories of each statement, subtracting the number of statements and adding unity. In this study there are 12 statements in each of the two categories. All the statements are two response categories. The number of possible scale types would be equal to 2+2+2+2+2+2+2+2+2+2+2+2=24 -12+1=13.

g. Scale and Non-Scale Types:

Those subjects who obtain a particular score in the accordance to the predicted response pattern of the bar chart are scale types. Those subjects who obtain a particular score other than the predicted response pattern shown in the bar chart were considered as non-scale types. The scale and non-scale types of 12 statements of 2 sets were calculated and represented in the Table 3.8 among the hundred subjects.

Table 3.8 Attitude statement wise frequencies of errors under each subset obtained through Cornell and Good Enough technique

Statements	Set-1		TE	Set-1		TE
	Cornell	Good Enough		Cornell	Good Enough	
1	12	14	26	10	12	22
2	2	4	6	9	12	21
3	12	16	28	**23**	**28**	**51**
4	6	10	16	11	12	23
5	14	21	35	14	16	30
6	14	18	32	4	6	10
7	**16**	**28**	**44**	3	4	7
8	5	7	12	**13**	**22**	**35**
9	13	19	32	6	6	12
10	6	12	18	14	16	30
11	**18**	**18**	**36**	11	16	27
12	13	14	27	12	15	27

h. Elimination of Statements Contributing More Error

The subset of statements having the CR value less than 0.85 can be improved by deleting the statements which contribute to the maximum error. It could be vividly seen from the Table 3.8 that CR of first and second subset of statements was lower than the required. Elimination of the statements with more number of errors in both the techniques will helps us in improving the coefficient or reproducibility, in this way errors were reduced which will automatically bring down the non-scale types and the CR can also be improved. It can be seen from the Table 3.8 that in set-1 statements 7 and 11 were having more numbers of errors, hence these statements were eliminated and then CR is calculated with the remaining statements i.e.,

$$CR= 1- (183 - (28 + 18)) / 1200$$

$$= 0.88583$$

Similarly for the second set, statements 3 and 8 were contributing the maximum number of the errors, thus these statements were eliminated and C.R was calculated.

$$CR= 1- (203 - (28 +22)) / 1200$$

$$= 0.8725$$

Table 3.9 Attitude statements selected for the administration of draft scale on the respondents

S.No	Statements	Yes	No
I.	**Attitude of respondents towards general concept of CRA**		
1	In my view drought is not a doomed fate but there are strategies to minimize its effects.		
2*	In my view there is no need to spend money on CRA technologies		
3*	I observed that small farmers are not able to receive full benefit of improved CRA technologies		
4	Due to the adoption of CRA technologies there is substantial improvement of crop yields in my area during adverse drought situation.		
5*	In my view trying climate resilient technologies in farming involves risk and wastage of resources		
6	I strongly feel that food security can be achieved by adopting climate resilient technologies		
7*	CRA technology is highly generalized and not location specific		
8	CRA technologies have come as a real boon for the farmers for managing drought conditions.		
9*	In my view it is simply waste of time to practice climate resilient technologies		
10	CRA technology develops self – reliance among dry land farmers		
11	One can easily use the drought mitigating strategies		
12*	The use of CRA technology is less profitable in relation to the cost involved		
II.	**Attitude of respondents towards specific Climate Resilient Agriculture technologies**		
1*	There is no improvement in soil moisture retention levels by adopting the moisture conservation methods (dead furrows, mulch, cover crops, etc.)		
2	Irrigation with sprinkler/drip had helped my crop in mitigating the soil moisture stress		
3	I feel that village level seed bank is necessary to combat seed shortages in drought situations		
4*	In my view construction of rain water harvesting structures are very costly and risky		
5	I believe that crop rotation technique has improved the crop yield		
6	I observed that the Performance of climate resilient varieties is good in drought areas		
7	In my view composting of organic waste would upgrade soil quality		
8*	I strongly feel that Soil test based nutrient management technique improves the soil fertility		
9*	I feel that there is no improvement in crop yield due to crop diversification		
10*	In my view farm operations are delayed due to improper functioning of custom hiring centers		
11*	I strongly feel that there is no recharge of bore wells in the vicinity of percolation ponds		
12	I observed that Performance of contingent crops under delayed monsoon is good		

'*' Indicate that statement is negative

Table 3.10 Attitude statements finally selected for the administration of scale on the respondents

S. No	Statements	AG (2)	UD (1)	DA (0)
I.	**Attitude of respondents towards general concept of Climate Resilient Agriculture technologies**			
1	In my view drought is not a doomed fate but there are strategies to minimize its effects.			
2*	In my view there is no need to spend money on CRA technologies			
3*	I observed that small farmers are not able to receive full benefit of improved CRA technologies			
4	Due to the adoption of CRA technologies there is substantial improvement of crop yields in my area during adverse drought situation.			
5	I strongly feel that food security can be achieved by adopting climate resilient technologies			
6	CRA technologies have come as a real boon for the farmers for managing drought conditions.			
7*	In my view it is simply waste of time to practice climate resilient technologies			
8	CRA technology develops self – reliance among dry land farmers			
9*	The use of CRA technology is less profitable in relation to the cost involved			
II.	**Attitude of respondents towards specific Climate Resilient Agriculture technologies**			
1*	There is no improvement in soil moisture retention levels by adopting the moisture conservation methods (dead furrows, mulch, cover crops, etc.)			
2	Irrigation with sprinkler/drip had helped my crop in mitigating the soil moisture stress			
3*	In my view construction of rain water harvesting structures are very costly and risky			
4	I observed that Performance of contingent crops under delayed monsoon is good			
5	I observed that the Performance of climate resilient varieties is good in drought areas			
6	In my view composting of organic waste would upgrade soil quality			
7*	I feel that there is no improvement in crop yield due to crop diversification			
8*	In my view farm operations are delayed due to improper functioning of custom hiring centers			
9*	I strongly feel that there is no recharge of bore wells in the vicinity of percolation ponds			

'*' Indicate that statement is negative

i. Conclusion

As per the thumb rule, the CR should be more than 0.85 and the MMCR should not be less than 0.65 i.e., the difference should not be more than 0.2. These set of statements support the assumptions that the items tapped a single variable that is uni-dimensionality was assured.

j. Standardization of the Scale:

A Scale should measure what it is intended to measure. Similarly it should be consistent in its measurement. So a scale has to be standardized before it is administered or recommended as a scale. Here the scale was standardized by testing its validity as well as reliability.

Test of Reliability

A scale is said to be reliable when it consistently produces the same response when applied to the same sample (Goode and Halt, 1952). In this study, reliability of the attitude scale towards CRA was computed by adopting test- retest method. The objective is to ensure that responses are not varied across time periods, so that a measurement taken at any point in time is reliable. The scale was administered to a group of 30 respondents other than the sample with an interval time of 14 days. The two sets of scores were correlated to get the reliability coefficient. The correlation coefficient was 0.83, which was highly significant at 0.01 per cent level of probability.

Test for Validity

A scale possess validity when it actually measures what it claims to measure (Goode and Hatt, 1952). In this study, the validity of the attitude scale was ensured through two methods.

a. Content Validity:

This is a non-statistical type of validity. The main criterion here is how well the list of attitude statements matches the subject matter, which is important for the variable under study. This was ensured by perusing relevant literature, discussion with concerned experts and members of the doctoral advisory committee for the collection of attitude statements covering the universe of content, relating to the farmers attitude towards the general concept of CRA and specific CRA technologies. This validity subjectively assess the correspondence between individual items and the concept through ratings by expert judges, pretests with multiple sub populations. The objective is to ensure that the selection of scale

items beyond experimental issues to include both for theoretical and practical considerations.

b. Intrinsic Validity:

The intrinsic validity of the attitude scale was determined using Guilford's formula where in the intrinsic validity was defined as the square root of its reliability. If the reliability coefficient is rtt, then the validity is given by '√rtt'. As the reliability coefficient of the attitude scale was found to be 0.83, the validity coefficient of the scale is 0.91.

Administration of the scale:

The final scale consisting of 18 statements (9 positive and 9 negative statements) categorized into two categories as attitude towards concept of CRA and specific CRA technologies and were presented to respondents with instructions to indicate their agreement on three continuum viz., agree, undecided and disagree. The weightage of 2, 1 and 0 for positive statements and vice versa for negative statements, the attitude score of each respondent is obtained by summing up the scores on all attitude statements. Based on the actual scores, the highest (56) and lowest scores (27) were considered and range was calculated, then the respondents were grouped into five categories of highly unfavorable, unfavorable, moderately favorable, favourable and highly favourable.

S. No.	Category	Scores
1	Highly Un favorable	27-32
2	Un favorable	33-38
3	Moderately favorable	39-44
4	Favourable	45-50
5	Highly favourable	51-56

3.3.1.1.3 Overall Adaptive Capacity

In order to have comprehensive understanding on adaptive capacity of the farmers overall adaptive capacity was calculated. The overall adaptive capacity was operanalized as the sum of climate readiness and attitude of the farmers towards CRA. The score of overall adaptive capacity for each respondent was calculated by summing up the scores of climate readiness and attitude. The maximum and minimum obtained scores were 86 and 32 respectively. The respondents were grouped into following five categories based on exclusive class interval technique.

S. No.	Category	Scores
1	Very Low	32-42
2	Low	43-53
3	Medium	54-64
4	High	65-75
5	Very High	76-86

3.3.1.2 Level of adoption of Climate Resilient Agriculture technologies (CRA) and Coping mechanisms:

This objective was divided into two different subheadings for clarifying the details of each part. It includes Level of adoption of technologies and Coping mechanisms. The description and details of variables and their measurement are given under the following subheads:

3.3.1.2.1 Level of adoption of CRA technologies: Adoption can be defined as a decision to make full use of an innovation as the best course of action available. Adoption has been operationalized as adoption of individuals to take up the recommended climate resilient agriculture technologies to their field.

In the present study adoption of technologies was measured by four different components those were NRM, crop related technologies, live stock and institutional interventions. A list of NICRA recommended practices were deployed for these four components and responses on adoption level of these practices were elicited.

3.3.1.2.1.1 NRM: It was operationally defined as adoption of farmers to take up the NRM technologies to their field level.

Scoring: The farmers were asked to elicit the extent to which they have adopted NRM technologies on a three point continuum i.e adopted, partial adopted and never. The scores of 2, 1 and 0 were assigned accordingly to these three categories of the continuum. The total score of each farmer was worked out by summing up scores of all statements. Whereas the maximum and minimum scores obtained were 24 and 1 respectively.

Categorization: The respondents were grouped into following three categories i.e. low adoption of NRM technologies, medium adoption of NRM technologies and high adoption of NRM technologies to drought based on exclusive class interval technique.

S.No	Category	Class interval
1	Low	1-8
2	Medium	9-16
3	High	17-24

3.3.1.2.1.2 Crop related technologies: It was operationally defined as adoption of farmers to take up the crop related technologies to their field level.

Scoring: The farmers were asked to elicit the extent to which they have adopted crop related technologies on a three point continuum i.e adopted, partial adopted and never. The scores of 2, 1 and 0 were assigned accordingly to these three categories of the continuum. The total score of each farmer was worked out by summing up scores of all statements. Whereas the maximum and minimum scores obtained were 27 and 4 respectively.

Categorization: The respondents were grouped into following three categories i.e. low adoption of NRM technologies, medium adoption of NRM technologies and high adoption of NRM technologies to drought based on exclusive class interval technique.

S.No	Category	Class interval
1	Low	4-11
2	Medium	12-19
3	High	20-27

3.3.1.2.1.3 Livestock: It was operationally defined as adoption of farmers to take up the livestock technologies to their field level.

Scoring: The farmers were asked to elicit the extent to which they have adopted livestock technologies on a three point continuum i.e adopted, partial adopted and never. The scores of 2, 1 and 0 were assigned accordingly to these three categories of the continuum. The total score of each farmer was worked out by summing up scores of all statements. Whereas the maximum and minimum scores obtained were 11 and 3 respectively.

Categorization: The respondents were grouped into following three categories i.e. low adoption of NRM technologies, medium adoption of NRM technologies and high adoption of NRM technologies to drought based on exclusive class interval technique.

S.No	Category	Class interval
1	Low	0-3
2	Medium	4-7
3	High	8-11

3.3.1.2.1.4 Institutional interventions: It was operationally defined as adoption of farmers to take up the Institutional interventions to their field level.

Scoring: The farmers were asked to elicit the extent to which they have adopted Institutional interventions technologies on a three point continuum i.e adopted, partial adopted and never. The scores of 2, 1 and 0 were assigned accordingly to these three categories of the continuum. The total score of each farmer was worked out by summing up scores of all statements. Whereas the maximum and minimum scores obtained were 5 and 1 respectively.

Categorization: The respondents were grouped into following three categories i.e. low adoption of NRM technologies, medium adoption of NRM technologies and high adoption of NRM technologies to drought based on exclusive class interval technique.

S.No	Category	Class interval
1	Low	0-1
2	Medium	2-3
3	High	4-5

3.3.1.2.1.5 Level of overall adoption of CRA: In order to have comprehensive understanding on adoption of CRA technologies the farmers overall adoption of CRA was calculated. The overall adoption of CRA was operanalised as the sum of adoption of four components (NRM, crop related technologies, livestock and institutional). The score of overall adoption of CRA for each respondent was calculated by summing up the scores of four components of adoption. The maximum and minimum obtained scores were 54 and 7 respectively. The respondents were grouped into following three categories based on exclusive class interval technique.

S.No	Category	Class interval
1	Low	7-22
2	Medium	23-38
3	High	39-54

3.3.1.2.2 Level of Adoption of Coping Mechanism: It refers to the extent of adoption of measures to cope up the effects or to minimize the impact of climate change (drought) for CRA.

Scoring: The farmers were asked to elicit their extent of adoption of coping mechanisms on a three point continuum i.e many times, some times and never. The scores of 2, 1 and 0 were assigned respectively to these three categories of the continuum. The total score of each farmer was worked out by summing up scores of all statements. The maximum and minimum scores obtained were 18 and 4 respectively.

Categorization: The respondents were grouped into the following three categories i.e. low, medium and high adoption of coping mechanisms to drought based on exclusive class interval technique.

S.No	Category	Class interval
1	Low	4-8
2	Medium	9-13
3	High	14-18

3.3.2 Independent Variables

3.3.2.1 Age: It refers to the chronological age of the respondents in completed years at the time of investigation.

The respondents were asked to indicate their age in completed years as on the date of data collection. A score of one was assigned foe each completed year. The farmers were grouped into three categories based on their total score. The results were expressed in the form of frequencies and percentages.

Category	Years
Young	35 Years and below
Middle	36-60 Years
Old	60 Years and above

3.3.2.2 Education: It was operationally defined as the educational level attained by the individual respondent at the time of investigation.

According to their education level, the respondents were grouped in to 6 categories and scoring was assigned as fallows. The results were expressed in the form of frequencies and percentages.

S.No	Education	Score
1	Illiterate	0
2	Primary School	1
3	Middle School	2
4	High School	3
5	College Education	4
6	Graduation & above	5

3.3.2.3 Farming experience: The farming experience was operationalised as the number of years completed in farming at the time of investigation.

Scoring: A score of one was assigned to each completed year of experience.

Categorization: The respondents were grouped into following three categories i.e. low, medium and high based on exclusive class interval technique.The results were expressed in the form of frequencies and percentages.

Category	Class interval
Low farming experience	2-18
Medium farming experience	19-35
High farming experience	36-52

3.3.2.4 Farm size: It was operationally defined as the number of acres of land possessed by the respondents.

Scoring: One score was assigned for each acre of land possessed by the farmer. The total score of each farmer is worked out by summing up scores on all acres of land possessed by the farmer.

Categorization: The respondents were grouped into five categories namely marginal , small, semi medium , medium and large respectively, the grouping were done to have clear picture about the land holding size of the respondents .

Sl.No	Category	Score
1	Marginal (0.5 to 1 ha)	1
2	Small (1.1-2.0 ha)	2
3	Semi medium (2.1-4.0 ha)	3
4	Medium (4.1 ha- 10.0 ha)	4
5	Large (above 10 ha)	5

3.3.2.5 Availability of water resources: It was operationalized as the water resources available with the respondent's *viz.*, Rainfed or irrigated.

Scoring: The score of 1 is assigned to the rainfed farmers, whereas "0" for no. In case of irrigated, if yes score 1 was assigned and 0 for no. The sum of the scores of all the respondents was represented in the form of percentages and frequencies.

If the farmers were irrigated than, the sources of irrigation were also identified and one score was given to each source. The total score of each respondent is worked out by summing up scores obtained on of all irrigation sources possessed by him.

S. No	Source of irrigation	Yes (1)	No (0)
1	Open wells		
2	Bore wells		
3	Tanks/water house		
4	Canals		

3.3.2.6 Frequency of occurrence of drought: It refers to the number of times of droughts have occurred a period of time.

Depending up on the occurrence of drought, It was measured in terms of Yearly once, Once in 2 years, Once in 3 years and Once in 4 years with scores '4', '3' 2 and '1' respectively. The maximum and minimum possible scores are 4 and 1 respectively. Later they were grouped into four categories as given below.

S. No	Frequency of occurrence of drought	score
1	Once in 4 years	1
2	Once in 3 years	2
3	Once in 2 years	3
4	Yearly once	4

3.3.2.7 Farming systems: It was operationalized as complex combination of enterprises existing with respondents.

Depending up on the type of farming systems taken up by the respondents, the response categories were Single crop, >1 crop (Ag or Horticultural crops), Ag+Hort, Ag/Hort+ AH/poultry/goat, Ag crops + Horticultural crops + AH/poultry / goat, and Ag crops + Horticultural crops + AH/poultry / goat+ Mulberry+ Sericulture. The scores assigned were 1,2,3,4,5,6,7 and 8 respectively. The maximum and minimum possible scores are 4 and 1 respectively. The respondents were categorized as under.

S. No	Farming system	Score
a.	Single crop	1
b.	>1 crop (Ag or Horticultural crops)	2
c.	Ag crops + Horticultural crops	3
d.	Ag/Hort+ AH/poultry/goat	4
e.	Ag crops + Horticultural crops + AH/poultry / goat	5
f.	Ag crops + Horticultural crops + AH/poultry / goat+ Mulberry+ Sericulture	6

3.3.2.8 Socio Economic Status: Socio economic status was operationalized as consisted of 4 items namely a) family size b) occupation c) annual income d) socio political participation. The respondents score on the socio economic status was computed by adding all scores obtained in the above items. The maximum obtained score was 15 and the minimum obtained score was 4. Based on the exclusive method of class interval, the socio economic status of respondents was categorized as follows.

S.No	Category	Score
1	Low	4-7
2	Medium	8-11
3	High	12-15

A. Family size: Family size implies the size of the family, measurement and scoring was done in accordance with the socio-economic status scale developed by Venkatramaiah (1983) revised (1990) and the women were grouped into the following categories.

S. No	Category	Score
1	Small (1 to 4 members)	1
2	Medium (4 to 6 members)	2
3	Large (>6 members)	3

b) Occupation: This variable was operationally defined as the nature of the job held by the respondents' at the time of investigation. The response categories were agriculture, labour + agriculture, subsidiary + agriculture and labour + subsidiary + agriculture and the scores assigned were 1, 2, 3 and 4 respectively. The respondents were categorized as under.

S.No	Occupation	Score
1	Farming/Agriculture	1
2	Labour + Agriculture	2
3	Subsidiary + Agriculture	3
4	Labour + Subsidiary + Agriculture	4

C. Annual income: It refers to the annual income of the respondents. An open ended schedule was developed to know the annual income of the respondents.

The schedule developed to identify their annual income of the respondents was furnished in the Appendix I. The respondents were asked to indicate their annual income with their annual income. Based on their annual incomes they were divided into three categories viz., low annual income group for below Rs. 60,000 income/ annum, middle annual income group for Rs. 60,000-1, 20,000 income/ annum, high annual income group for respondents with the income above Rs. 1, 20,000 per annum. Scores assigned for the three categories are 3, 2, and 1 for the high, medium and low annual income.

S. No	Annual income (Rs.)	Scores
1	Low (below 60,000)	1
2	Medium (60,000-1,20,000)	2
3	High (above 1,20,000)	3

d) Socio-political participation: Socio-political participation scale developed by the Venkataramaiah (1990) was used to measure the socio-political participation with the suitable modifications. The membership position of the respondents was given a score of 4, 3, 2, 1, and 0 for the office bearer, financial contribution/suggestions/support for developmental activities, official position in social and political committee, Official position in one or more organizations and no official position in socio political participation. The maximum and the minimum scores ranged between 4 and 0. Later they were grouped into five categories as given below.

S.No	Level of participation	Score
1	No official position in socio political participation	0
2	Official position in one or more organizations	1
3	Official position in social and political committee	2
4	Financial contribution/suggestions/supportfor developmental activities	3
5	office bearer in any organization	4

3.3.2.9 Social Affiliation: It was operationally defined as extent of a respondent's desire to feel a sense of belonging or involvement with in a social group.

Scoring: This variable comprised of 6 statements with a three point continuum of Agree, Undecided and Disagree for which scores of 3, 2 and 1 were assigned respectively. The scores obtained on all the statements were summed up to arrive at a total score of each respondent. The maximum and minimum possible scores were 18 and 6.

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

S.No	Category	Class interval
1	Low	14-15
2	Medium	16-17
3	High	18-19

3.3.2.10 Training received: In this study training received operationally defined as number of training programmes farmers have undergone on CRA and on what areas they have received the trainings. Trainings attended weigh up whether farmers undergone any training programme if yes score 1 was assigned and 0 for no.

The areas on which farmers were trained studied with the help of an schedule. based on the review of the literature the areas of training were categorized into integrated farming systems, soil moisture conservation measures, organic farming, water harvesting technologies, demonstration on silage making and micro irrigation techniques. Scores were assigned to each of the category and respondents were graded accordingly.

The score of 1 is assigned to the area of trainings undergone by the respondents. The sum of the scores of all the respondents were represented in the form of percentages and frequencies.

3.3.2.11 Sources of Information Utilization: It is operationalized as individual, group and mass contact information sources utilized by the respondents. Respondents score on Sources of Information Utilization was obtained by adding all the scores obtained in the above sources. The respondents were grouped into the following five categories based on exclusive class interval technique.

S.No	Category	Class interval
1	low	8-12
2	Medium	13-17
3	High	18-22

3.3.2.11.1 Individual and Mass Media Exposure: Respondents were asked how often they were exposed to individual, group and mass media sources on a three point continuum of regular, occasional and never for which scores of 2, 1 and 0 were assigned respectively. The scoring pattern followed was given below.

S. No	Source	Regular (2)	Occasional (1)	Never (0)
a) Individual contact				
1	Adarsha Rythu			
2	Agricultural Extension Officer / MAO			
3	Scientists of Agricultural Universities			
4	Input Agencies/ Dealer			
5	NGO personnel			
6	Neighbors/ Friends			
7	Any other			
b) Mass Media Exposure				
1	Radio			
2	Television			
3	News paper			
4	Magazines/Books on agriculture and allied fields			
5	Mobiles			
6	Computers			
7	Others			

3.3.2.12 Credit Availability: It was operationalized as the extent of availability of credit to meeting the needs of the respondent. It was also defined as the number of times the respondents availed the loan and source of the loan amount. A schedule was developed for all the components and was furnished in the Appendix-I. Scoring for the components was done in the method as given below.

a) No of times received loan: This section clearly indicates the number of times the farmers had received the loan. Scoring was given as itself the number that they have taken, based on the number they were grouped into three categories of less , average and more number of loans.

Sl. No	Category	Criterion
1	Low	1-8
2	Medium	9-17
3	High	18-26

b) Source of Credit: This head clearly indicated that, from where the farmers have taken the loans. Scores were assigned to the each source as given below.

S.No.	Source	Score
1.	Private Money Lenders	1
2.	Banks	2
3.	Relatives and Friends	3

3.3.2.13 Food Security:

Food security is defined as a state in which “all the people at all times have sufficient food to meet their dietary needs for a productive and healthy life”. For measuring food security of a respondent’s family Household Food Insecurity Access Scale (HFIAS) used by Jennifer et al. (2007), which is an adaptation of approach used to estimate the prevalence of food insecurity in the United States (U.S.) annually was referred and used with slight modifications. The scale comprised of the nine statements.

Scoring:

Five statements about occurrence of certain events related to food accessibility for which the respondents has to answer on three point continuum regular, occasional and never and scores assigned were 2, 1 and 0 respectively. The scores obtained on all the statements were summed up to arrive at a total score of each respondent. The maximum and minimum possible scores were 12 and 4.

Categorization: Based on the total score, the respondents were categorized into three categories i.e. low, medium and high food security.

Category	Score
Low	4-6
Medium	7-9
High	10-12

3.3.2.14 Traditionalism:

This variable was operationalized as the extent of agreement about relationship that is believed to exist between the cultural beliefs, religious practices and farming.

Scoring and Categorization: A scale was developed for the variable. It was measured on three point continuum i.e., agree, undecided and disagree with the scores of 1, 2, 3 respectively. The individual score was obtained by summing up all the scores of all the statements. The respondents were categorized into following three categories based on exclusive class interval method. The maximum and minimum scores were 20 and 6 respectively.

S.No.	Category	Class Interval
1.	Low	6-10
2.	Medium	11-15
3.	High	16-20

3.3.2.15 Risk taking ability: Risk taking ability was operationalized as the degree to which the farmer is oriented towards taking risk and facing uncertainty in farming.

To measure this variable a set of 5 statements were prepared related to risk taking ability of a farmer.

Scoring: A score of three '3', '2' and '1' is assigned to agree, undecided and dis agree responses respectively. The maximum and minimum possible scores are 15 and 5 respectively. Whereas the maximum and minimum scores obtained were 18 and 7 respectively. The total score of each farmer is worked out by summing up the scores obtained on all the statements.

Categorization: The respondents were grouped into following three categories i.e. low risk taking ability, medium risk taking ability and high risk taking ability based on exclusive class interval technique. The results were expressed in the form of frequencies and percentages.

Category	Class interval
Low	7-10
Medium	11-14
High	15-18

3.3.2.16 Weather Based Agro Advisory Services: It was operationally defined as the extent to which a respondent is receiving WBAAS from various sources such as mass media, extension officers etc. The maximum and minimum possible scores are 37 and 9 respectively. Whereas the maximum and minimum scores obtained were 29 and 0 respectively. The total score of each farmer is worked out by summing up the scores obtained on all the statements. Based on the total scores obtained by the respondents they were classified into three categories low, medium and high by using exclusive class interval technique as given below

S.No	Category	Score
1	Low	0-9
2	Medium	10-19
3	High	20-29

3.3.2.17 Community Infrastructural facilities: Community infrastructural facilities were measured in terms infrastructure possessed by the community members. The score of one was assigned if the community has the infrastructure facility. The total score of each farmer is worked out by summing up the scores obtained on all the statements. Whereas the maximum and minimum scores obtained were 8 and 3 respectively. Based on the total

scores obtained by the respondents they were classified into three categories low, medium and high by using exclusive class interval technique as given below.

S.No	Category	Score
1	Low	3-4
2	Medium	5-6
3	High	7-8

3.4 Rural settings analysis on changing climate through participatory approaches

It was operationalized as the rural settings to overcome the drought were analyzed through selected PRA tools by community farmers.

In this present study, village resource map, transect walk, agro- ecology map and seasonal calendar are selected from a range of tools of the PRA.

3.4.1 Village resource mapping

Village mapping is the method used to help the village people to know and understand clearly the actual situation of the villages. it provides the information on how the village is being utilized. The village mapping is used as a mirror to see clearly and identify problems and potentials of the village.

This indicates both the natural resources and man-made resources needed for development of agriculture. Ensure the participation of all stakeholders (male, female, old, young and children). Depict main crops, trees, animals, farm implements, communication items, human resources for agriculture like skilled labour, technical manpower (AO, VO) etc.

The village resource map shows the different kind of natural and manmade recourses such as land, vegetation, common land use, soil, water, minerals, transport and source of communication and different supply and service organization.

3.4.2 Transect walk

A transect is a walk across the village following a predetermined route on the map which indicates environmental, physical and socio economic diversity. It involves recording the landscape, soil types, vegetation, farming activities degradation and

tendencies, services. The walk verifies what has been indicated on the map. It enriches the resident's knowledge about their village and fills in the information gaps missed during mapping. The farmers appreciate this trip to the field for it helps them to internalize problems related to farming, activities, which affect development.

Objectives

- On spot verification of information obtained through mapping of village and to provide source of information for semi structured interview
- To identify the diversity of resources, potential and problem in the village
- To identify find out tendencies and problems of each zone of the village
- Presentation of transect diagram

The transect is made by mixed sub groups with representatives from various socio interest groups. Each subgroup should select a recorder to take notes of what will be observed. At the end of the walk the information collected from the transect conducted is presented in a tabulated form. The drawing is made by the recorder with the help of sub groups.

Table 3.11 Showing the format of transect axis

Distance			
Soil Type			
Vegetation			
Crops			
Weeds			
Live Stock			
Water Bodies			
Water Table			
Problems			
Solutions			
Opportunities			

3.4.3 Agro-ecology map

Agro ecological map was drawn to identify the various agro ecological zones present in the village. Special emphasis was given to mark the various crops, soil types, water bodies, weeds, water sources and irrigation system, livestock, trees and other aspects related to agro ecology.

3.4.4 Seasonal calendar

This is a calendar which indicates month wise, abnormalities, specialties, threats, problem, abundance, shortage, with regard to agriculture in a dramatic way. This explores seasonal constraints and opportunities by diagramming changes, month by month throughout the year. The items to be included in seasonal analysis must be of those items, which really affect the agriculture. The entire agriculture is based on season. For preparing realistic action plan, farm plan, need based extension programme and need based technology development project, seasonal analysis will be a boon.

In this present study it is prepared for climatic variations (rain fall, temperature and humidity) by diagramming changes, month by month throughout the year. The climate plays an important role in agricultural development of an area. The rainfall, temperature and relative humidity affect the cropping pattern, crop production and adoption of crop technologies. The growth, health and yield of a crop are greatly influenced by the climatic factors.

3.5 Problems and Suggestions Elicited by the Respondents in Adoption of Technologies for Climate Resilient Agriculture

Problems by the respondents were operationally defined as difficulties/constraints faced by respondents in adoption of technologies for CRA. The respondents were asked to express the problems faced by them and elicit suggestions simultaneously.

Suggestions by the respondents were operationally defined as the solutions given by them for overcoming the problems faced by them during the adoption of technologies for CRA. The respondents were requested to give their suggestions against the problem stated by them and were recorded. The results were explained in the form of frequency and percentages.

3.5 COLLECTION OF DATA

3.5.1 Instruments used for the study

Data were collected from the selected respondents by using the interview schedule developed for the study. The interview schedule was developed in consultation with the advisory committee, experts in the field of CRA, Agricultural Extension, Statistics and Mathematics etc. extensive review of literature was done for developing the schedule. The interview schedule was pre-tested with the respondents (15 members) outside the study area, where similar conditions prevailed. Based on the experience gained in the pre-testing, the interview schedule was suitably modified wherever necessary. The finalized interview schedule used for the study was provided in Appendix A.

Interview schedule consisted of four parts. The first part consisted of primary information of the respondent i.e., respondent number, name, village and mandals. The second part consisted of independent variable i.e. profile characteristics of respondent and third part consisted of the dependent variables, i.e., climate readiness, attitude and level of adoption of respondents of CRA. In fourth part schedule selected for PRA techniques was given. Interview schedule was constructed in English and translated to Telugu language.

3.5.2 Method of data collection

Each selected respondent 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, behaviour, emotions, feelings, ideas, aspirations and surroundings were also made use of during interview. Participatory techniques were also used to analyse rural settings in view of changing climate.

3.6 STATISTICAL TOOLS USED

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

3.6.1 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 if it is part of a total which is 100.

3.6.2 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.

3.6.3 Arithmetic mean ($\overline{X}$)

The mean is the quotient that results when sum of all the items in the series is divided by the number of items.

$$\overline{X} = \frac{\sum x}{n}$$

Where

$\overline{X}$ = Mean

Σx = Sum of all the items

n = Number of items

3.6.4 Ranking

The responses of the farmers were analyzed by using the ranking method in some of the variables. Ranks were assigned for all the statements as per the priorities given by the respondents.

When the statement was developed with a scale of 'n' point continuum carrying scores of n, n-1, n-2, n-3,…., the total score for each item was obtained by the following formula:

Total score = n×f1+ (n-1) ×f2 + (n-2) ×f3+ (n-3) ×f4…. where, f1, f2, f3, f4,… are the frequencies of the respondents scoring n, n-1, n-2, n-3, n-4… respectively. Ranking was done based on the total obtained score.

3.6.5 Coefficient of Correlation

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

$$r = \frac{\sum xy - \frac{\left(\sum x\right)\left(\sum y\right)}{n}}{\sqrt{\sum x^2 - \frac{\left(\sum x\right)^2}{n} \cdot \sum y^2 \frac{\left(\sum y\right)^2}{n}}}$$

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

3.6.6 Multiple Linear Regression Analysis (MLR)

Regression:

Multiple linear regression analysis was employed to find out the contribution of various independent variables, in combination with dependent variables. In other words the

influence of various independent variables on dependent variables viz., attitude and knowledge was obtained by regression analysis.

Multiple linear regression analysis:

Multiple linear regression was used to find out the relative contribution of each of the significant independent variables with level of adoption of CRA.

The regression equation may be written as

$$\mathbf{Y=}\ a+b_1x_1+b_2x_2+b_3x_3+\ldots\ldots..b_kx_k$$

Where a = intercept

$b_{1=}$ the partialregression coefficient represents the amount of the change in Y that can be associated with a unit change in x_1 the remaining independent variables held constant.

x_i= I^{th}independent variable for I = 1, 2, 3……k

3.6.7 Wilcoxon-Mann–Whitney's U test

It is a non-parametric statistical test for assessing whether one of two samples of independent observations tends to have larger values than the other. It is a non-parametric test equivalent of Student's t-test.

3.6.8 Kruskal–Wallis one-way analysis of variance:

A non-parametric method for testing whether samples originate from the same distribution and are used for comparing more than two samples those are independent, or not related. The parametric equivalence of the Kruskal-Wallis test is the one-way analysis of variance (ANOVA). The factual null hypothesis is that the populations from which the samples originate have the same median. When the Kruskal-Wallis test leads to significant results, then at least one of the samples is different from the other samples. It is an extension of the Mann–Whitney U test to 3 or more groups.

3.7 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

This chapter is the central core of the research study. It is an amalgam of the results and findings based on data collected from the field and from other sources. The results are based on analysis of the data with regard to adoption level of climate resilient agriculture technologies, constraints in adoption and suggestions for up-scaling and out scaling the technologies. The results are presented, discussed and interpreted under the following rubics:

Keeping the above objectives in view, the empirical evidences obtained in terms of actual data have been analyzed by subjecting them to the appropriate statistical and analytical tests and the findings thus arrived are presented in order and suitable conclusions were drawn. The results of the study are presented under the following sub heads.

4.1 Profile characteristics of respondents

4.2 Rural settings on changing climate through participatory approaches

4.3 Assess the adaptive capacity of farmers in terms of their climate readiness and attitude of respondents towards Climate Resilient Agriculture technologies

4.4 Level of adoption of Climate Resilient Agriculture technologies and coping mechanisms for Climate Resilient Agriculture

4.5 Relationship between profile characteristics of respondents and level of adoption of Climate Resilient Agriculture technologies

4.6 Problems and suggestions elicited by the respondents in adoption of technologies for Climate Resilient Agriculture

4.7 Strategies for transfer of technologies for Climate Resilient Agriculture

4.1. PROFILE CHARACTERISTICS OF RESPONDENTS

This section deals with the findings and discussion regarding the profile characteristics of the climate resilient agriculture farmers of the both NICRA and non NICRA. Profile of the respondents included age, education, farming experience, farm size, availability of water resources, frequency of occurrence of drought, farming system, socio economic status, social affiliation, trainings undergone on CRA, sources of information utilisation, credit availability, food security, traditionalism, risk taking ability, weather

based agro advisory services and community infrastructural facilities. The distribution of the respondents into the different categories based on their profile characteristics were presented in the tables by dividing the sample into three groups by class interval method and discussed.

4.1.1 Age

It could be observed from the Table 4.1 and Figure.4.1 that majority (75.00%) of the NICRA farmers of Ananthapur district were belonged to middle age group followed by 21.67 per cent were old age group and rest of them (3.33%) were young age group. Among the non NICRA farmers of Ananthapur district majority (83.33%) of the farmers were middle aged group followed by young (10.00%) and old age (6.67%).

Table 4.1. Distribution of respondents according to their Age

S. No	Age in years	Ananthapur				Nalgonda				(Overall)		(Overall)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=120)		Non NICRA farmers (n=120)	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Young (up to 35 years)	2	3.33	6	10.00	13	21.66	10	16.67	15	12.50	16	13.34
2	Middle (35 to 60)	45	75.00	50	83.33	43	71.67	47	78.33	88	73.33	97	80.83
3	Old (above 60)	13	21.67	4	6.67	4	6.67	3	5.00	17	14.17	7	5.83
	Total	60	100	60	100	60	100	60	100	120	100	120	100

In Nalgonda district the majority (78.33%) of the NICRA farmers belonged to middle age (71.67%) group followed by young (21.66%) and old age category (6.67%). In non NICRA majority (78.33%) of the farmers were middle age group followed by young (16.67%) and old age (5.00%).

On the whole it was found that majority (73.33%) of NICRA farmers belonged to middle age followed by old (14.17%) and young age (12.50%) category. In Non NICRA majority (80.83%) of farmers belonged to middle age followed by young (13.34%) and old age (5.83%) category.

It could be concluded from the Table 4.1 that middle age respondents were dominated the sample in both NICRA and non NICRA categories. The probable reason

might be that young people prefer to go to towns and cities for higher education and business. The young generation did not have an aptitude to take up farming as profession because of low profitability and are not willing to take up hard works, only preferring white collar jobs. The old age farmers preferred to stay at their home. The above two reasons might account for low per cent of young and old age group farmers respectively. Hence the Government and Department of Agriculture should ensure more profitability in agriculture, there by the young generation of our society may opt farming as their profession. This is in conformity with the results by Sharma *et al.* (2012) and Omid *et al.* (2012).

4.1.2 Education

Table 4.2. Distribution of respondents according to their Education

S. No	Education	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	F	%
1	Illiterate	13	21.67	13	21.67	20	33.33	50	83.33	33	27.50	63	52.50
2	Primary school	19	31.67	9	15.00	7	11.67	2	3.33	26	21.67	11	9.17
3	Upper Primary school	3	5.00	6	10.00	5	8.33	2	3.33	8	6.67	8	6.67
4	High School	10	16.67	20	33.33	13	21.67	3	5.00	23	19.17	23	19.17
5	Intermediate	9	15.00	5	8.33	9	15.00	1	1.67	18	15.00	6	5.00
6	Graduation and above	6	10.00	7	11.67	6	10.00	2	3.33	12	10.00	9	7.50
	Total	60	100.00	60	100.00	60	100.00	60	100.00	120	100.00	120	100.00
	Literate	47	78.34	47	78.33	40	66.67	10	16.66	87	72.51	57	47.51

It could be vividly seen from the Table 4.2 and Figure.4.2 that in Ananthapur district 31.67 per cent of the NICRA farmers were primary school followed by illiterate (21.67%), high school (16.67%), intermediate (15.00%), graduation (10.00%) and upper primary school (5.00%). While in case of non NICRA 33.33per cent of the respondents were belonged to high school education followed by the illiterate (21.67%), primary school (15.00%), graduation and above (11.67%), upper primary school (10.00%) and intermediate (8.33%). In Nalgonda district the majority (33.33%) of the NICRA farmers were illiterate followed by high school (21.67%), intermediate (15.00%), primary school (11.67%), graduation and above (10.00%) and upper primary school (8.33%). While in case of majority (83.33%) of non NICRA farmers were illiterate followed by high school (5.00%), primary school (3.33%), upper primary school (3.33%), graduation and above (3.33%) and intermediate.

On the whole it was noticed that 27.50 per cent of the of the NICRA farmers were illiterates followed by primary school education (21.67%), high school education (19.17%), intermediate (15.00%), graduation and above (10.00%) and upper primary school (6.67%). while in case of non NICRA majority (52.50%) of farmers were illiterates followed by high school education (19.17%), primary school (9.17%), graduation and above (7.50%) and upper primary school (6.67%).

On the whole the above categorization revealed that majority of respondents of the both groups fell under illiterate category. It was noticed that difference was found in terms of their education among the NICRA and non NICRA village farmers. In NICRA it was counted high as remaining per cent of the respondents were educated which can be concluded that literacy per cent was high compared to that of the illiteracy. This might be due to the increased awareness on importance of education, access to government schools in and around their villages where the students could get free education might have resulted in change of educational status of the farmers compared to the earlier days. The print media along with leaflets, magazines and social media could be easily utilized to increase the adoption level about CRA among the farmers. While in case of non NICRA illiteracy seems to be dominant, it probably speaks the hard life of the non NICRA farmers discouraging them from attending the schools and taking interest in education. The outcomes of this variable were in line with the finding of Lokhande (2013) and Sujit (2014).

4.1.3 Farming experience

It could be indicated from the Table 4.3 and Figure.4.3 that in Ananthapur district the majority (71.67%) of respondents of NICRA were fell under medium farming experience followed by high (25.00%) and low (3.33%). In the non NICRA majority of the farmer were fell under medium (58.33%) followed by low (21.67%) and high (20.00%).

In Nalgonda district majority (66.67%) of NICRA farmers were belonged to medium followed by low (33.33). With respect to non NICRA majority (65.00%) of the farmers were belonged to medium followed by high (23.33%) and low (11.67%).

On the whole the majority (69.17%) of respondents of NICRA were fell under medium farming experience followed by low (18.33%) and high (12.50%). While in case of non NICRA majority (61.67%) of the farmers were belonged to medium followed by high (21.67%) and low (16.67%).

Table 4.3. Distribution of respondents according to their farming experience

S. No	Farming experience	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	F	%
1	Low (2-18)	2	3.33	13	21.67	20	33.33	7	11.67	22	18.33	20	16.67
2	Medium (19-35)	43	71.67	35	58.33	40	66.67	39	65.00	83	69.17	74	61.67
3	High (36-52)	15	25.00	12	20.00	0	0.00	14	23.33	15	12.50	26	21.67
	Total	60	100	60	100	60	100	60	100	120	100	120	100

On the whole the results revealed that majority of the respondents in overall NICRA group had medium farming experience might be due to NICRA farmers had medium farming experience in both Ananthapur and Nalgonda leads them to fell under the medium category. Similar results were found in over all non NICRA also. The probable reason for this medium experience of the respondents in farming in both NICRA and non NICRA groups might be attributed to their middle age. Definitely the farming experience is an important factor which influences the farmers to accept, evaluate and experiment the innovative technologies in their farm. But the richness of farming experience is more important than no. of years of farming experience. Hence, to improve the quality and richness of experience the extension agencies have to conduct extension activities like trainings, result demonstrations, method demonstrations, meetings, exposure visits and group discussions etc., to encourage them to adopt CRA technologies. This is in conformity with the results of Raju (2002), Chidananda (2008), Chinnam Naidu (2012) and Pynbianglang Kharumnuid (2011).

4.1.4 Farm size

It could be observed from the Table 4.4 and Figure.4.4 that majority (81.67%) of NICRA farmers of Ananthapur district were belonged to Semi medium followed by similar portion (6.67%) of small and medium, marginal (3.33%) and large farmers (1.67%). While in case of non NICRA majority (81.67%) of framers were belonged to medium farm size followed by semi medium (18.33%) and none of them found to be marginal, small and large farmers. In the Nalgonda district the 46.67 per cent of the NICRA farmers were medium followed by semi medium (38.33%), small (15.00%) and none of them found to be

marginal and small. Whereas in non NICRA farmers majority (40.00%) of them were belonged to small followed by marginal (33.33%) and semi medium (23.33%), medium (3.33%) and none of them found to be large farmers .

On the whole majority (60.00%) respondents of NICRA were belonged to semi medium followed by medium (26.67%), small (10.83%), marginal (1.67%) and large (0.83%). Whereas 42.50 per cent of respondents of non NICRA were belonged to medium followed by semi medium (20.83%), small (20.00%), marginal (16.67%) and none of them found to be large farmers.

The above results could be perceived that the majority of overall NICRA farmers had semi medium followed by medium might be due to semi medium farmers in Ananthapur NICRA and medium farmers in Nalgonda NICRA lead them to fall under the semi medium category. The most of the overall non NICRA farmers had medium farm size might be due to medium farm size in Ananthapur non NICRA and small farmers in Nalgonda NICRA lead them to fall under the medium category. The reason could be the sub division and fragmentation of the farm land from one generation to another generation is the main cause for declining the land holding size of each farmer in the rural areas. This is in conformity with the results of Sridhar (2002), Reddy (2005), Savita (2011) and Chinnam Naidu (2012).

Table 4.4. Distribution of respondents according to their size of land holding

S. No	Farm size	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	F	%
1	Marginal (<1 acres)	2	3.33	0	0.00	0	0.00	20	33.33	2	1.67	20.0	16.67
2	Small (1-2 acres)	4	6.67	0	0.00	9	15.00	24	40.00	13	10.83	24.0	20.00
3	Semi medium (2-4 acres)	49	81.67	11	18.33	23	38.33	14	23.33	72	60.00	25.0	20.83
4	Medium (4-10 acres)	4	6.67	49	81.67	28	46.67	2	3.33	32	26.67	51.0	42.50
5	Large (>10 acres)	1	1.67	0	0.00	0	0.00	0	0.00	1	0.83	0	0.00
	Total	60	100	60	100	60	100	60	100	120	100	120	100

4.1.5 Availability of water resources

It could be observed from the Table 4.5 and 4.6 that majority (96.67%) of NICRA farmers of Ananthapur district were rainfed farmers. Majority (66.67%) of them was not Irrigated farmers and rests (33.33%) of the farmers were giving irrigation to their fields only in critical stages of crop, while in case of Ananthapur non NICRA cent per cent (100.00%) of the farmers were rainfed farmers. Majority (68.33%) of the farmers were not irrigated farmers and rest (31.67%) of farmers were giving irrigation to their fields in critical stages of crop.

In Nalgonda district majority (98.33%) of the NICRA farmers were rainfed farmers. Majority (76.67%) of farmers irrigated only in critical stages of crop and rest (23.33%) of farmers were not giving irrigation to their crops. While in case of Nalgonda non NICRA majority (98.33%) of the farmers were belonged to rainfed farmers. Majorities (78.33%) of the farmers were not irrigated farmers and rests (21.67%) of farmers were giving irrigation to their fields only in critical stages of crop.

On the whole majority (97.50%) of the NICRA farmers were belonged to rainfed farmers. Among them about 55 per cent of farmers was giving irrigation to the fields only in critical stages by using mostly bore wells (60.00%). Where as in non NICRA majority (99.17%) of the farmers were belonged to rainfed farmers among them only few farmers (26.67%) were giving irrigation to the fields only in critical stages by using mostly bore wells (65.83%).

It could be seen from the results that in both groups NICRA and non NICRA farmers were belonged rainfed but comparatively in NICRA group most of the farmers were giving irrigation with bores in critical stages of the crop than non NICRA. The probable reason for this adoption of NRM technologies were medium category by NICRA farmers due to this soil erosion was controlled, increased soil moisture conservation measures, by formation of feeder channel, check dam was filled water. Water level raised 5-6 m in bore wells, which were located in the vicinity of check dam. In case of non NICRA framers fell under low category of adoption of NRM technologies due to this the bore wells also not recharged, farmers were not able to give irrigation to the fields in critical stages also and these farmers were completely rainfed farmers without doing any operations in the field. This is in conformity with the results of Praveena (2010), Subramanyam (2003) and Kruparkar (2001).

Table 4.5. Distribution of respondents according to their Availability of water resources

S. No	Availability of water resources		Ananthapur				Nalgonda				(Overall)		(Overall)	
			NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=120)		Non NICRA farmers (n=120)	
			F	%	F	%	F	%	F	%	F	%	F	%
1	Rainfed	Yes	58	96.67	60	100	59	98.33	59	98.33	117	97.50	119	99.17
		No	2	3.33	0	0	1	1.67	1	1.67	3	2.5	1	0.83
2	Irrigated	Yes	20	33.33	19	31.67	46	76.67	13	21.67	66	55.00	32	26.67
		No	40	66.67	41	68.33	14	23.33	47	78.33	54	45.00	88	73.33
	Total		60	100	60	100	60	100	60	100	120	100	120	100

Table 4.6. Distribution of respondents according to their source of irrigation

Source of Irrigation	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
	NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
	F	%	F	%	F	%	F	%	F	%	F	%
Open wells	22	36.67	19	31.67	39	65.00	38	63.33	61	50.83	57	47.50
Bore wells	31	51.67	50	83.33	41	68.33	29	48.33	72	60.00	79	65.83
Tanks/Water house	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Canals	0	0.00	3	5.00	0	0.00	0	0.00	0	0.00	3	2.50

4.1.6 Frequency of occurrence of drought

It could be observed from the Table 4.7 and Figure.4.5 that 46.67 per cent of the NICRA farmers of Ananthapur got drought yearly once followed by once in two years (35.00%) and once in three years (18.33%),whereas in Ananthapur non NICRA majority (65.00%) of them got drought yearly once followed by once in two years (35.00%). In respect to Nalgonda majority (61.67%) of NICRA farmers got drought once in three years followed by once in two years (38.33%), whereas in Nalgonda non NICRA majority (56.67%) of them got drought once in three years followed by once in two years (43.33%).

On the whole 40.00 per cent of the of NICRA famers got drought once in three years followed by once in two years (36.67%) and yearly once (23.33%), where as in non NICRA majority (39.17%) of farmers got drought once in two years followed by yearly once (32.50%) and once in three years (28.33%).

The results revealed that majority of the NICRA farmers got drought once in three years followed by once in two years might be due to in Ananthapur NICRA farmers got drought yearly once and in Nalgonda NICRA farmers got drought once in three years this lead them to fell under the category of once in three years. The probable reason for this in Ananthapur the average rain fall is 552 mm per year, but in the selected all villages of Anantapur the rain fall was below the average rainfall (552 mm). Anantapur is the second most drought affected district of INDIA. Over the years, the process of desertification has been taking place in large tracts of the district because of soil erosion and crust formation, deforestation, over grazing and exec use of ground water level. The normal rain fall for the south west monsoon period is 338.0 mm which forms about 61.2 per cent of the total rain fall for the year. The failure of the rains in south west monsoon period of June to September would lead this area to drought by failure of rainfed crops (ground nut+ red gram). In Nalgonda the average rain fall is 750-850 mm but the distribution of rain fall is erratic. This was not suitable to get the normal yield of rain fed crops (cotton+red gram). This is in conformity with the results of Srinivasa Rao and Gopinath (2016), Srinivasa Rao *et al.* (2013), Anil Kumar and Indira (2007) and Tarhule and Lamb (2003).

Table 4.7. Distribution of occurrence of drought as elicited by the respondents

S. No	Frequency of occurrence of drought	Ananthapur				Nalgonda				(Overall)		(Overall)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=120)		Non NICRA farmers (n=120)	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Once in 4 years	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2	Once in 3 years	11	18.33	0	0.00	37	61.67	34	56.67	48	40.00	34	28.33
3	Once in 2 years	21	35.00	21	35.00	23	38.33	26	43.33	44	36.67	47	39.17
4	Yearly once	28	46.67	39	65.00	0	0.00	0	0.00	28	23.33	39	32.50
5	Total	60	100	60	100	60	100	60	100	120	100	120	100

4.1.7 Farming system

It could be observed from the Table 4.8 and Figure.4.6 that majority (55.00%) of the NICRA farmers of Ananthapur, had Ag/ Horticultural crops + AH/poultry/goat of integrated farming systems followed by Ag crops + Horticultural crops + AH/poultry / goat (38.33%), Ag crops + Horticultural crops (3.33%) and Single crop (3.33%). Where as in

non NICRA farmers of Ananthapur, majority (51.67%) of them had Ag/Horticultural crops + AH/poultry/goat followed by Ag crops + Horticultural crops + AH/poultry / goat (26.67%), Ag crops + Horticultural crops (13.33%) and Single crop (8.33%). In Nalgonda majority (68.33%) of the NICRA farmers had Ag crops + Horticultural crops + AH/poultry / goat followed by Ag crops + Horticultural crops + AH/poultry / goat+ mulberry + sericulture (25.00%), Ag/Hort+ AH/poultry/goat (3.33%) and >1 crop (Ag or Horticultural crops (1.67%). Whereas in Nalgonda majority (63.33%) of non NICRA farmers had Ag crops + Horticultural crops + AH/poultry/goat followed by Ag/Hort+ AH/poultry/goat (23.33%), >1 crop (Ag or Horticultural crops)(8.33%) and Ag crops + Horticultural crops (5.00%).

On the whole majority (54.16 %) of NICRA farmers had Ag crops + Horticultural crops + AH/poultry / goat followed by Ag/Horticultural crops + AH/poultry/goat (29.17 %), Ag crops + Horticultural crops + AH/poultry / goat+ mulberry + sericulture (12.50%), Ag crops + Horticultural crops (1.67%), Single crop (1.67%) and >1 crop (Ag or Horticultural crops) (0.83%), whereas in non NICRA 45.00 per cent of them had Ag crops + Horticultural crops + AH/poultry / goat followed by Ag/Horticultural crops + AH/poultry/goat(37.50%), Ag crops + Horticultural crops(9.17%), >1 crop (Ag or Horticultural crops) (4.17%)and Single crop (4.17%).

The results revealed that majority of the NICRA farmers had Ag crops + Horticultural crops + AH/poultry / goat. The probable reason for this is both the NICRA and non NICRA villages have red soils which are suitable to vegetable cultivation and orchard crops like mango, sapota, pomegranate, sweet oranges etc., and growing contingency crop like sorghum for grain and fodder purpose to feed the cattle and utilizing the bio manure to field which was obtained from the animal husbandry, also rearing poultry and goats for generating secondary income during lean period to sustain economically. In case of Nalgonda NICRA the farmers were motivated to do the sericulture for getting extra income round the year around 3 lacks. After realizing the importance of sericulture most of the farmers were shifted their cultivation from cotton to mulberry cultivation and also farmers were getting manure from the mulberry sheds and using mulberry leaves to feed their animals. In case of two NICRA villages very few farmers were doing vermi compost and applied to their field for improving the soil fertility. This results in improvement of farmer’s income more than the farmers who are following single enterprise. This is in

conformity with the results of Magombo *et al.* (2012), Ugmimba *et al.* (2010), Barik *et al.* (2010), Shivani *et al.* (2010) and Jayanthi *et al.* (2007).

Table 4.8. Distribution of respondents according to their Farming system

S. No	Farming systems	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	F	%
1	Single crop	2	3.33	5	8.33	0	0.00	0	0.00	2	1.67	5	4.17
2	>1 crop (Ag or Horticultural crops)	0	0.00	0	0.00	1	1.67	5	8.33	1	0.83	5	4.17
3	Ag crops + Horticultural crops	2	3.33	8	13.33	0	0.00	3	5.00	2	1.67	11	9.17
4	Ag/Hort+ AH/poultry/goat	33	55.00	31	51.67	2	3.33	14	23.33	35	29.17	45	37.50
5	Ag crops + Horticultural crops + AH/poultry / goat	23	38.33	16	26.67	45	70.00	38	63.33	65	54.16	54	45.00
6	Ag crops + Horticultural crops + AH/poultry / goat+ mulberry + sericulture	0	0.00	0	0.00	15	25.00	0	0.00	15	12.50	0	0.00

4.1.8 Socio Economic Status

It could be observed from the Table 4.9 and Figure.4.7 and that majority (71.70%) of the NICRA farmers of Ananthapur were belonged to medium socio economic status followed by low (25.00%) and high (3.30%), where as in non NICRA farmers Ananthapur, majority (83.30%) of them were belonged to low followed by medium (16.70%).In Nalgonda majority (93.30%) of the NICRA farmers were belonged to medium socio economic status followed by low (5.00%) and high (1.70%), whereas in Nalgonda non NICRA farmers, majority (63.30%) of them were belonged to medium followed by low (36.70%).

On the whole majority (82.50%) of NICRA farmers were belonged to medium socio economic status followed by low (15.00%) and high (2.50%). Whereas in non NICRA majority (60.00%) of them were from low socio economic status followed by medium (40.00%). This is in conformity with the results of Manakar *et.al.* (2000), Shinde *et.al.* (2000) and Kumari (2004).

Table 4.9. Distribution of respondents according to their Socio Economic Status

S. No	Socio-economic status	Ananthapur				Nalgonda				Over all		Over all		Total	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=120)		Non NICRA farmers (n=120)			
		F	%	F	%	F	%	F	%	F	%	F	%	F	%
1	Low (4-7)	15	25.00	50	83.30	3	5.00	22	36.70	18	15.00	72	60.00	90	37.50
2	Medium (8-11)	43	71.70	10	16.70	56	93.30	38	63.30	99	82.50	48	40.00	147	61.25
3	High (12-15)	2	3.30	0	0.00	1	1.70	0	0.00	3	2.50	0	0.00	3	1.25
	Total	60	100	60	100	60	100	60	100	120	100	120	100	240	100

4.1.8.1 Family size

It was observed from the Table 4.10 the 46.67 per cent of the NICRA farmers of Ananthapur district had medium family size followed by small (33.33%) and large (20.00%). While in Ananthapur non NICRA majority (50.00%) of them were from medium sized families followed by small (41.67%) and large (8.33%). In Nalgonda district majority (53.33%) of farmers of NICRA had medium followed by small (35.00%) and large family size (11.67%). Whereas in Nalgonda 43.33 per cent of the farmers of non NICRA were medium sized followed by small (41.67%) and large (15.00%).

On the whole the half (50.00%) of the NICRA farmers were medium sized followed by small (34.17%) and large (15.83%), whereas in non NICRA majority (51.67%) of farmers were from medium sized followed by small (38.33%) and large (10.00%).

Table 4.10. Distribution of respondents according to their Family size

S. No	Family size	Ananthapur				Nalgonda				(Overall)		(Overall)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=120)		Non NICRA farmers (n=120)	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Small (1 to 4 members)	20	33.33	25	41.67	21	35.00	25	41.67	41	34.17	46	38.33
2	Medium (4 to 6 members)	28	46.67	30	50.00	32	53.33	26	43.33	60	50.00	62	51.67
3	Large (>6)	12	20.00	5	8.33	7	11.67	9	15.00	19	15.83	12	10.00
	Total	60	100	60	100	60	100	60	100	120	100	120	100

The Table 4.10 highlights that in both groups NICRA and non NICRA majority of farmers had medium followed by small and large. The reason for this finding of more number of medium and small families could be because of their increased awareness on the problems that may occur with the increased family members, providing educational facilities to the children and greater exposure to external world. Further as the cost of living is increased day by day, they might have found it beneficial to have medium and small families to lead a better and comfortable life. This is in conformity with the results of Jeyamissie (2000), Manay and Farzana (2000).

4.1.8.2 Occupation

It was observed from the Table 4.11 that 46.67 per cent of the NICRA farmers of Ananthapur district were having subsidiary + agriculture followed by labour + subsidiary + agriculture (33.33%), farming/agriculture (11.67 %) and labour + agriculture (8.33%), while in Ananthapur non NICRA half of them were labour + agriculture (50.00%) followed by farming/agriculture (31.67%), subsidiary + agriculture (11.67%) and labour + subsidiary + agriculture (6.67%). In Nalgonda district majority (51.67%) of farmers of NICRA were labour + subsidiary + agriculture followed by subsidiary + agriculture (26.67%), farming/agriculture (16.67%) and labour + agriculture (5.00%). Whereas in Nalgonda majority (55.00%) of the farmers of non NICRA were labour + agriculture followed by farming/agriculture (28.33%), subsidiary + agriculture (13.33%) and labour + subsidiary + agriculture (3.33%).

Table 4.11. Distribution of respondents according to their Occupation

S. No	Occupation	Ananthapur				Nalgonda				(Overall)		(Overall)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=120)		Non NICRA farmers (n=120)	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Farming/Agriculture	7	11.67	19	31.67	10	16.67	17	28.33	17	14.17	36	30.00
2	Labour + Agriculture	5	8.33	30	50.00	3	5.00	33	55.00	8	6.67	63	52.50
3	Subsidiary + Agriculture	28	46.67	7	11.67	16	26.67	8	13.33	44	36.67	15	12.50
4	Labour + Subsidiary + Agriculture	20	33.33	4	6.67	31	51.67	2	3.33	51	42.50	6	5.00
	Total	60	100	60	100	60	100	60	100	120	100	120	100

On the whole the 42.50 per cent of the NICRA farmers had labour+subsidiary+agriculture followed by subsidiary+agriculture (36.67%), farming/agriculture (14.17%) and labour + agriculture (6.67%), whereas in non NICRA majority (52.50%) of farmers were labour + agriculture followed by farming/agriculture (30.00%), subsidiary + agriculture (12.50%) and labour + subsidiary + agriculture (5.00%) occupation.

It could be predicted from the results that the majority of NICRA farmers had labour+subsidiary+agriculture, whereas in non NICRA majority of farmers had labour + agriculture as their occupation. The reason for this might be due to lack of continuous and regular income, employment opportunities, outcome and profits from the agriculture sector farmers were diverting to the other subsidiary source of income where they can earn income regularly. If not they were being engaged in two or three kinds occupations such as agriculture + labour + subsidiary or labour + agriculture and subsidiary + agriculture in order to have their regular earning throughout the year at one or other means to full fill their economic needs. This is in conformity with the results of Kiran and Kanani (2010) and Meenakshi (2011).

4.1.8.3 Annual income

It was apparent from the Table 4.12 that majority (56.67%) of the NICRA farmers of Ananthapur district were belonged to low followed by high (25.00%) and medium (18.33%). While in Ananthapur non NICRA 45.00 per cent of them were belonged to medium followed by high (31.67%) and low (23.33%). In Nalgonda district majority (68.33%) of farmers of NICRA had high followed by medium (30.00%) and low (1.67%) annual income, whereas in Nalgonda majority (53.33%) of the farmers of non NICRA had medium followed by high (35.00%) and low (11.67%) annual income.

On the whole the 46.67per cent of NICRA farmers had high annual income followed by low (29.17%) and medium (24.17%). Whereas in non NICRA all most half (49.17%) of farmers were belonged to medium followed by high (33.33%) and low (17.50%) annual income.

Table 4.12. Distribution of respondents according to their Annual income

S. No	Annual income	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	F	%
1	Low (<60000)	34	56.67	14	23.33	1	1.67	7	11.67	35	29.17	21	17.50
2	Medium (60000-120000)	11	18.33	27	45.00	18	30.00	32	53.33	29	24.16	59	49.17
3	High (>120000)	15	25.00	19	31.67	41	68.33	21	35.00	56	46.67	40	33.33
	Total	60	100	60	100	60	100	60	100	120	100	120	100

It could be predicted from the results that the majority of NICRA farmers had high followed by low annual income might be due to in Ananthapur NICRA majority of the farmers had low fallowed by high annual income and in Nalgonda NICRA majority of the farmers had high followed by medium leading them to fall under the high followed by low annual income.

In non NICRA majority of farmers had medium followed by high annual income might be due to fact that majority of farmers had medium annual income in both Anantapur and Nalgonda districts.

The reason for these results might be, due to their participation and engagement in several entrepreneurial activities, respondents were employed in the secondary and tertiary occupations other than major occupation based on the availability to overcome their financial crises and to improve their economic conditions, hence the annual income for the majority of the respondents might had been increased. This is in conformity with the results of Santosh (2014), Osondu and Ibezim (2013), Swati *et al.* (2013) and Chinnam Naidu (2012).

4.1.8.4 Socio political participation

It was apparent from the Table 4.13 that 33.33 per cent of the NICRA farmers of Ananthapur district had no official membership in any organization followed by fund raising or financial contribution for common work (26.67%), membership in one organization or group (20.00%), official position in social and political committee (16.67%) and office bearer (3.33%). While in Ananthapur non NICRA majority (78.33%)

of them had no official membership in any organization followed by membership in one organization or group (11.67%), official position in social and political committee (8.33%) and fund raising or financial contribution for common work (1.67%). In Nalgonda district majority (73.33%) of farmers of NICRA had no official membership in any organization fallowed by fund raising or financial contribution for common work (16.67%), membership in one organization or group (8.33%) and official position in social and political committee (1.67%), whereas in Nalgonda majority (96.67%) of the farmers of non NICRA had no official membership in any organization followed by membership in one organization or group (3.33%).

On the whole the majority (53.33%) of the NICRA farmers had no official membership in any organization followed by fund raising or financial contribution for common work (21.67%), membership in one organization or group (14.17%), official position in social and political committee (9.17%) and office bearer (1.67%), whereas in non NICRA majority (87.50%)of farmers had no official membership in any organization fallowed by membership in one organization or group (7.50%), official position in social and political committee (4.17%) and fund raising or financial contribution for common work (0.83%).

Table 4.13. Distribution of respondents according to their Socio political participation

S. No	Socio political participation	Ananthapur				Nalgonda				(Overall)		(Overall)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=120)		Non NICRA farmers (n=120)	
		F	%	F	%	F	%	F	%	F	%	F	%
1	No official Membership in any organization	20	33.33	47	78.33	44	73.33	58	96.67	64	53.33	105	87.50
2	Membership in one organization or group	12	20.00	7	11.67	5	8.33	2	3.33	17	14.17	9	7.50
3	Official position in social and political committee	10	16.67	5	8.33	1	1.67	0	0.00	11	9.17	5	4.17
4	Fund raising or financial contribution for common work	16	26.67	1	1.67	10	16.67	0	0.00	26	21.67	1	0.83
5	Office bearer	2	3.33	0	0.00	0	0.00	0	0.00	2	1.67	0	0.00
	Total	60	100	60	100	60	100	60	100	120	100	120	100

The results revealed in Table 4.13 that in both NICRA and non NICRA majority of the farmers belonged to the category of no official membership in any organization. This might be due to the fact that few social organizations are active in the villages and the small and marginal farmers were not in reach of social organizations present in the villages and it might also be due to their low level of education and not knowing the importance of the organizations. Farmers were still active, participating in the community activities than other political activities.

Extension agencies should encourage the farmers' social participation by helping them to form youth clubs, welfare associations, farmers discussion groups etc. so that they will get more exposure and empowerment. This is in conformity with the results of Mohan and Ramesh (2012) and Reddy (2009).

4.1.9 Social Affiliation

It was apparent from the Table 4.14 and Figure.4.8 that majority (80.00%) of the NICRA farmers of Ananthapur district were belonged to high followed by medium (13.33%) and low (6.67%) social affiliation. While in Ananthapur non NICRA majority (68.33%) of them were belonged to medium followed by low (21.67%) and high (10.00%). In Nalgonda district majority (51.67%) of farmers of NICRA had medium followed by high (28.33%) and low (20.00%), whereas in Nalgonda majority (51.67%) of the farmers of non NICRA had medium social affiliation followed by low (33.33%) and high (15.00%).

On the whole the majority (54.17%) of the NICRA farmers had high social affiliation followed by medium (32.50%) and low (13.33%), whereas in non NICRA majority (60.00%) of farmers had medium followed by low (27.50%) and high (12.50%) social affiliation.

The results revealed in Table 4.14 that majority of the NICRA farmers had high social affiliation. The reason might be the farmers were maintaining cordial relation with other farmers, maintaining relation with the officials for getting new technical information, helping each others when they are in crisis and regular meeting with other fellow farmers.

The results indicate that majority of non NICRA farmers were found with medium to low social affiliation which imply that inadequate motivation and lack of interest and awareness created among the group members regarding maintenance of affiliation. Majority of the members have formed into groups with the motive of attaining economic benefits. The initiation of group meeting, consult the house hold before taking any decision, maintain friendly relation with others, help them in crisis, maintain relation with elders

collective activities and collective thinking which promote cordial relation was also found lacking in the group. The affiliation and concern among the members is more where "felt-need" for the group was emphasized. These results were in conformity with findings of Preethi and Shashi (2008).

Table 4.14. Distribution of respondents according to their Social Affiliation

S. No	Social Affiliation	Ananthapur				Nalgonda				(Overall)		(Overall)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=120)		Non NICRA farmers (n=120)	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Low (14-15)	4	6.67	13	21.67	12	20.00	20	33.33	16	13.33	33	27.5
2	Medium (16-17)	8	13.33	41	68.33	31	51.67	31	51.67	39	32.50	72	60.00
3	High (18-19)	48	80.00	6	10.00	17	28.33	9	15.00	65	54.17	15	12.50
	Total	60	100	60	100	60	100	60	100	120	100	120	100

4.1.10 Trainings undergone on CRA

It was apparent from the Table 4.15 and Figure.4.9 that majority (73.33%) of the NICRA farmers of Ananthapur district had undergone training programmes followed by 26.67 per cent of respondents not undergone any training programme. While in Ananthapur non NICRA majority (75.00%) of farmers had not undergone any training programme. Only, 25.00 per cent of farmers had undergone training programmes. In Nalgonda district majority (83.33%) of farmers of NICRA had undergone training programmes followed by 16.67 per cent of respondents not undergone any training programme, whereas in Nalgonda majority (80.00%) of the farmers of non NICRA had not undergone any training programme. Only, 20.00 per cent had undergone training programmes.

On the whole the majority (78.33%) of the NICRA farmers had undergone training programmes followed by 21.67 per cent of respondents not undergone any training programme, whereas in non NICRA majority (77.50%) of farmers had not undergone any training programme. Only, 22.50 per cent of farmers had undergone training programmes.

The results revealed in Table 4.15 that majority of NICRA farmers had received high level trainings. The reason might be that these villages were adopted by NICRA project through KVK scientists who were giving trainings to the farmers, farmers were

aware about the training programmes conducted by various agencies and their importance. Farmers were found to have medium source of information utilization.

Majority of the non NICRA farmers had received low level of training. It indicates that the farmers were not aware about the training programmes conducted by various agencies and their importance. The farmers should be inculcated the habit of attending the training programmes for their benefit. Special training programmes may be designed by department of agriculture to suit to the needs and interests of farmers highlighting the adaptable mechanisms to cope up with the climate variability effects.

Table 4.15. Distribution of respondents based on number of farmers undergone training

S. No	Training under gone	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	F	%
1	yes	44	73.33	15	25.00	50	83.33	12	20.00	94	78.33	27	22.50
2	no	16	26.67	45	75.00	10	16.67	48	80.00	26	21.67	93	77.50
	Total	60	100	60	100	60	100	60	100	120	100	120	100

It was evident from the Table 4.16 that majority (70.45%) of the NICRA farmers of Ananthapur district had undergone the training on Water harvesting technologies followed by Micro irrigation techniques (50.00%), integrated Farming systems(43.18%), soil moisture conservation measures(36.36%), Organic farming (34.09%) and Demonstration on Silage making (27.27%). While in Ananthapur non NICRA majority (80.00%) of farmers had received the training on Micro irrigation techniques followed by Water harvesting technologies (53.33%), Organic farming (33.33%) and soil moisture conservation measures (13.33%). In Nalgonda district majority (85.71%) of farmers of NICRA had received the training on Water harvesting technologies followed by Micro irrigation techniques (71.43%), soil moisture conservation measures (53.06%), integrated Farming systems (44.90%), Organic farming (36.73%) and Demonstration on Silage making (36.73%). Whereas in Nalgonda majority (66.67%) of the farmers of non NICRA had received the training on Micro irrigation techniques followed by organic farming (41.67%), integrated Farming systems (33.33%) and Water harvesting technologies (25.00%).

On the whole the majority (78.49%) of the NICRA farmers had Water harvesting technologies followed by Micro irrigation techniques (61.29%), soil moisture conservation measures (45.16%), integrated Farming systems (44.09%), Organic farming (35.48%) and Demonstration on Silage making (32.26%). The probable reason for this might be the in NICRA villages more number of need based training were given to the farmers through KVKs as the farmers showed interest towards the natural resource management practices to conserve the soil and water for better improvement of ground water level, to recharge their bore well to give the life saving irrigation to their fields to get optimum yield.

Whereas in non NICRA majority (74.07%) of farmers had received the training on Micro irrigation techniques followed by Water harvesting technologies (40.74%), Organic farming (37.04%), integrated Farming systems (14.81%) and soil moisture conservation measures (7.41%). The probable reason for this might be most of the non NICRA village framers did not have the awareness on NRM practices. But the farmers had the horticultural crop in their farming systems for giving irrigation to their fields they have used drip systems for this purpose they had undergone on trainings related to micro irrigation techniques and to store the water they have attended training on water harvesting technologies in KVKs. These results were in conformity with findings of Praveena (2010), Rahman and Yamao (2006) and Doli (2006).

Table 4.16. Distribution of respondents based on content of training programme

S. No	Content of the Training	Ananthapur				Nalgonda				(Overall)		(Overall)	
		NICRA farmers (n=44)		Non NICRA farmers (n=15)		NICRA farmers (n=49)		Non NICRA farmers (n=12)		NICRA farmers (n=93)		Non NICRA farmers (n=27)	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Integrated Farming systems	19	43.18	0	0.00	22	44.90	4	33.33	41	44.09	4	14.81
2	Soil moisture conservation measures	16	36.36	2	13.33	26	53.06	0	0.00	42	45.16	2	7.41
3	Organic farming	15	34.09	5	33.33	18	36.73	5	41.67	33	35.48	10	37.04
4	Water harvesting technologies	31	70.45	8	53.33	42	85.71	3	25.00	73	78.49	11	40.74
5	Demonstration on Silage making	12	27.27	0	0.00	18	36.73	0	0.00	30	32.26	0	0.00
6	Micro irrigation techniques	22	50.00	12	80.00	35	71.43	8	66.67	57	61.29	20	74.07

*n= No.of farmers who had undergone training

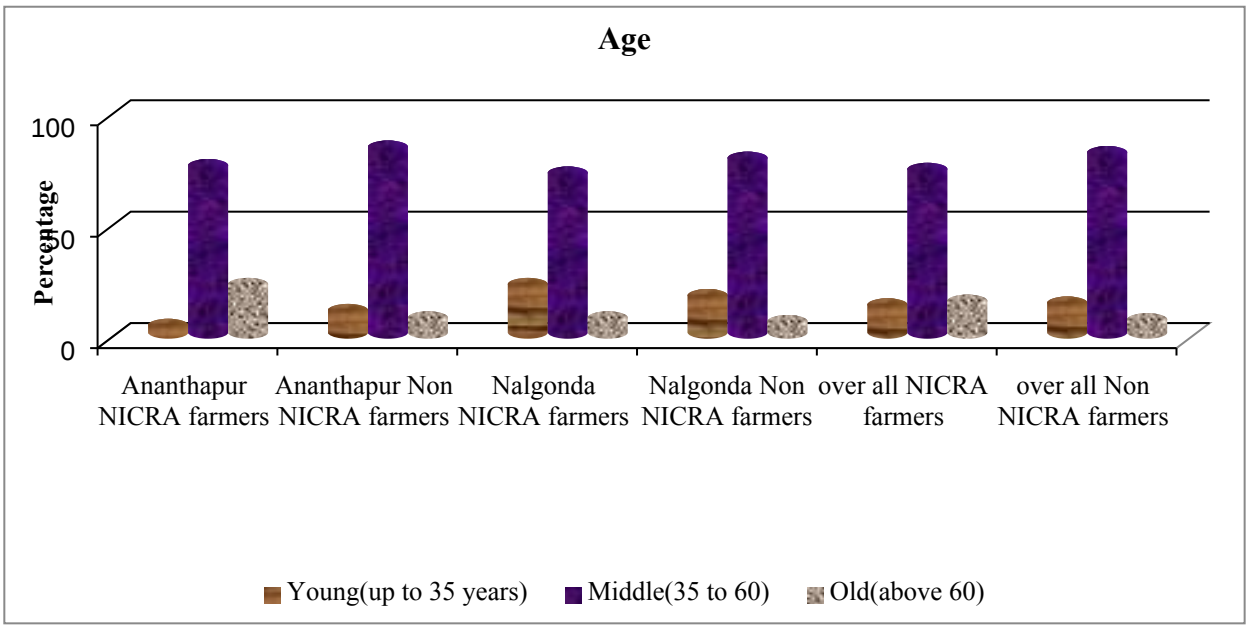


Figure.4.1. Distribution of the respondents according to their Age

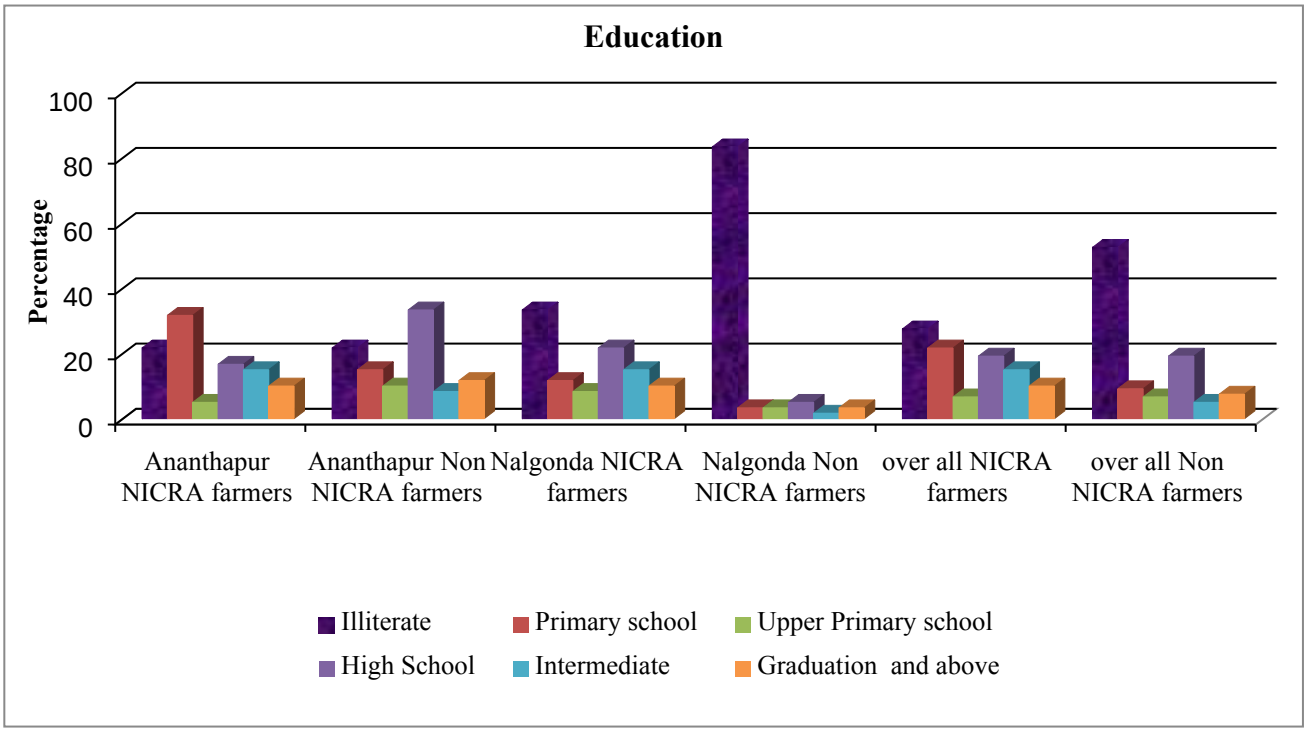


Figure.4.2. Distribution of the respondents according to their Educational status

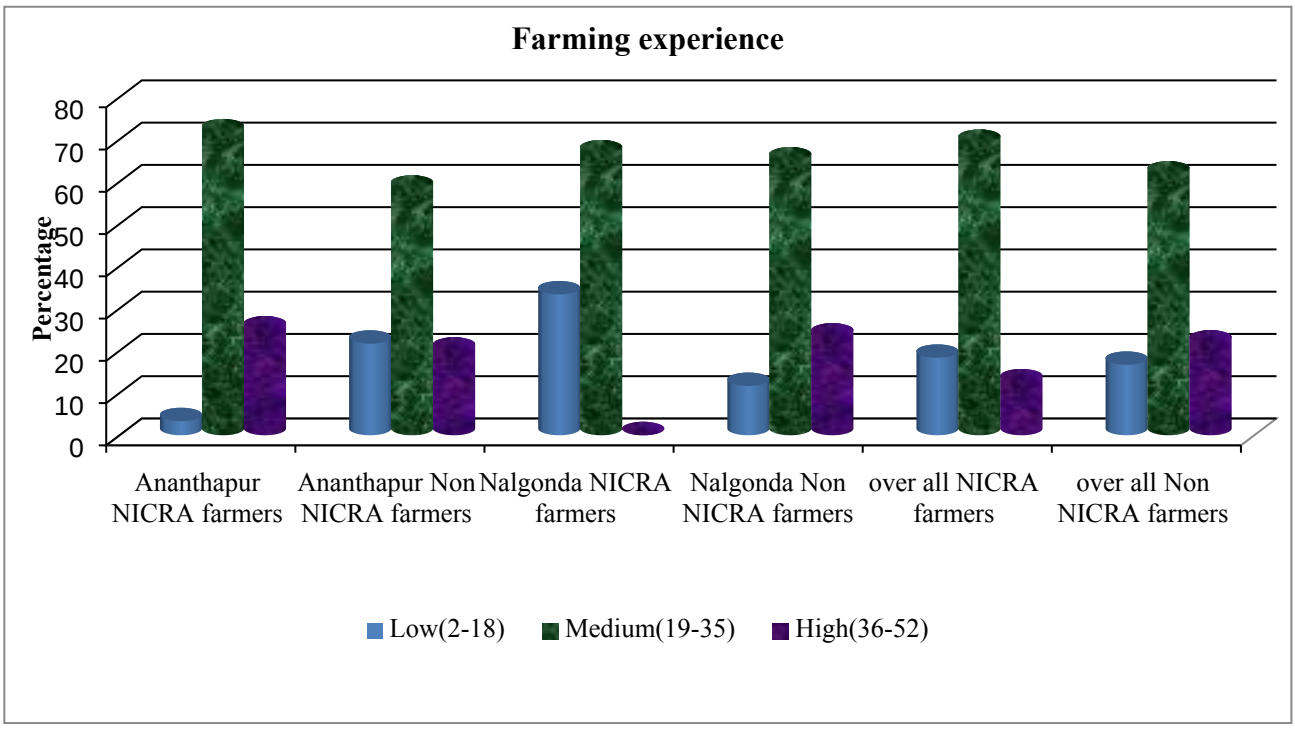


Figure.4.3. Distribution of the respondents according to their Farming experience

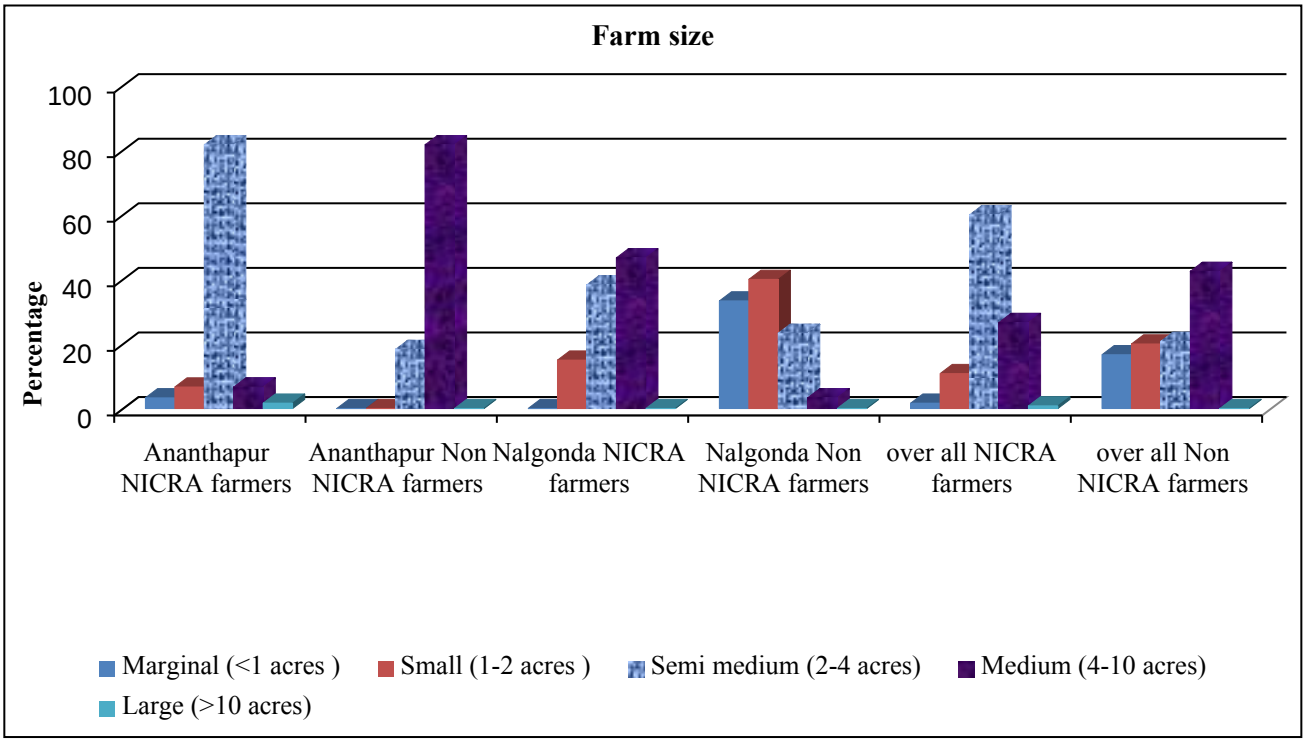


Figure.4.4. Distribution of the respondents according to their Farm size

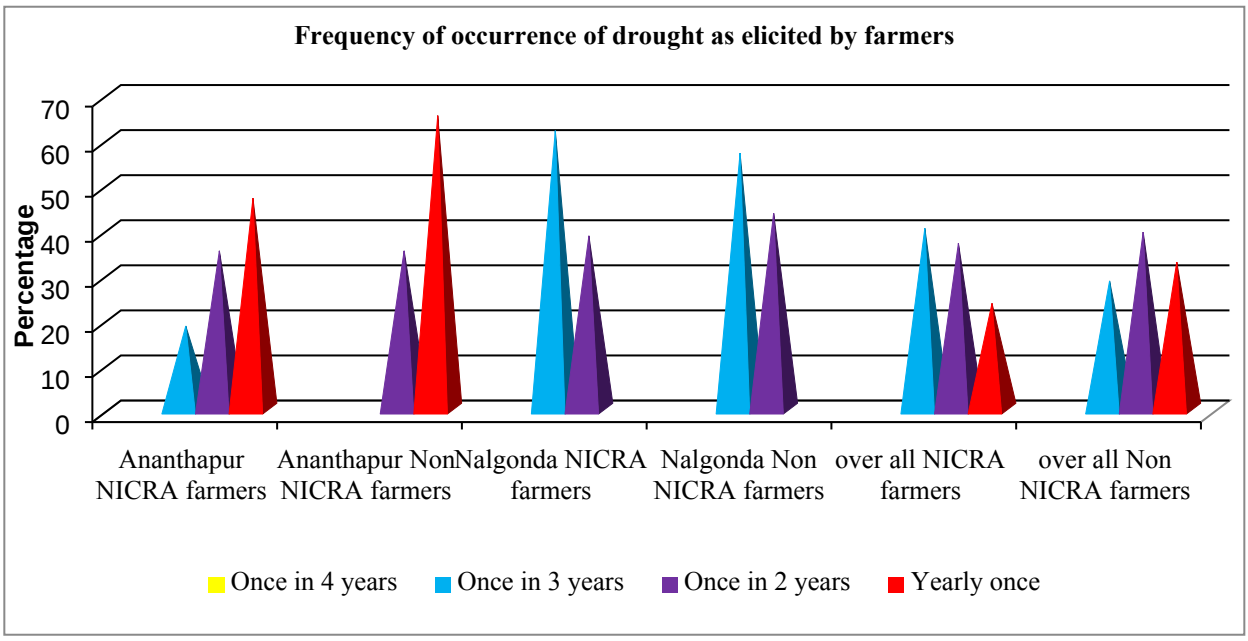


Figure.4.5. Frequency of occurrence of drought as elicited by farmers

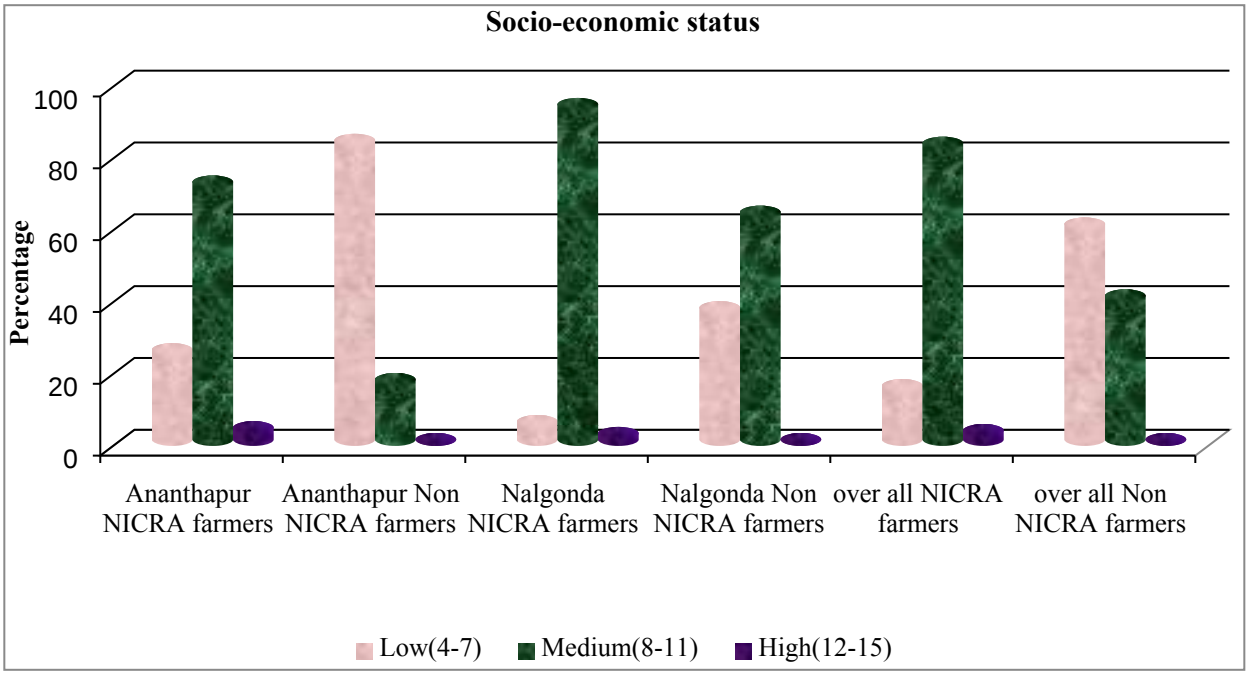


Figure.4.7. Distribution of the respondents according to their Socio-economic status

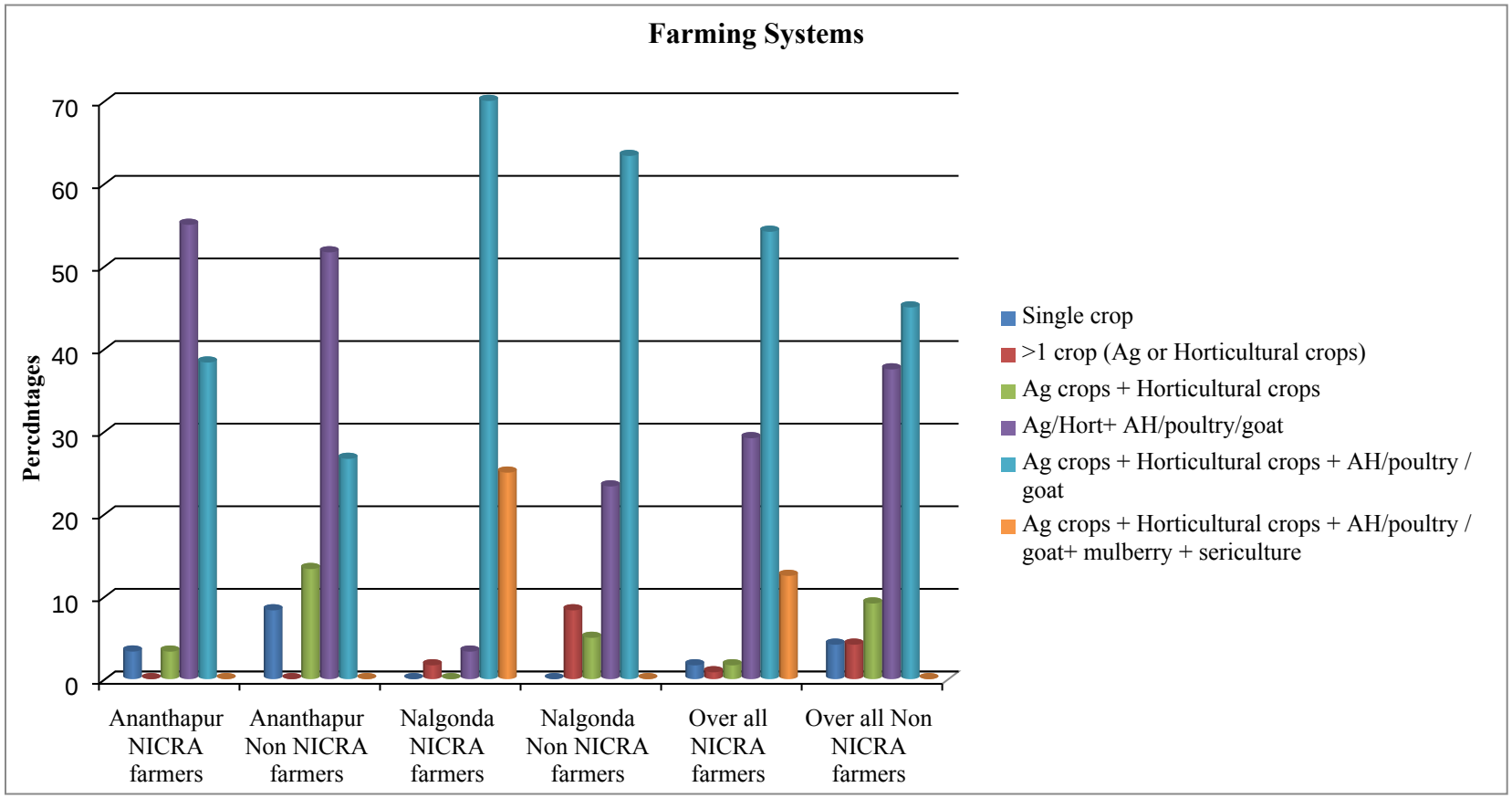


Figure.4.6. Distribution of the respondents according to their Farming systems

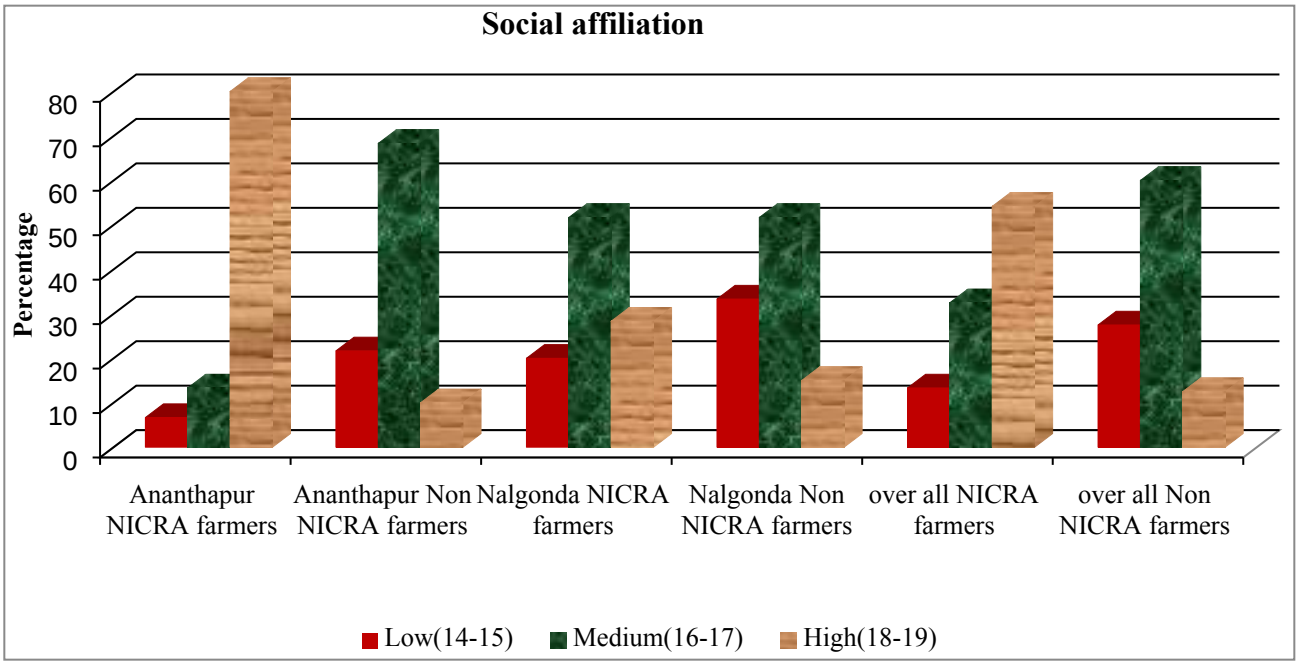


Figure.4.8. Distribution of the respondents according to their Social affiliation

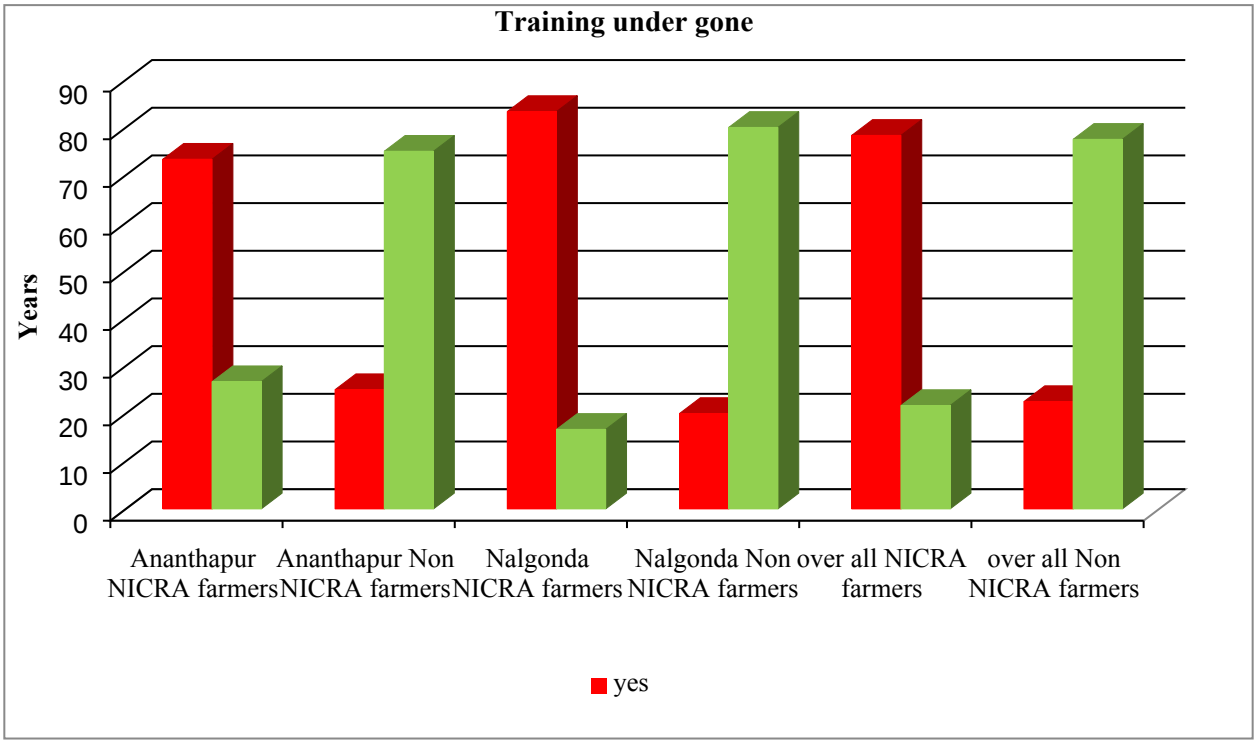


Figure.4.9. Distribution of the respondents according to their Training under gone

It could be inferred from the Table 4.17 and Figure.4.10 that, majority (66.67%) of the NICRA farmers of Ananthapur district had medium followed by low (26.66%) and high

(6.67%) source of information utilization. While in Ananthapur non NICRA half (50.00%) of farmers had medium followed by low (45.00%) and high (5.00%) level. In Nalgonda district majority (65.00%) of farmers of NICRA had medium followed by low (21.67%) and high (13.33%) source of information utilization. Whereas in Nalgonda majority (90.00%) of the farmers of non NICRA had low followed by medium (10.00%) and none of them found to have high source of information utilization.

On the whole the majority (65.83%) of the NICRA farmers had medium followed by low (24.17%) and high (10.00%), whereas in non NICRA majority (67.50%) of farmers had low followed by medium (30.00%) and high (2.50%) level of source of information utilization.

The possible explanation for this could be that the variable source of information utilization included sub terms individual and mass contact in which majority of respondents scored medium in NICRA group might be due to NICRA farmers had access to KVK/project staff and participated in various individual and group contact extension activities implemented under project, whereas low source of information utilization in non NICRA group might be due to lack of extension contact and mass media exposure. These results were in conformity with findings of Romash *et al.* (2012), Romashkumar (2012), Thaddeus *et al.* (2011) and Saha (2010).

Table 4.17. Distribution of respondents based on source of information utilization

S. No	Sources of Information Utilisation	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	F	%
1	Low (8-12)	16	26.66	27	45.00	13	21.67	54	90.00	29	24.17	81	67.50
2	Medium (13-17)	40	66.67	30	50.00	39	65.00	6	10.00	79	65.83	36	30.00
3	High (18-22)	4	6.67	3	5.00	8	13.33	0	0.00	12	10.00	3	2.50
	Total	60	100	60	100	60	100	60	100	120	100	120	100

4.1.11.1 Information utilization through individual contact

It could be inferred from the Table 4.18 that, majority (73.30%) of the NICRA farmers of Ananthapur district had medium individual contact followed by low (26.67%). While in

Ananthapur non NICRA majority (73.30%) of farmers had low individual contact followed by medium (21.70%) and high (5.00%). In Nalgonda district majority (76.70%) of farmers of NICRA had medium followed by low (21.67%) and high (1.70%) individual contact. Whereas in Nalgonda majority (96.70%) of the farmers of non NICRA had low followed by medium (3.30%) and none of them found to have high individual contact.

On the whole the majority (75.00%) of the NICRA farmers had medium followed by low (24.17%) and high (0.83%), whereas in non NICRA majority (85.00%) of farmers had low followed by medium (12.50%) and high (2.50%).

From the above results it could be perceived that majority of NICRA farmers had medium individual contact might be due to medium individual contact by the NICRA farmers of both Ananthapur and Nalgonda. The reason could be most of these NICRA farmers could establish good contact with the extension staff, scientists, input agencies/ dealer, neighbors/ friends. The farmers who were frequently contacted by these officials participated actively in various extension activities and also willingly tried out the latest technological recommendations.

Whereas in non NICRA majority of farmers had low individual contact might be due to low individual contact by the non NICRA farmers of both Ananthapur and Nalgonda. This might be due to the fact that as majority of respondents were medium farmers with illiterate to high school education may not be having frequent contact with officials. Inadequate staff in department of agriculture might be another reason for this result, as one Agricultural Officer with 5-6 Agricultural Extension Officers has to manage the entire mandal. Hence deployment of adequate staff and providing quality extension services will improve the situation. Further, instead of expecting farmers to visit the extension workers/research stations, these extension and research functionaries should go to villages very frequently and organise extension activities in villages itself, which serves a dual purpose of increasing knowledge among farmers and getting feedback from farmers for formulating the need based research. These findings were in concurrence with the findings of Priya (2010).

Table 4.18. Distribution of respondents based on Individual contact

S. No	Individual contact	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	F	%
1	Low (4-7)	16	26.67	44	73.30	13	21.67	58	96.70	29	24.17	102	85.00
2	Medium (8-11)	44	73.30	13	21.70	46	76.70	2	3.30	90	75.00	15	12.50
3	High (12-15)	0	0.00	3	5.00	1	1.70	0.0	0.00	1	0.83	3	2.50
	Total	60	100	60	100	60	100	60	100	120	100	120	100

4.1.11.2 Information utilization through mass media contact

It could be inferred from the Table 4.19 that, majority (50.00%) of the NICRA farmers of Ananthapur district had low followed by medium (45.00%) mass media contact. While in Ananthapur non NICRA majority (55.00%) of farmers had low followed by medium (45.00%). In Nalgonda district majority (55.00%) of farmers of NICRA had medium followed by low (45.00%), whereas in Nalgonda majority (93.30%) of the farmers of non NICRA had low followed by medium (6.70%).

On the whole half (50.00%) of the NICRA farmers had medium followed by low (47.50%) and high (2.50%), whereas in non NICRA majority (74.17%) of farmers had low followed by medium (25.83%).

Table 4.19. Distribution of respondents based on mass media contact

S. No	Mass media contact	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	F	%
1	Low (4-6)	30	50.00	33	55.00	27	45.00	56	93.30	57	47.50	89	74.17
2	Medium (7-9)	27	45.00	27	45.00	33	55.00	4	6.70	60	50.00	31	25.83
3	High (10-12)	3	5.00	0	0.00	0	0.00	0.0	0.00	3	2.50	0	0.00
	Total	60	100	60	100	60	100	60	100	120	100	120	100

On the whole the results revealed that majority of the respondents in NICRA group had medium group and mass media contacts might be due to low contact by the NICRA

farmers of Ananthapur and medium contact by the NICRA farmers of Nalgonda. This trend might be due to the fact that majority of the respondents were semi medium farmers with illiteracy. Due to their low literacy level, they do not depend on newspapers, farm magazines and agricultural news articles, as the most of the farmers were getting information from the television, getting WBAAS to their mobiles regularly.

Whereas in non NICRA farmers had low followed by medium level of mass media contact. The reason for this most of the farmers was illiterate, due to their low literacy level and no project extension activities in these villages. Mass media consumption by farmers is the dire need for quick acquisition and evaluation of technologies. Mass media is also considered as the most credible source of information. Hence the officials may help the farmers to get opportunities to increase the mass media exposure. The same result was generated by Gattu (2001), Neelaveni *et al.* (2002) and Suresh (2004).

4.1.12 Credit Availability

4.1.12.1 Credit Received

It could be vividly seen from the Table 4.20and Figure.4.11 majority (70.00%)of the NICRA farmers of Ananthapur district had received average number of loans followed by less number (25.00%) and 5.00 per cent had taken more number of loans. While in Ananthapur non NICRA 40.00 per cent of farmers had received average number of loans followed by less number (33.33%) and 26.67 per cent had taken more number of loans. In Nalgonda district majority (51.67%) of NICRA farmers had received average number of loans followed by less number (48.33%).Whereas in Nalgonda majority (55.00%) of the farmers of non NICRA farmers had received less number followed by average number of loans (45.00%).

On the whole the majority (60.83%) of the NICRA farmers had received average number of loans followed by less number (36.67%) and 2.50 per cent had taken more number of loans, whereas in non NICRA 45.83per cent of farmers had received less number followed by average number of loans (40.83%) and more number of loans(13.33%).

From the above results it could be perceived that majority of NICRA farmers the received average number of loans, whereas in non NICRA majority of the farmers had received less number of loans. It was observed that NICRA farmers had received more number of loans compared to non NICRA as they were availing credit from the government

as well as from the relatives and friends. The frequency of getting loans was less in non NICRA because the new sanction of new loan depends on time taken by the farmers to repay the old debt, confidence, credibility of the bank officials towards their group, savings amount of the group to get the loans from the bank to acquire a new loan. The bank officials were considering the entire scenario of the group including the savings, repayments of the loan, repayment period, loan utilization and group response to meeting in before sanctioning a new loan. Hence the NICRA farmers were availing more frequent loans than compared to the non NICRA farmers.

Table 4.20. Distribution of respondents according to the number of loans availed

S. No	Credit received	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	F	%
1	Less (1-8)	15	25.00	20	33.33	29	48.33	33	55.00	44	36.67	55	45.83
2	Average (9-17)	42	70.00	24	40.00	31	51.67	27	45.00	73	60.83	49	40.83
3	More (18-26)	3	5.00	16	26.67	0	0.00	0	0.00	3	2.50	16	13.33
	Total	60	100	60	100	60	100	60	100	120	100	120	100

4.1.12.2 Sources of Credit

It could be vividly seen from the Table 4.21 that in Ananthapur NICRA most (66.67%) of the farmers got the bank loan followed by relative and friends (21.66%) and private money lenders (11.67%). In respect to Ananthapur non NICRA also majority (61.67%) of farmers had received banks loan followed by relative and friends (26.67%) and private money lenders (11.67%). In Nalgonda district majority (60.00%) of farmers of NICRA had received banks loan followed by relative and friends (28.33%) and private money lenders (11.67%). In case of non NICRA in Nalgonda majority (56.67%) of them received bank loan followed by relative and friends (30.00%), private money lenders (13.33%).

On the whole the majority (63.33%) of the NICRA farmers had received banks loan followed by relative and friends (25.00%) and private money lenders (11.67%). Whereas in non NICRA majority (59.17%) of farmers had received banks loan followed by relative and friends (28.33%) and private money lenders (12.50%). These results were in

conformity with findings of Etwire *et al.* (2013), Mann *et al.* (2010) and Todd and Sharma (2010).

Table 4.21. Distribution of respondents according to their Source of loan

S. No	Credit Source	Ananthapur				Nalgonda				(Overall)		(Overall)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=120)		Non NICRA farmers (n=120)	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Private Money Lenders	7	11.67	7	11.67	7	11.67	8	13.33	14	11.67	15	12.5
2	Banks	40	66.67	37	61.67	36	60	34	56.67	76	63.33	71	59.17
3	Relatives and Friends	13	21.66	16	26.67	17	28.33	18	30	30	25.00	34	28.33
	Total	60	100	60	100	60	100	60	100	120	100	120	100

The above results revealed that majority of the respondents in NICRA and non NICRA both the groups got loan from banks only. The probable reason for this the farmers taking loans for doing different integrated farming systems. The farmers could able to get income from these enterprises so they were repaying the loans for every season to do further farm operations. These results were in conformity with findings of Etwire *et al.* (2013), Mann *et al.* (2010) and Todd and Sharma (2010).

4.1.13 Food Security

It could be inferred from the Table 4.22 and Figure.4.12 that, majority (55.00%) of the NICRA farmers of Ananthapur district had medium food security followed by high (40.00%) and low (5.00%). While in Ananthapur non NICRA majority (90.00%) of farmers had medium food security followed by high (8.33%) and low (1.67%). In respect to Nalgonda district majority (96.67%) of farmers of NICRA had medium food security followed by low (3.33%), whereas in Nalgonda majority (66.67%) of the farmers of non NICRA had low followed by medium (26.67%) and high (6.67%).

On the whole the majority (75.83%) of the NICRA farmers had medium followed by high (20.00%) and low (4.17%), whereas in non NICRA majority (58.33%) of farmers had medium followed by low (37.50%) and high (4.17%).

Table 4.22. Distribution of respondents according to their Food Security

S. No	Food Security	Ananthapur				Nalgonda				(Overall)		(Overall)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=120)		Non NICRA farmers (n=120)	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Low (4-6)	3	5.00	5	1.67	2	3.33	40	66.67	5	4.17	45	37.50
2	Medium (7-9)	33	55.00	54	90.00	58	96.67	16	26.66	91	75.83	70	58.33
3	High (10-12)	24	40.00	1	8.33	0	0.00	4	6.67	24	20.00	5	4.17
	Total	60	100	60	100	60	100	60	100	120	100	120	100

It could be seen from the results that in NICRA group majority of farmers had medium followed by high food security. The possible reason for this was, the majority of the farmers had Ag+ horticultural crops +AH/poultry/goat of integrated farming systems. Majority of the farmer's occupation was labour+subsidiary+agriculture (labour works of 100 days wage employment under Mahatma Gandhi National Rural Employment Guarantee Act) by this farmer's income level was increased. This states that NICRA group members were getting income from other than agriculture also to sustain the drought condition. This enabled the NICRA group farmers to had sufficient food for their families.

In non NICRA majority of the farmers had medium followed by low food security. The possible reason for this was, the majority of the non NICRA farmers had also Ag+ horticultural crops +AH/poultry/goat of integrated farming systems through and their major occupation was labour+agriculture (labour works of 100 days wage employment under NAREGA) through this the farmers were able to sustain during drought periods. Most of the farmer's rainfed crops and horticultural crops were dried up and not able to get full returns from the crop this enabled non NICRA farmers to had medium followed by low level of food security. These results were in conformity with findings of Kumbhare *et al.* (2014) and Cumba *et al.* (2009).

4.1.14 Traditionalism

It could be inferred from the Table 4.23 and Figure.4.13 that, majority (76.67%) of the NICRA farmers of Ananthapur district belonged to low followed by medium (20.00%) and high (3.33%). While in Ananthapur non NICRA half (50.00%) of farmers belonged to low followed by medium (45.00%) and high (5.00%) traditionalism. In respect to Nalgonda

district majority (93.33%) of farmers of NICRA had low followed by medium (6.67%), whereas in Nalgonda majority (68.33%) of the farmers of non NICRA had medium followed by low (25.00%) and high (6.67%) traditionalism.

On the whole the majority (85.00%) of the NICRA farmers had low traditionalism followed by medium (13.33%) and high (1.67%), whereas in non NICRA majority (56.67%) of farmers had medium followed by low (37.50%) and high (5.83%) traditionalism.

It could be seen from the results that in NICRA majority of farmers had low traditionalism might be due to medium age, medium farming experience, had extension, mass media contact and most of the farmers received trainings, this results improvement in their knowledge and skills and also they were aware with the latest scientific technologies, whereas in non NICRA majority of the farmers had medium traditionalism might be due to illiterate farmers, low source of information utilization, most of the farmers did not receive any training. This results in lack of knowledge and skills on latest scientific technologies due to low extension contact as the farmers fallowed traditional and cultural practices. These results were in conformity with findings of Kiran (2011), Raj and Pawan (2008) and Bindu (2001).

Table 4.23. Distribution of respondents according to their Traditionalism

S. No	Traditionalism	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	F	%
1	Low (6-10)	46	76.67	30	50.00	56	93.33	15	25.00	102	85.00	45	37.50
2	Medium (11-15)	12	20.00	27	45.00	4	6.67	41	68.33	16	13.33	68	56.67
3	High (16-20)	2	3.33	3	5.00	0	0.00	4	6.67	2	1.67	7	5.83
	Total	60	100	60	100	60	100	60	100	120	100	120	100

4.1.15 Risk taking ability

It could be inferred from the Table 4.24 and Figure.4.14 that, majority (53.33%) of the NICRA farmers of Ananthapur district was belonged to medium followed by high (46.67%). While in Ananthapur non NICRA majority (78.34%) of farmers were belonged to medium followed by low (18.33%) and high (3.33%). In respect to Nalgonda district

majority (63.33%) of farmers of NICRA had high followed by medium (35.00%) and low (1.67%), whereas in Nalgonda majority (66.66%) of the farmers of non NICRA had low followed by medium (31.67%) and high (1.67%).

On the whole the majority (55.00%) of the NICRA farmers had high followed by medium (44.17%) and low (0.83%) risk taking ability, whereas in non NICRA majority (55.00%) of farmers had medium followed by low (42.50%) and high (2.50%) risk taking ability.

The findings presented in Table 4.24 inferred that majority of NICRA farmers had high followed by medium risk taking ability might be due to their ability to face the crop losses due to low rain fall and prolonged dry spells as they were financially stable as they were following Ag+Horti+AH/poutry/goat type of farming systems. After realizing the benefit of natural resource management they were motivated to take up soil conservation practices like excavate and renovate percolation tanks and farm ponds and constructed check dams in both Anantapur and Nalgonda adopted villages with encouragement and support of NICRA, IWMP, MGNREGS. Anantapur adopted village farmer took risk in construction of contour bunds, stone checks across the slopes, doing contour cultivation across the slope. Besides this most of the NICRA farmers received high level of trainings, medium farming experience, medium socio economic status.

In respect to non NICRA majority of farmers had medium followed by low risk taking ability. The reason for this might be their inability to face losses as they were had low socio economic status, having received low level of training and illiteracy. Only in Anantapur non NICRA village the IWMP, MGNREGS activities had done, constructed check dams left without any renovations and repairing and they have excavated farm ponds recently under MGNREGS to harvest the water to give the life saving irrigation to get yield from rainfed crops but drought occurred yearly once due to this farmers also not showed any interest to take the more risk. This results in medium followed by low risk taking ability of non NICRA farmers. These results were in conformity with findings of Priya (2010), Chidananda (2008) and Subramaniyam (2003).

Table 4.24. Distribution of respondents according to their Risk taking ability

S. No	Risk taking ability	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	F	%
1	Low (7-10)	0	0.00	11	18.33	1	1.67	40	66.66	1	0.83	51	42.50
2	Medium (11-14)	32	53.33	47	78.34	21	35.00	19	31.67	53	44.17	66	55.00
3	High (15-18)	28	46.67	2	3.33	38	63.33	1	1.67	66	55.00	3	2.50
	Total	60	100.00	60	100.00	60	100.00	60	100.00	120	100.00	120	100.00

4.1.16 Weather Based Agro Advisory Services (WBAAS)

It could be inferred from the Table 4.25 and Figure.4.15 that, majority (51.67%) of the NICRA farmers of Ananthapur district had medium followed by low (41.66%) and high (6.67%). While in Ananthapur non NICRA cent per cent (100.00%) of farmers got low and none of them found to be in medium and high. In respect to Nalgonda district 48.33per cent of farmers of NICRA got medium followed by low (45.00%) and high (6.67%). Whereas in Nalgonda majority (100.00%) of the farmers of non NICRA got low and none of them found to be medium and high category of WBAAS.

On the whole the half (50.00%) of the NICRA farmers got medium followed by low (43.33%) and high (6.67%) WBAAS. Whereas in non NICRA all (100.00%) the farmers got low and none of them found to be in medium and high WBAAS.

The findings presented in Table 4.25 inferred that majority of NICRA farmers had medium WBAAS followed by low might be due to majority of the farmers had medium followed by low WBAAS in both Ananthapur and Nalgonda. The probable reason for this might be in both the groups of farmers had medium source of information utilization. The farmers were getting timely WBAAS to their mobiles regularly but that information of WBAAS was not trustworthy due to these farmers were not following advisories regularly. The farmers were observed that the distribution of rainfall vagaries on spatially and time. Rainfall distribution was different from one famer field to another farmer field. So the data sent by the WBAAS was not accurate and realistic to their field level.

Whereas in non NICRA majority of farmers had low WBAAS might be due to low WBAAS in both non NICRA farmers of Ananthapur and Nalgonda. The probable reason for this might be non NICRA farmers were not receiving WBAAS to their mobiles. In case of Nalgonda non NICRA most of the farmers were illiterate and had low source of information utilization. These results were in conformity with findings of Rani Saxena *et al.* (2015), Venkatesh *et al.* (2013) and Nagasree *et al.* (2013).

Table 4.25. Distribution of respondents according to the available Weather Based Agro Advisory Services

S.No	Category	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	F	%
1	Low (0-9)	25	41.66	60	100.00	27	45.00	60	100.00	52	43.33	120	100.00
2	Medium (10-19)	31	51.67	0	0.00	29	48.33	0	0.00	60	50.00	0	0.00
3	High (20-29)	4	6.67	0	0.00	4	6.67	0	0.00	8	6.67	0	0.00
	Total	60	100	60	100	60	100	60	100	120	100	120	100

4.1.17 Community Infrastructural facilities

It could be inferred from the Table 4.26 and Figure.4.16 that, majority (55.00%) of the NICRA farmers of Ananthapur district had high followed by medium (45.00%) community infrastructural facilities. While in Ananthapur non NICRA majority (80.00%) of farmers had low followed by medium (20.00%) facilities. In respect to Nalgonda district majority (56.67%) of farmers of NICRA had medium followed by high (43.33%), whereas in Nalgonda majority (90.00%) of the farmers of non NICRA had low followed by medium (10.00%) facilities.

On the whole the majority (50.84%) of the NICRA farmers had medium followed by high (49.16%) community infrastructural facilities, whereas in non NICRA majority (85.00%) of farmers had low followed by medium (15.00%) community infrastructural facilities.

The results revealed that NICRA farmers had medium infrastructure facilities might be due to the villagers had infrastructural facilities like water tank, farm implement and machinery, fair price shops, all weather roads, house hold electricity, hand pumps and

general electric supply, whereas non NICRA farmers had low infrastructure facilities might be due to not having adequate farm implement and machinery, fair price shops and dried up hand pumps. These results were in conformity with findings of Chakraborty *et al.* (2012) and Anil Kumar and Indira (2007).

Table 4.26. Distribution of respondents according to the available Community Infrastructural facilities

S. No	Category	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	f	%
1	Low (3-4)	0	0.00	48	80.00	0	0.00	54	90.00	0	0.00	102	85.00
2	Medium (5-6)	27	45.00	12	20.00	34	56.67	6	10.00	61	50.84	18	15.00
3	High (7-8)	33	55.00	0	0.00	26	43.33	0	0.00	59	49.16	0	0.00
	Total	60	100	60	100	60	100	60	100	120	100	120	100

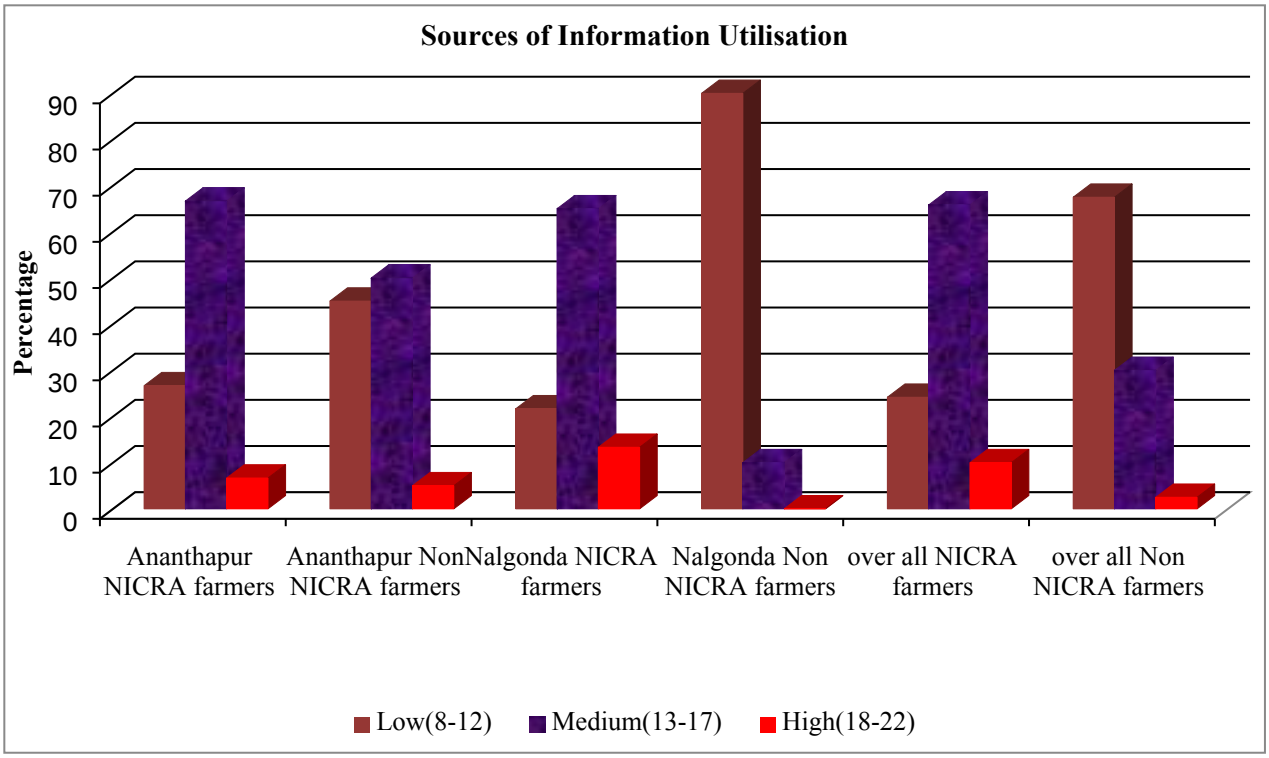


Figure.4.10. Distribution of the respondents according to their Sources of Information Utilisation

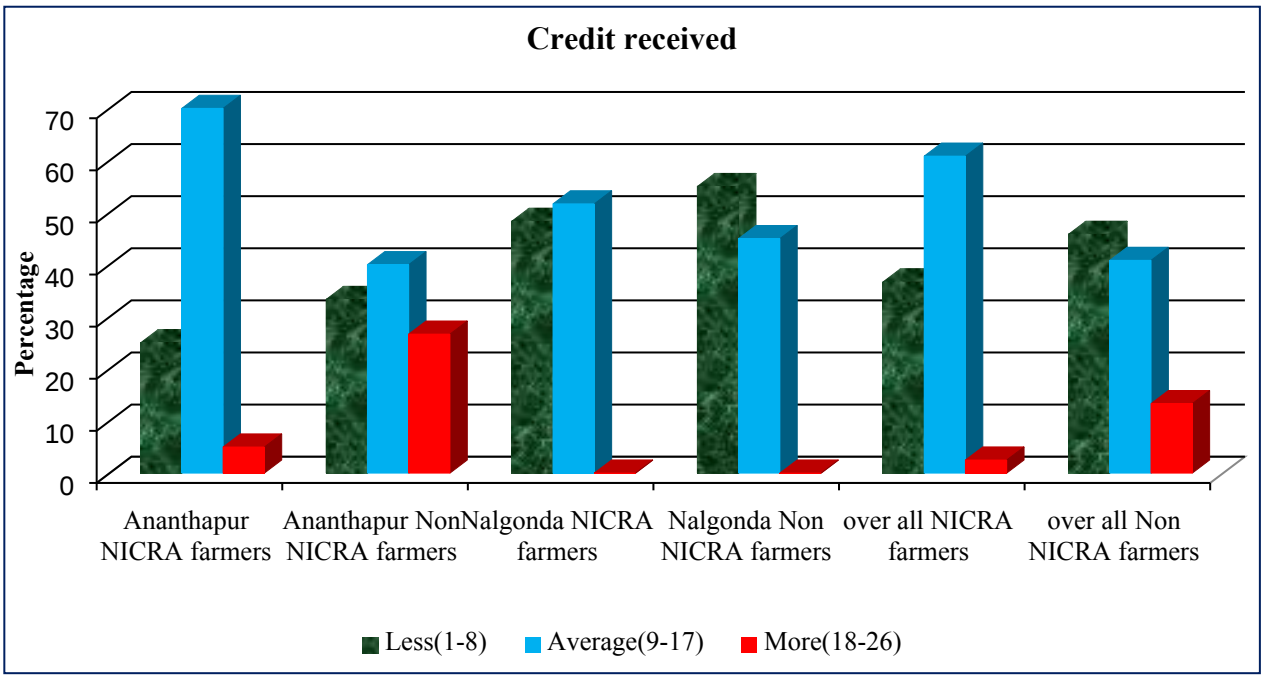


Figure.4.11. Distribution of the respondents according to their Credit received

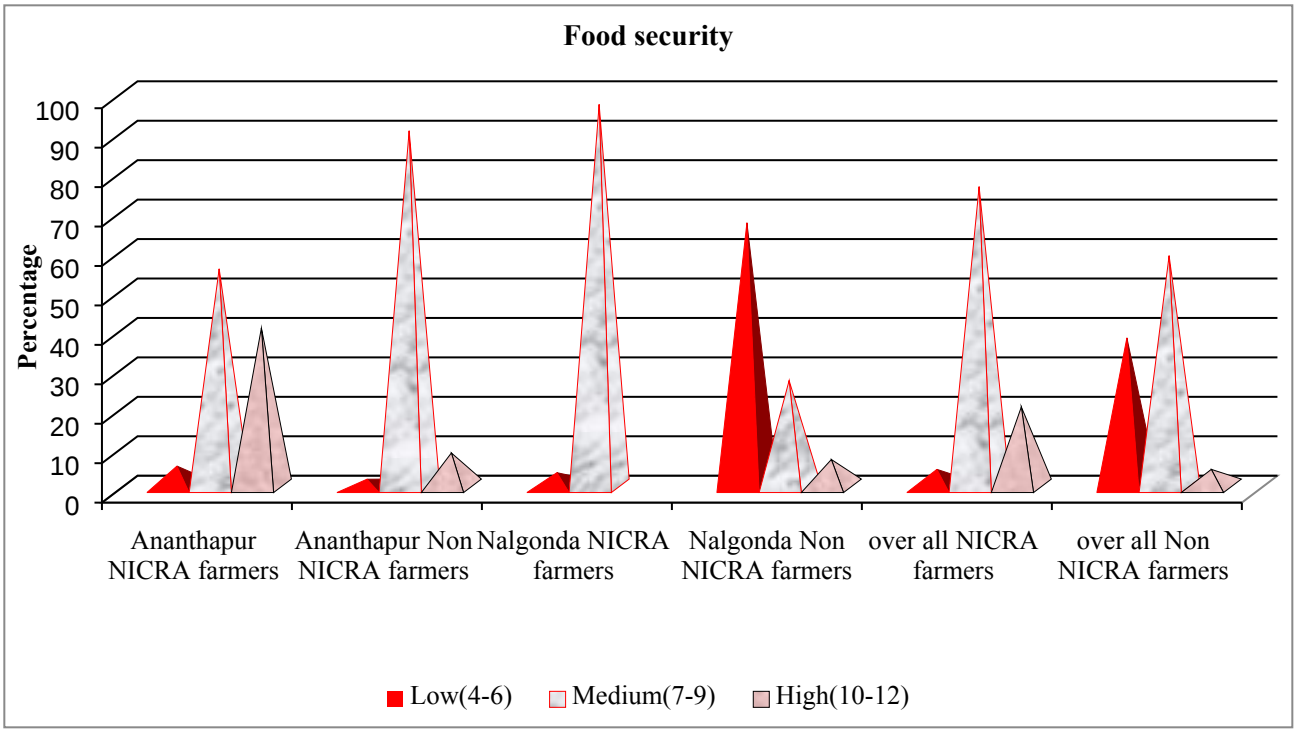


Figure.4.12. Distribution of the respondents according to their Food security

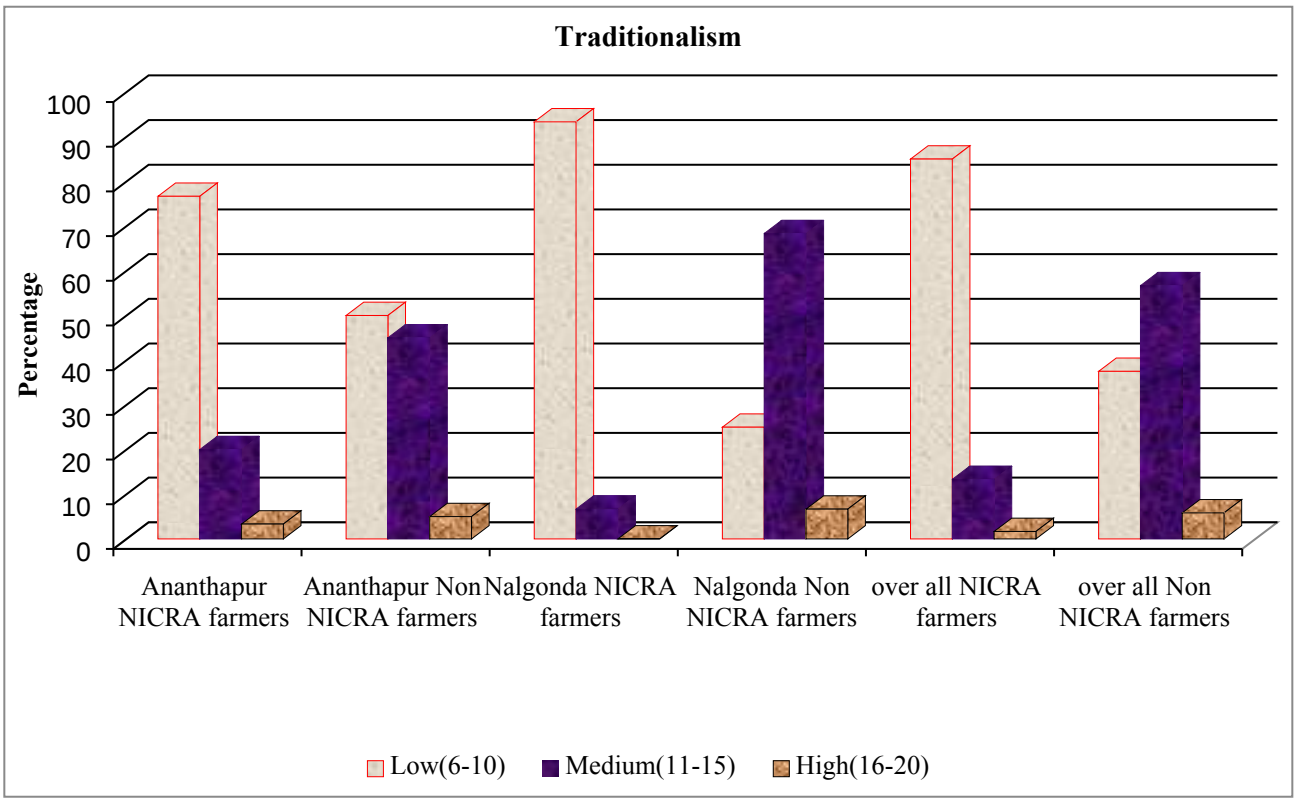


Figure.4.13. Distribution of the respondents according to their Traditionalism

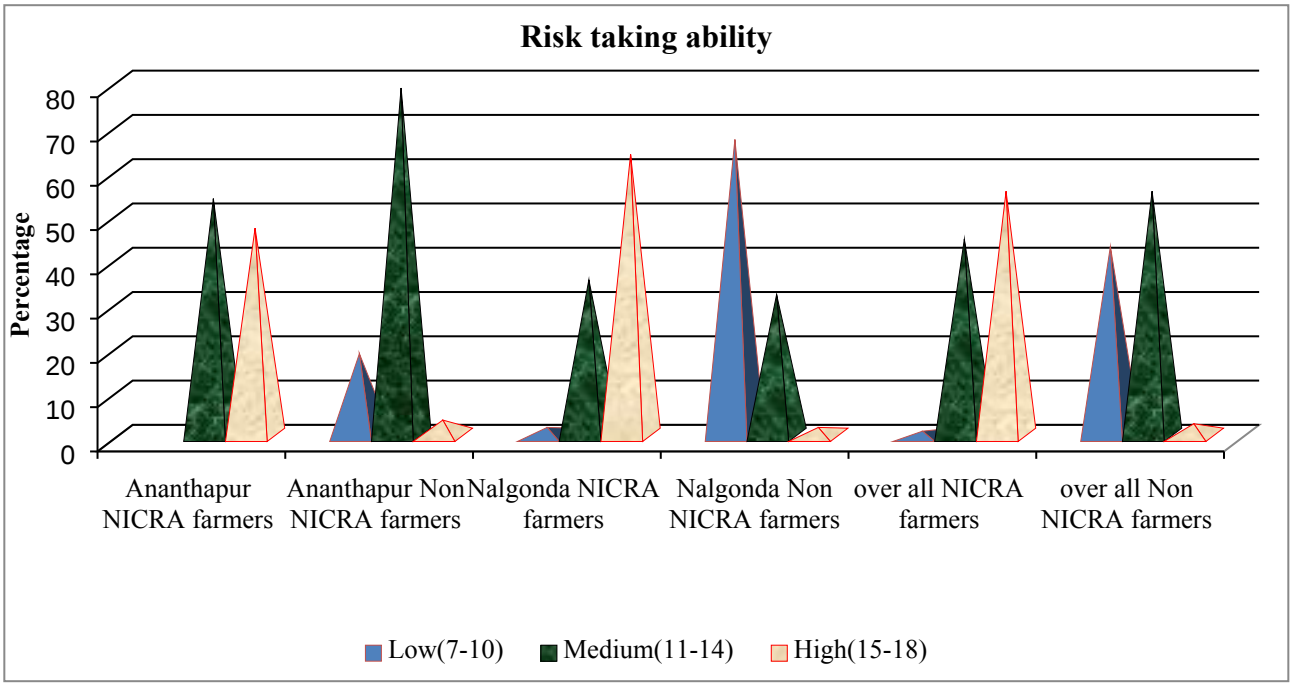


Figure.4.14. Distribution of the respondents according to their Risk taking ability

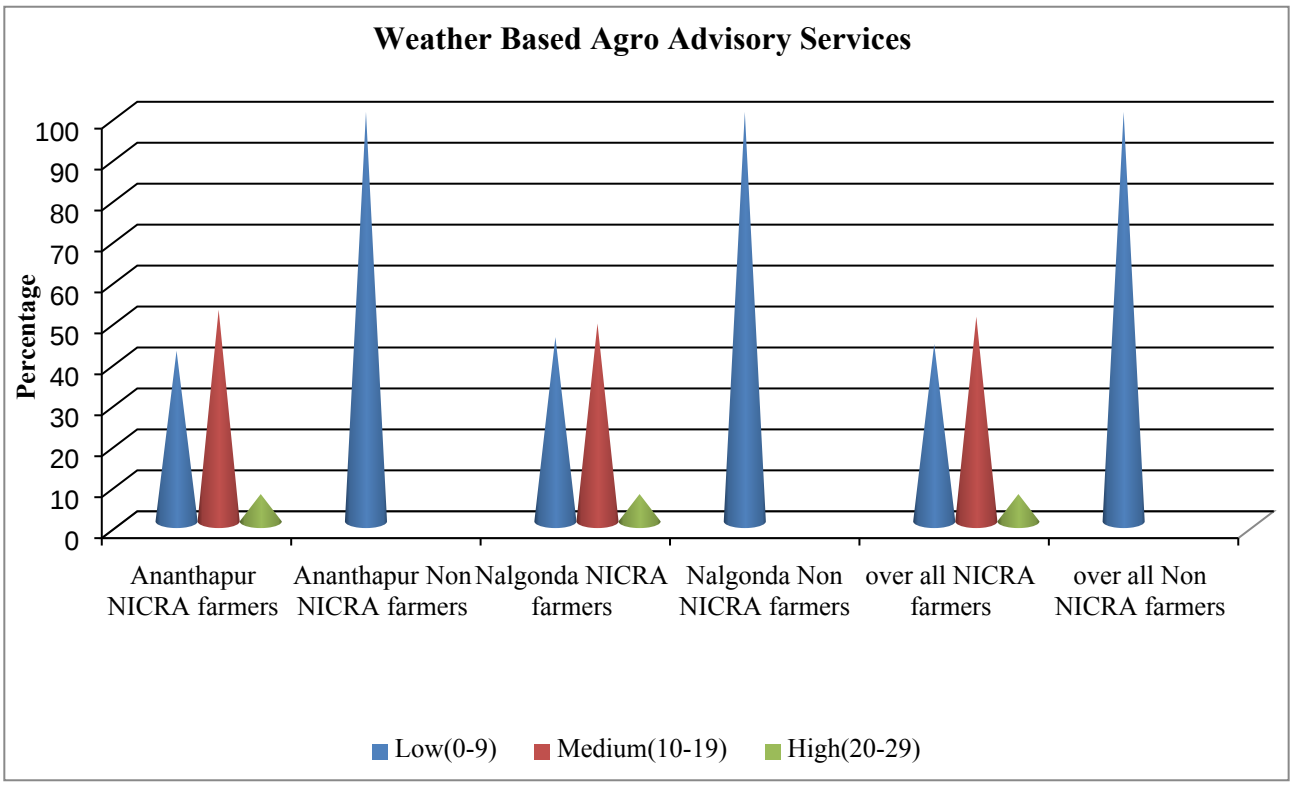


Figure.4.15. Distribution of the respondents according to the available WBAAS

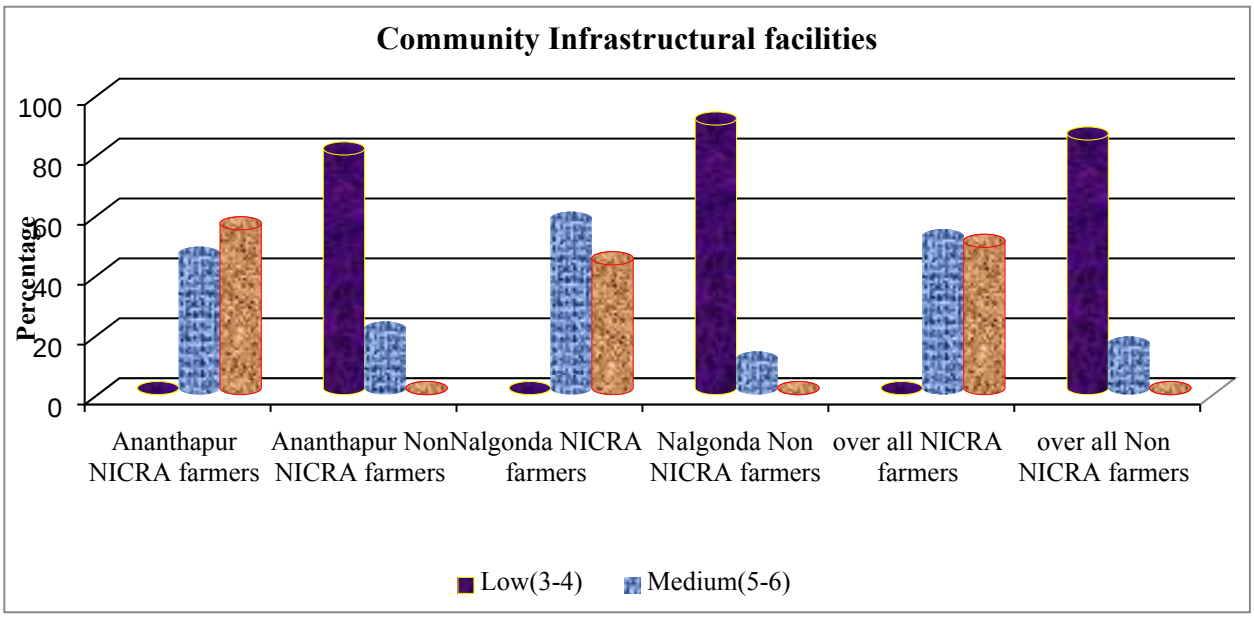


Figure. 4.16. Distribution of the respondents according to the available Community Infrastructural facilities

4.2 Rural settings on changing climate through participatory approaches

4.2.1 The analysis of rural settings based on information got through various PRA techniques done in Peravali village in Ananthapur districts of Andhra Pradesh state

4.2.1.1 Village transect

Key Informants: P. Chalapathi Naidu, P. Ramulu, A. Narayana Swami

The transect walk was carried out from north to west towards the south to east direction of Peravali village along with the above mentioned key informants covering an area of around 5 km. During transect each person of the group identified resource and allied problems. While carrying out the transect walk at most care was taken in noting down the land marks of the various natural, social and the other resources present in the area together with the boundary points. The transect walk map and transect axis were drawn by the farmers is given in Fig 4.17 and 4.18.

Initiation of transect was from the north to west marked by temple area of Peravali village. This village is endorsed with resources like solar plant, white mineral, dairy units,

agricultural fields, plantations, School, panchayat office, water tank, transformers etc. Religious institutions like temples, church and musjid were also present in the area.

This village is bordered by Naina Palli village in the east, Chakraya Peta in the west, Julalpuram village in the north and Narpalli in south. Most part of the village marked connecting the village to nearby town Anantapur.

The village had been divided into three zones for the purpose of general transect. The first transect covered an area of 1 km, the second one 2.5 km and the third one 1.5 km. the soils were mixed both red and black in three different transects.

In terms of vegetation, the number of trees found was more in the second transect. The number of trees found in the first transect were less. The crops were more in last one, but it was less in firs zone. Livestock was found in first transect. Bore wells, percolation tanks, canals and Kuthaleru River was passed around the boarder of village in first and second zones. Canals, bore wells, percolation tanks were present in last zone. Water table was found to be near in last zone (80-90 feet), it was 90- 100 feet in second zone, it was deep in the first zone (up to 350 feet).

In Peravali village, investigator along with key informants observed the same. Red soil was pre-dominant in upland area whereas black soil was predominant in low land area due to alluvial material near the water reservoir.

Red soil being poorly fertile due to low nutrient contents (N, P and K) and low organic matter requires more fertilizers for fulfilling the requirement whereas black soil is deep soil and contains high organic matter. The major crops grown here are ground nut, red gram than horse gram, korra, green gram, sorghum as dual purpose, fodder crop. The crops were cultivated in red soils in rainfed condition due to low water table and poor water holding capacity of red soils. Other crops include vegetables such as tomato, cucumber and ridge gourds, curry leaf and some leafy vegetables. Jasmine, Lilly flower crops. Among trees, we could observe neem, eucalyptus, tamarind, pongamia, amla tree, sweet oranges, banana etc.

The problems were different in different transects. Water scarcity in summer, labour and drainage canal were the problems, in first transect. Water scarcity, Pest and diseases and labour were the important problems in second transect. Water scarcity, Pest and diseases and low water table and labour were reported as important problems in last transect.

Improving the soil moisture conservation measure, labour banks, construction of roads in village, construction of godowns had good opportunity in first transect. There is scope for improvement in flower, forestry, and fodder cultivation. Renovation of soil moisture conservation measures, Labour bank and integrated pest management can be practiced to stop the attack of the pests in all zones.

4.2.1.2 Resource map

Key Informants: P. Chalapathi Nayudu, P Ramulu and A. Naryana Swami

The map was drawn by the farmers is given in Fig 4.19. Major crop was ground nut. Other like Ground nut and red gram as inter cropping, red gram, green gram, horse gram, sorghum, sweet oranges and banana orchards were present. Lilly and jasmine flower cultivation was also present. Vegetables like tomato, brinjal, cucurbits and curry leaf were present. Farmers were keeping stone checks around fields where the slope was present to control the runoff and to maintain soil moisture. Animals, farm implements and transport in the area are represented in this map. The main source of irrigation for the farmers is the Kuthaleru River which runs along the boundary starting from west, flowing through east. Apart from this bore wells, percolation tanks, and check dams available all through adds to the irrigation source of the village. Two water tanks and two hand pumps were also present in the village. Resources like one school, panchayat office and one church were present at entry point of the village and transformer was present. Three temples were also present. As far as the agricultural machinery is concerned, the farmers of this village were using implements from CHC on hiring basis to do the farm operations and some drip irrigation motor sets by farmers for fruit trees. The village has a little area under contour cultivation on one side of hills. The cropped and village residential areas have predominantly red soil. In the residential area livestock like cattle, goats, poultry were the important enterprises available. Coconut, eucalyptus, Pongamia, Prosopis and Neem trees are present along roads and canals. KVK was supplying seed varieties of major crops. However for most crop inputs like fertilizers, pesticides/ fungicides, high quality seeds etc. The farmers are dependent on external sources like shops in Ananthapur town.

4.2.1.3 Agro ecology map

Key Informants: P. Chalapathi Naidu, P Ramulu and A. Narayana Swami

The map was drawn by the farmers is given in Fig 4.20. Agro ecological map of the village Chakraya Peta was drawn by farmers to identify the various agro ecological zones

present in the village. The farmers were encouraged to draw the agro ecological map themselves marking the important landmarks. Special emphasis was given to mark the various topographical areas, cropping pattern and crops, soil types, water bodies, weeds, water sources and irrigation system, livestock, trees and other aspects related to agro ecology. Major landmarks used to differentiate various zones in the map include important road which was west to east direction (Anantapur to Thadipatri route) dividing the village in to two parts. Due to this village people were doing cultivation in these two parts, one was near the national highway and second part was having bulk of the fields near the hills. Kuthaleru River was passing around border of the Peravali village from Narpalli village to Julalpuram. Major crops were ground nut + red gram under rainfed and other crops were dual purpose sorghum, black gram, green gram, horse gram, korra, fodder. Isolated small areas in this zone were under sweet orange orchards. Apart from this the farmers were growing vegetables like tomato, brinjal, ladies finger for domestic consumption in this area.

The residential area of the village mainly consists of houses but all of the livestock i.e. cattle, poultry, goats were also present in this area. Low and erratic rain fall, uneven distribution of rainfall, delayed monsoon and early cessation of monsoon were the major climatic constraints. 90 per cent of the area under red soils. Shallow depth of the soils and low water holding capacity, saline soils were the major soil constraints.

The major source of water in the village for cultivation and household use was the bore wells. Trees like neem, prosopis, coconut, eucalyptus and tamarind were present continuously on sides of canal and roads. In this village water harvesting measures like percolation tanks were excavated, contour cultivation also practiced on hills, to stop the run off and soil erosion, from hill side check dams were constructed, stone bunds also used around the crops where the soil was having slope around the crops to control the soil erosion and to store the soil moisture.

4.2.1.4 Seasonal calendar

Key Informants: P. Chalapathi Naidu, P Ramulu and A. Narayana Swami

The map was drawn by the farmers is given in Fig 4.21.The month wise analysis as reported by the key informants were as follows.

January: The temperature was reported to be very low and in case of humidity, it was high.

February, March and April: According to the key informants, temperature was increasing gradually during these three months. In the case of humidity used to go down during these three months.

May: The temperature was reported to be very high in this month, it would be 48oC, had dry season. This was the high temperature period. In the case of humidity, it was very low compared to other months.

June: It was the beginning of rain.

June, July, August, September and October: The rain fall was gradually increasing from June to September than used to go down completely in the month of October. The humidity was gradually increasing from June to October. In case of temperature it was used to go down during these months. These months had rainy season (moisture excess), this was the crop rowing period.

November, December and January: The temperature was used to go down. The relative humidity was in increasing trend during these months. These months had winter with mist with less temperature.

In the month January to march farmers did activities like harvesting their crops (sorghum, green gram, korra etc.), labour demand was less during these days. In the months of May to June they did land preparation and FYM organic manure application. During April and May months they did sheep penning activity to improve the soil fertility. In the months of June to July they had sown ground nut and red gram intercutivation under rainfed and they gave vaccination and de-warming their animals. From July to September they did intercultivation in crops. In the month of September they had sown sorghum, green gram, some vegetables etc. The pest attack was more during October to December and in the month of December few farmers did de-warming their animals and labour demand was more for doing these activities during this period. Migration was more during January to May because of this was leas season, no water availability in the fields to do the farm operations. So they were migrating to Anantapur town for doing business activities.

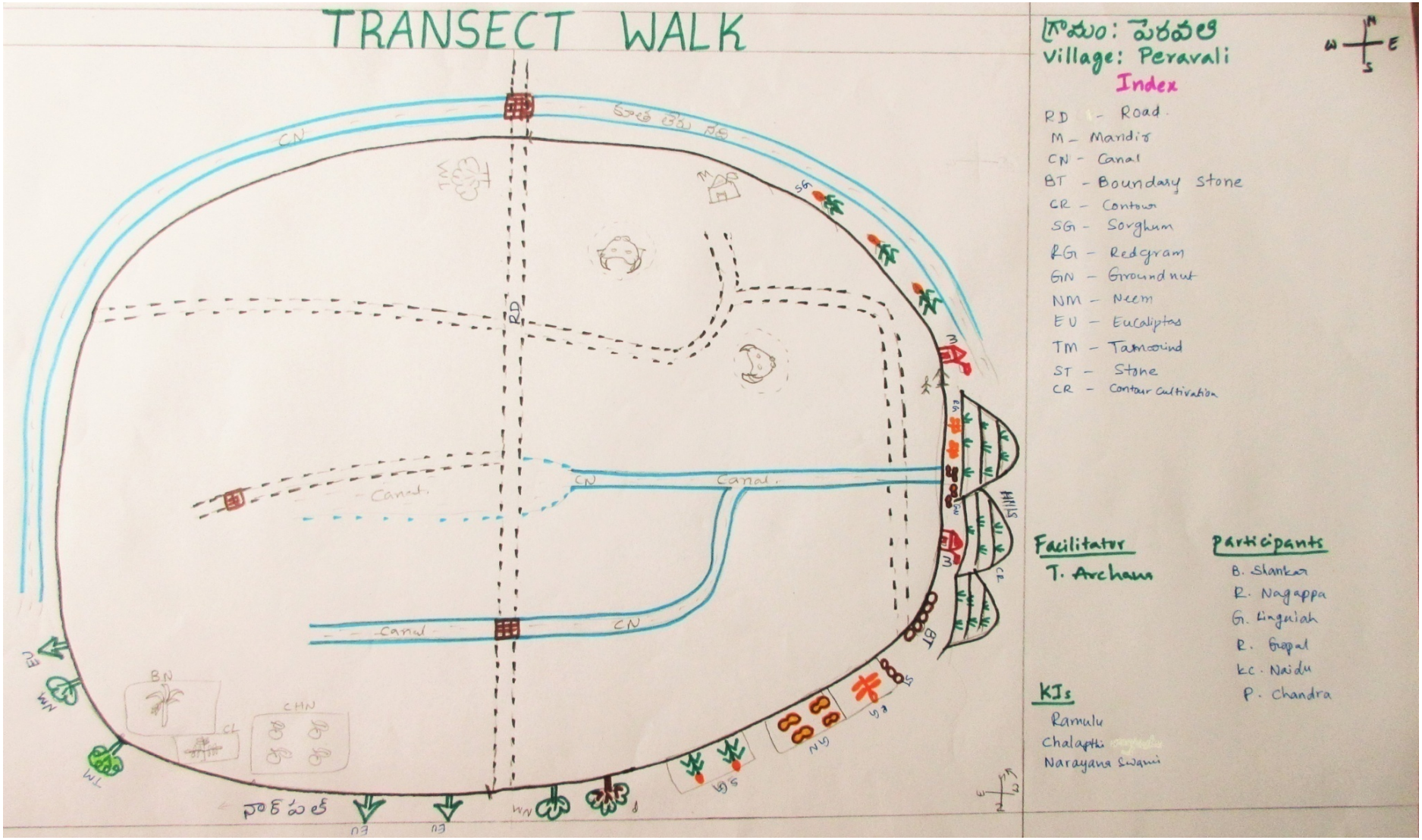


Fig. 4.17 An illustration of a transect walk of Peravali village of Anantapur district

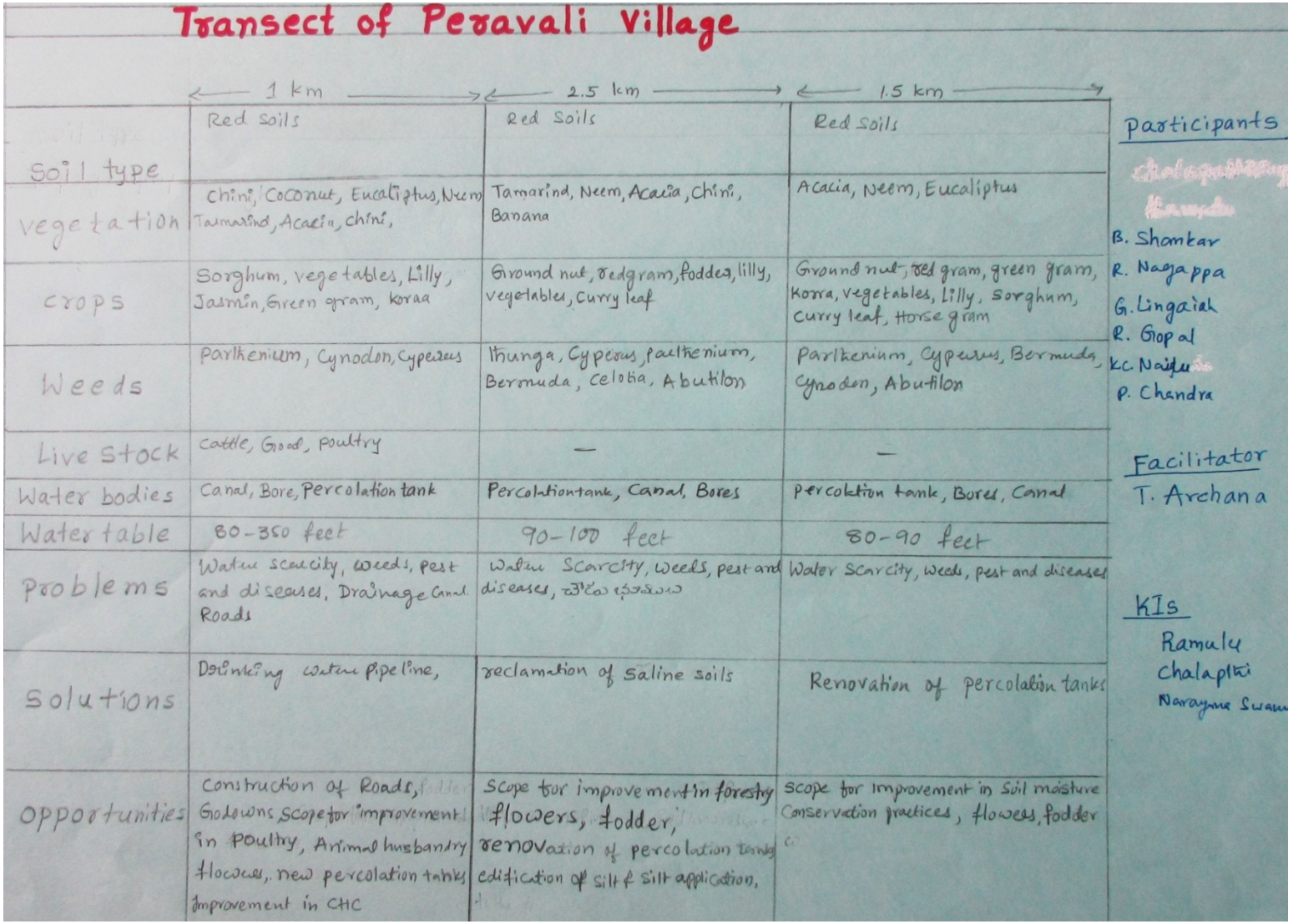


Fig.4.18 An illustration of a general transect of Peravali village of Anantapur district

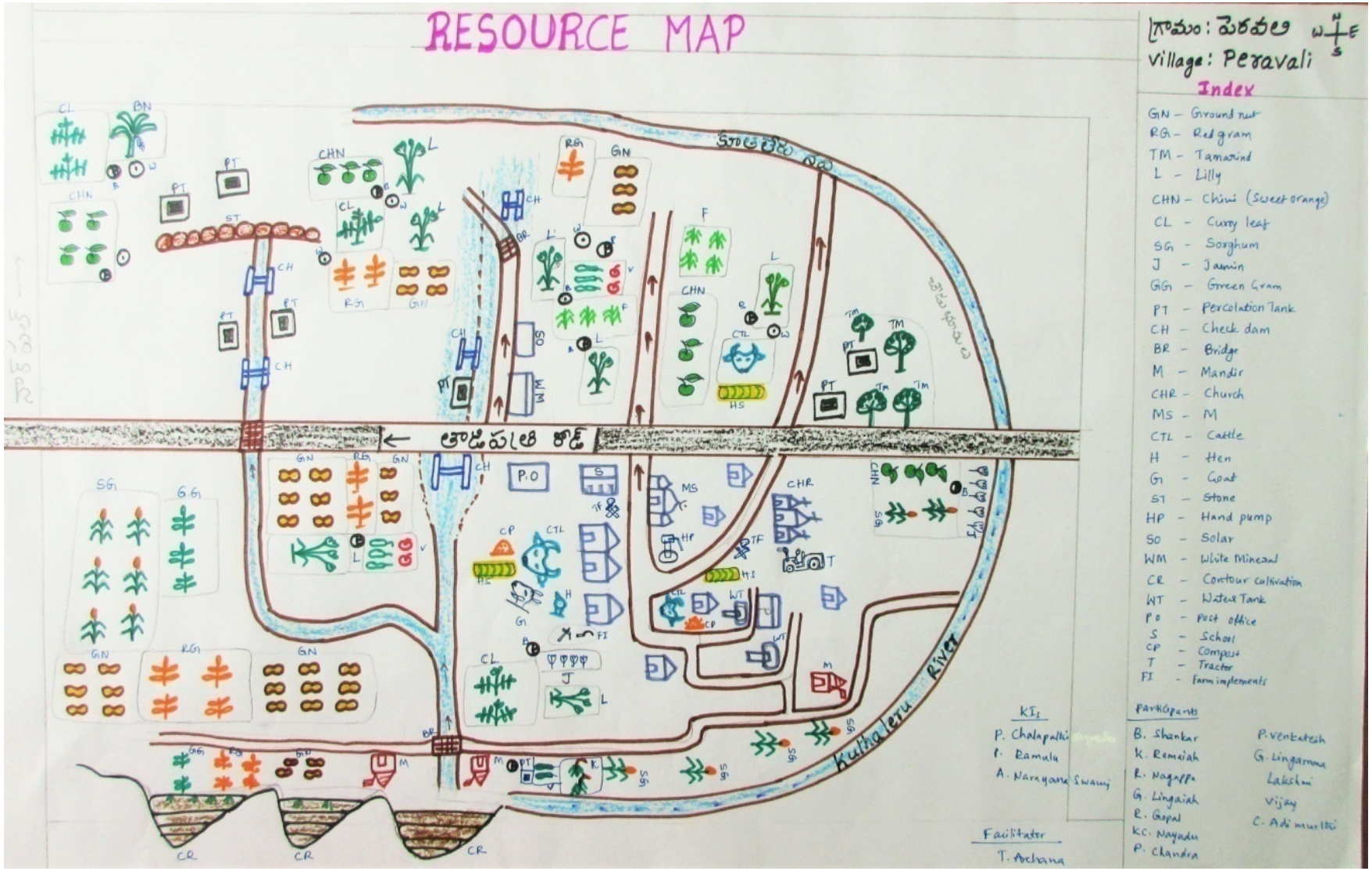


Fig.4.19 An illustration of a resource map of Peravali village of Anantapur district

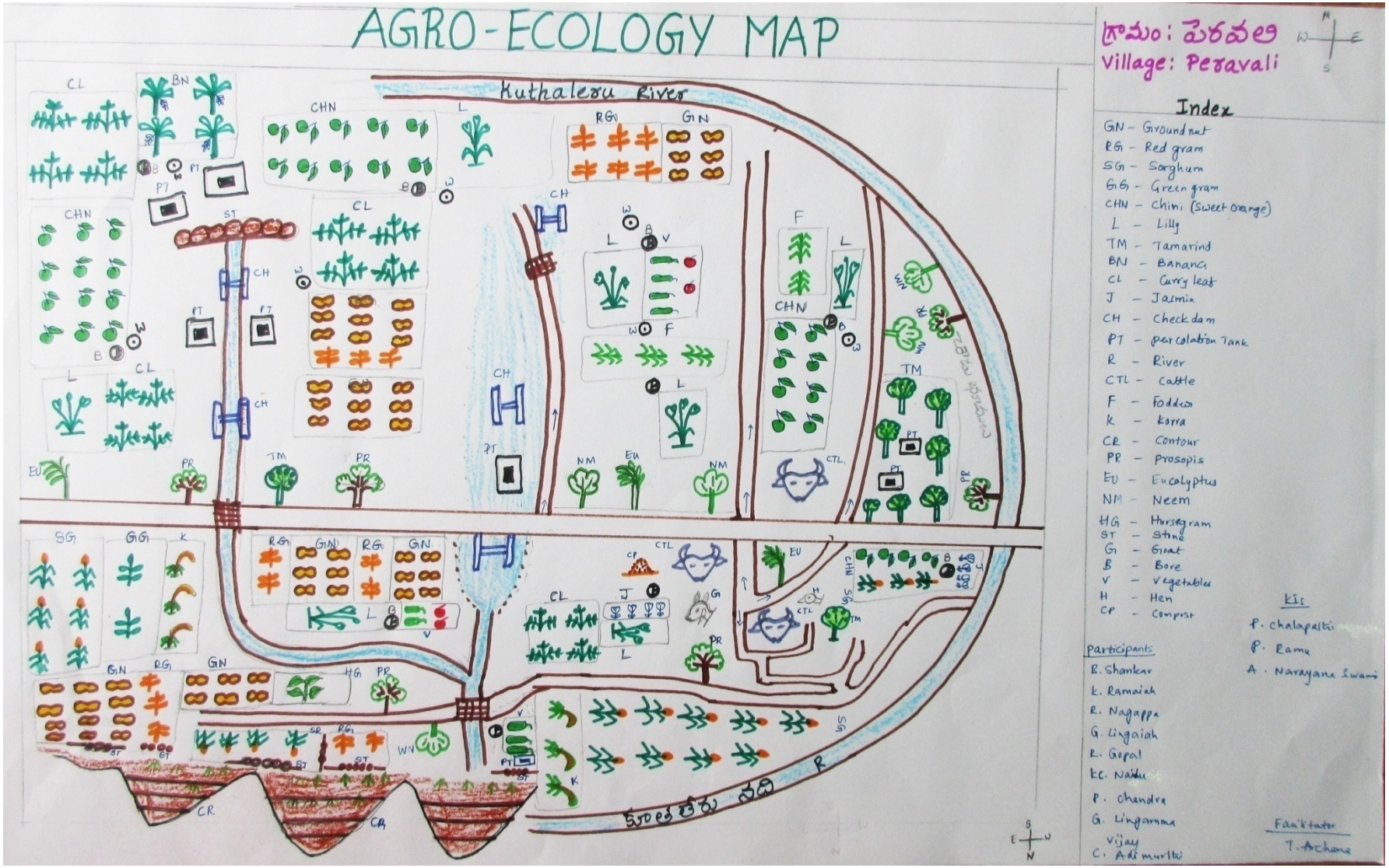


Fig.4.20 An illustration of a agro-ecology map of Peravali village of Anantapur district

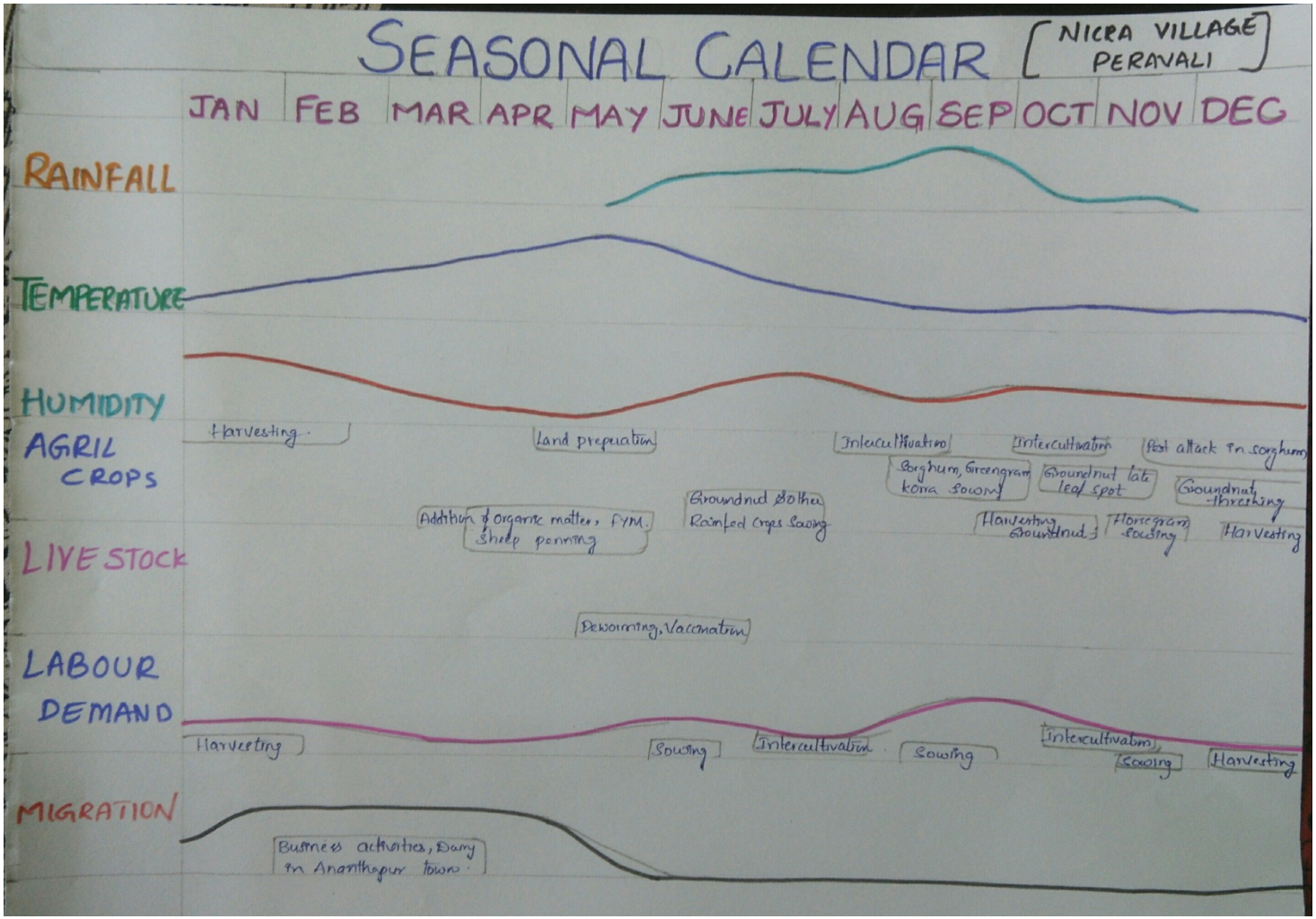


Fig.4.21 An illustration of a seasonal calendar of Peravali village of Anantapur district

4.2.2 The analyzed results of various PRA techniques done in Chakraya peta village in Ananthapur districts of Andhra Pradesh state

4.2.2.1 Village transect

Key Informants: Vijay Reddy, Shiva, Adinarayana, Rama Chandra, Mohammad

The transect walk was carried out from west to south towards the east to north direction of Chakraya Peta village along with the above mentioned key informants covering an area of around 3 km during transect each person of the group identified resource and allied problems. While carrying out the transect walk at most care was taken in noting down the land marks of the various natural, social and the other resources present in the area together with the boundary points. The transect walk and transect axis maps were drawn by the farmers is given in Fig 4.22 and 23.

Initiation of transect was from the West to south marked by house residential area of Chakraya Peta village. This village is endorsed with resources like water tank, transformers, dairy units, agricultural fields, nursery, plantations, one School and farmers regular meeting place (racha banda) etc. Religious institutions like temple was also present in the area. This village is bordered by Chamaluru village and hills with contour cultivation in the south, Potharaju Kaluva village in the north, Chennam Palli village in the west and Govindaraidu Peta in east. Most part of the village marked connecting the village to nearby towns like Anantapur. The village had been divided into three zones for the purpose of general transect. The first transect covered an area of 900 m, the second one 1 km and the third one 800 m. the soils were red in three different transects. In terms of vegetation, the number of trees found was more in the second transect. The number of trees found in the last transect was less. The crops were more in middle one, but it was less in last zone. Livestock was found in first and last transect. Bore wells and percolation tanks were present in three zones. More number of percolation tanks and check dams were present in second zone. One Pothu Raju canal was passed to second and third zone from the hills. Water table was found to be near in third transect (70 feet), it was deep in the second transect (95 feet) but, it was very deep in middle transect (250 feet). The major crop was ground nut + red gram intercrop under rainfed. Other crops like horse gram, korra, green gram, sorghum as dual purpose, fodder crop. Vegetables such as tomato, cucumber and ridge gourds. Among tress, we could observe neem, eucalyptus tamarind, pongamia, sapota, banana, mango etc. While Water scarcity in summer and renovation of soil moisture conservation measures and pest and disease attack were the problems three zones. Improving the soil moisture conservation measure, construction of roads in village and integrated pest management can be practiced to

stop the attack of the pests in three zones, while construction of godown in first zone and scope for improvement of agro forestry in second zone.

4.2.2.2 Resource map

Key Informants: Vijay Reddy, Shiva, Adinarayana, Rama Chandra and Mohammad

Resource map is a tool that helps us to learn about the community resource base in villager's perspective. This indicates both natural and man-made resources needed for development in agriculture and allied sectors. The map was drawn by the farmers is given in Fig 4.24.

Predominant crops are ground nut + red gram, other crops horse gram, sorghum under rainfed. Sapota, banana, mango orchards were under irrigation, at hill side area. Farmers were keeping stone checks around fields where the slope is occurred to control the runoff and to maintain soil moisture. Animals, farm implements and transport in the area are represented in this map. Resource map of Chakraya Peta village gives an idea of various resources such as crops, water sources, irrigation, agricultural implements, one water tank and two hand pumps etc. The main source of irrigation for the farmers is the Pothu Raju canal which runs along the boundary starting from east, flowing through west. Apart from this open wells, percolation tanks, check dams available all through ads to the irrigation source of the village. One school and vegetable nursery was present at entry point of the village. At the centre of residential area of village was having one regular meeting place of farmers (rachha banda). As far as the agricultural machinery is concerned, the farmers of this village were using implements from CHC on hiring basis to do the farm operations and some drip irrigation sets motors by farmers for fruit trees. In the residential area livestock like cattle, goats, poultry were the important resources available with the farmers, Coconut, eucalyptus, pongamia, prosopis and neem trees are present along roads and canals. Prosopis trees are the major source of firewood to the villagers. KVK was supplying seed varieties of major crops. However for most crop inputs like fertilizers, pesticides/ fungicides, high quality seeds etc. the farmers are dependent on external sources like shops in Ananthapur town.

4.2.2.3 Agro ecology map

Key Informants: Vijay Reddy, Shiva, Adinarayana, Rama Chandra and Mohammad

Agro-ecological map indicates the macro and micro ecological (subsystem) features in a village. The meteorological parameters like rainfall, temperature, relative humidity, flora

and fauna of the village and the basic land use pattern such as agro-forestry, forest cover and wasteland is depicted in the map. The map was drawn by the farmers is given in Fig 4.25.

Agro ecological map of the village Chakraya Peta was drawn by farmers to identify the various agro ecological zones present in the village. The farmers (KI's) were encouraged to draw the agro ecological map themselves marking the important landmarks. Special emphasis was given to mark the various topographical areas, cropping pattern and crops, soil types, water bodies, weeds, water sources and irrigation system, livestock, trees and other aspects related to agro ecology. Major landmarks used to differentiate various zones in the map include important roads, Pothu Raju canal, etc. the major crop in this village was ground nut, other crops were dual purpose sorghum, black gram, green gram, horse gram, korra, fodder. The cropped area is distributed in two zones, one near the national highway, on the southern side, having bulk of the fields near the hills, the soil here was red soils. Major crops were ground nut + red gram under rainfed and other crops were dual purpose sorghum, black gram, green gram, horse gram, korra, fodder. Isolated small areas in this zone were under Banana and Mango, Sapota Orchards. Apart from this the farmers were growing vegetables like tomato, brinjal, ladies finger for self consumption, in this area.

The residential area of the village mainly consists of houses but all of the livestock i.e. cattle, poultry, goats were also present in this area. Low and erratic rain fall, uneven distribution of rain fall, delayed monsoon and early cessation of monsoon are the major climatic constraints. 90 per cent of area under red soils. Shallow depth of the soils and low water holding capacity, saline soils were the major soil constraints. The major source of water in the village for cultivation and household use was the bore wells. Trees like teak, neem, prosopis, coconut, eucalyptus were present continuously on sides of canal and roads. In this village water harvesting measures like percolation tanks were excavated, contour cultivation also taken place on hills, to stop the run off and soil erosion of canal from hill side check dams were constructed, stone bunds also used around the crops where the soil was having slope around the crops where the soil was having slope to control the soil erosion and to store the soil moisture.

4.2.2.4 Seasonal calendar

Key Informants: Vijay Reddy, Shiva, Adinarayana, Rama Chandra and Mohammad

The seasonal analysis of Peravali village was done to find out the abnormalities in climate that were found to exist with regard to agriculture so that they could be taken care of

during the preparation of action plan for the village. The map was drawn by the farmers is given in Fig 4.26.The month wise analysis as reported by the key informants were as follows

January: the temperature was reported to be very low and in case of humidity, it was high.

February, March and April: According to the key informants, temperature was increasing gradually during these three months. In the case of humidity used to go down during these three months.

May: The temperature was reported to be very high in this month, it would be 48oC, had dry season. This was the high temperature period. In the case of humidity, it was very low compared to other months.

June: It was the beginning of rain.

June, July, august, September and October: the rain fall was gradually increasing from June to September than used to go down completely in the month of October. The humidity was gradually increasing from June to October. In case of temperature it was used to go down during these months. These months had rainy season (moisture excess), this was the crop rowing period.

November, December and January: The temperature was used to go down. The relative humidity was in increasing trend during these months. These months had winter with mist with less temperature.

The seasonal analysis results were almost same like Peravali village as these two were neighbouring villages. In the month January to march farmers did activities like harvesting their crops (sorghum, green gram, korra and horse gram), labour demand was less during these days. In the months of May to June they did land preparation and FYM organic manure application. During April and May months they did sheep penning activity to improve the soil fertility. In the months of May to July they gave vaccinations and de-warming to their animals, in the months of June to July they had sown rainfed crops ground nut, only few farmers had sown ground nut and red gram as intercrop and they gave vaccination and de-warming their animals. From July to September they did intercultivation in crops. In the month of September they had sown sorghum, green gram, cluster bean etc. at the end of September they harvested the ground nut crop. The pest attack was more during October to December. In the month of November they had sown horse gram crop and pest attack was more in sorghum crop. In the month of December farmers did activities like de-warming of animals, threshing of ground nut for doing these activities labour demand was

more during this period. These farmers were migrating to the Anantapur town for doing business activities in lean season from January to April months.

4.2.2.5 Gathered information from triangulation of PRA techniques conducted in two NICRA adopted villages (Peravali and Chakraya Peta) in Ananthapur district

The gathered information from PRA techniques which have conducted in two NICRA adopted villages (Peravali and Chakraya Peta) in Ananthapur district with the active participation of community farmers, these farmers were excavated more number of percolation tanks, constructed check dams with the help of KVK, watershed and MGNAREGA. There was increase in underground water level (15 feet) due to excavation of percolation ponds. In the year 2014, under NRM module, one check dam was renovated at Peravali village. One feeder channel was formed to carry leakage water from HLC canal to check dam at Chakraya Peta village. By formation of feeder channel, check dam was filled with HLC leakage water. Due to this, 36 ha of area brought under cultivation of different crops. About 55 bore wells and 9 open wells were recharged. Due to digging of percolation ponds, about 8 bore wells and 3 open wells were recharged. Water level increased by 5-7 meters in bore wells. 5 ha of land brought under cultivation of different crops. In these two villages farmers received very low rainfall (239.9 mm) it was less than the normal rain fall (493.7 mm). Farmers sown ground nut crop in first fort night of July with 20 mm rain fall only. The crop was subjected to prolonged dryspell at moisture sensitive stages resulted drastic reduction in yield. Some farmers sown sorghum, green gram, korra and guar crop in the month of second fort night of August, as contingent crops. Farmers were also cultivating on the slopes using with stone bunds. We also observed that in some places fodder, orchards like sweet oranges, banana, pomegranate, sapota, jasmine, lilly flowers and curry leaf and some other vegetable tact for household consumption where the water facility occurred. Farmers were also doing contour cultivation and dug out contour trenches on hills. Animal husbandry with hay stocks, goats and poultry also observed near the residential area. These farmers took farm implements on hiring basis from CHC.

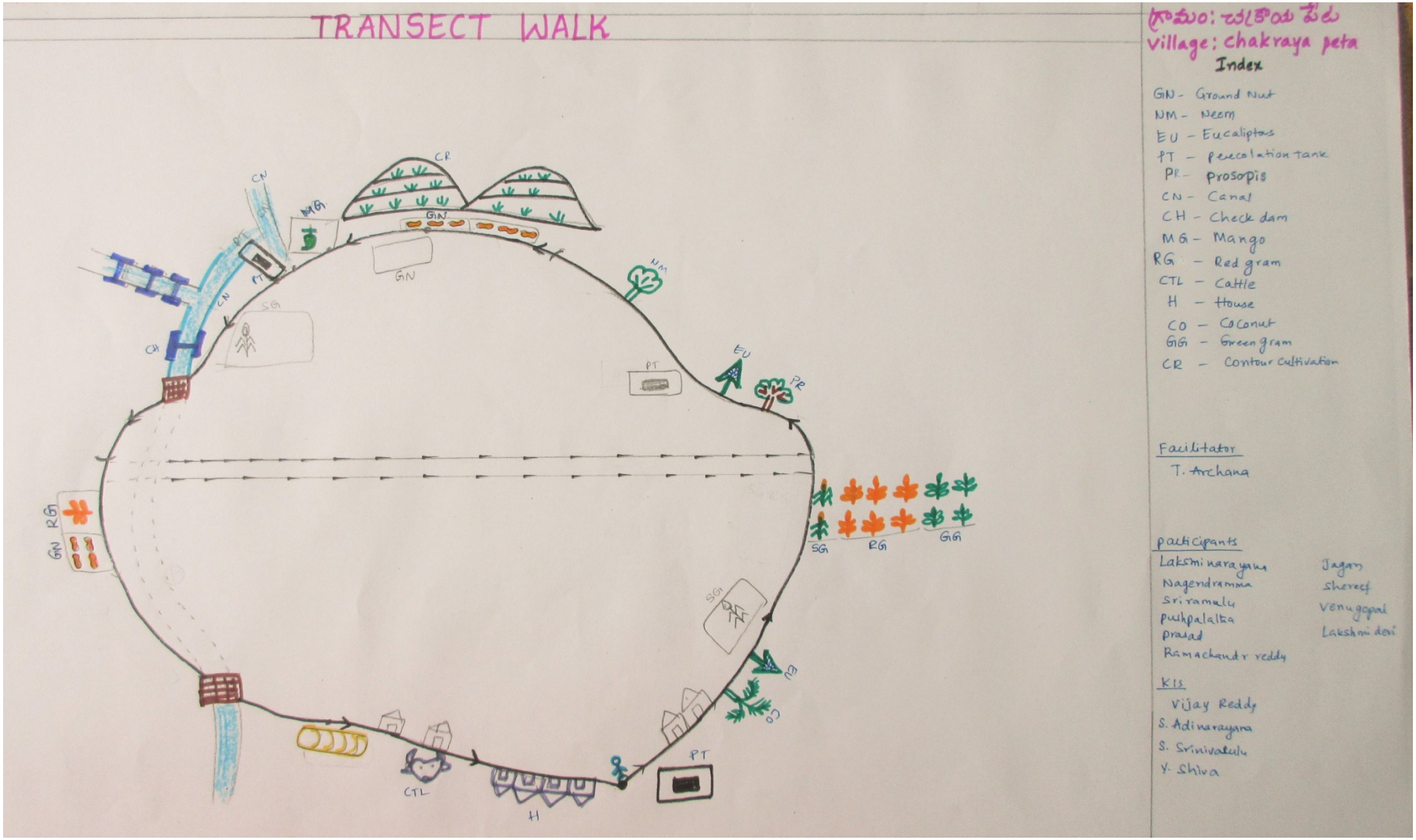


Fig.4.22 An illustration of a transect walk of Chakraya Peta village of Anantapur district

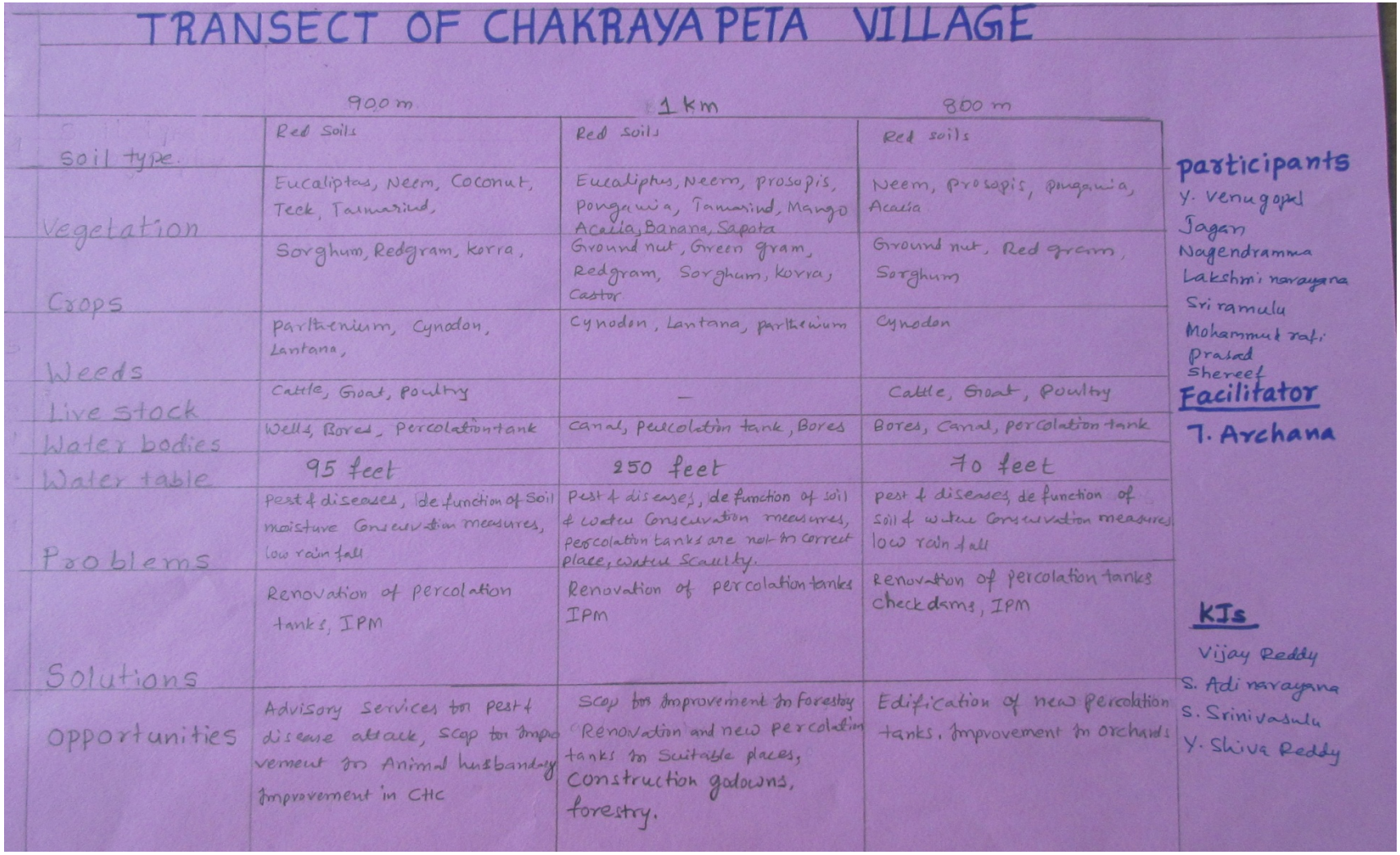


Fig.4.23 An illustration of a general transect of Chakraya Peta village of Anantapur district

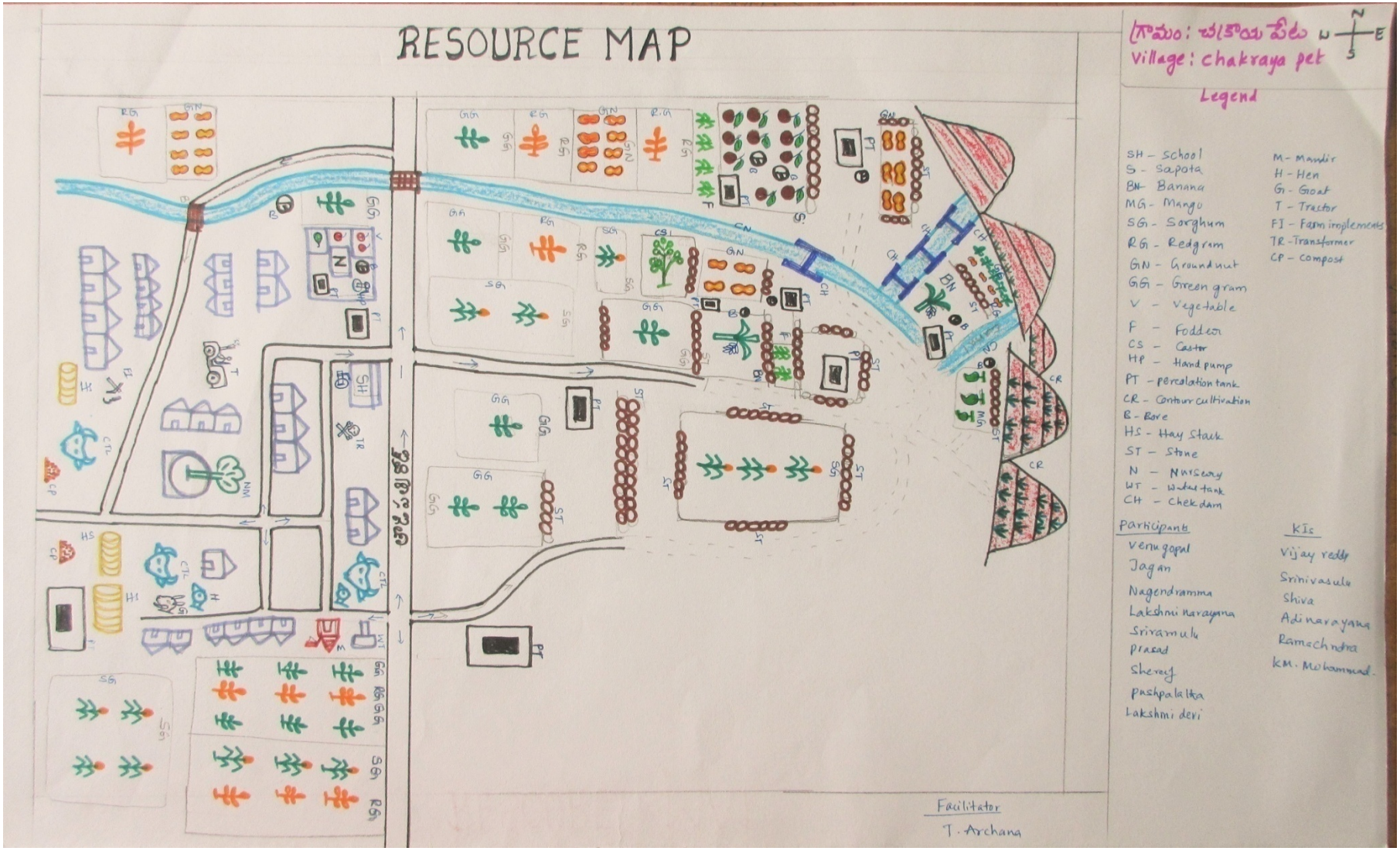


Fig.4.24 An illustration of a resource map of Chakraya Peta village of Anantapur district

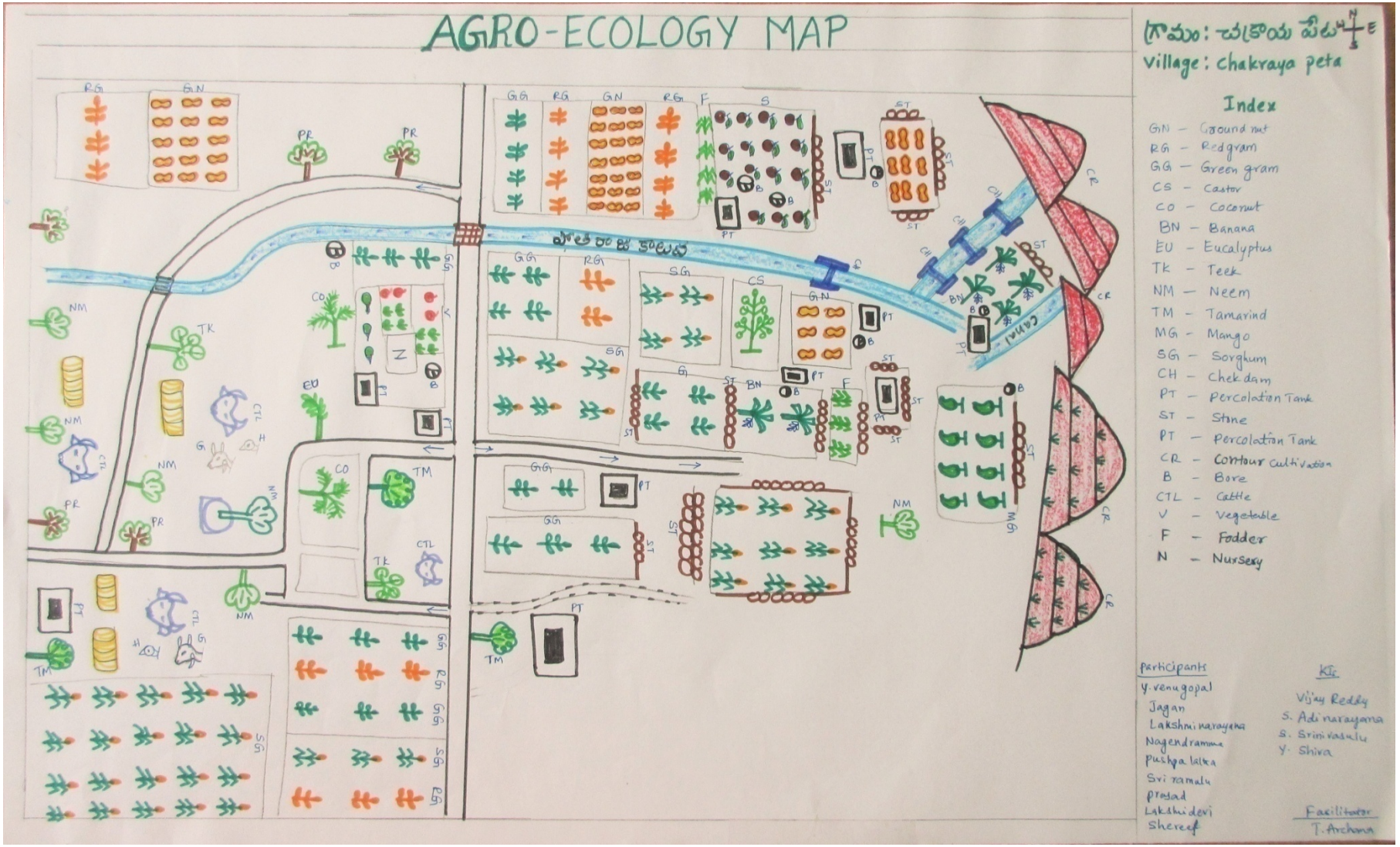


Fig.4.25 An illustration of a agro-ecology map of Chakraya Peta village of Ananthapur district

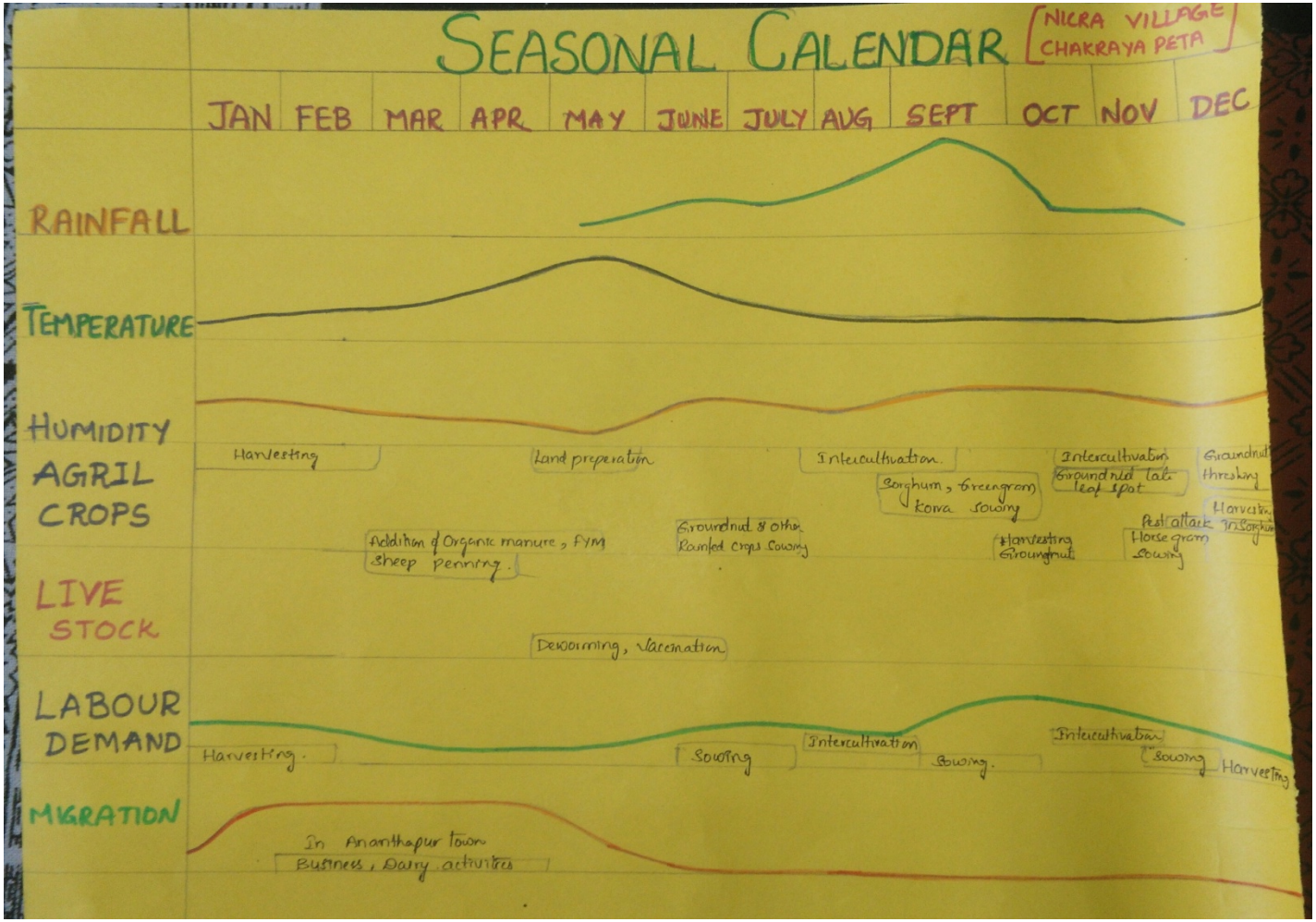


Fig.4.26 An illustration of a seasonal calendar of Chakraya Peta village of Anantapur district

4.2.2 The analyzed results of various PRA techniques done in Nandyala Gudem village in Nalgonda district of Telangana state was given below.

4.2.3.1 Village transect

Key Informants: N. Krishna Reddy, N. Bhargav and Laxmaiah

The transect walk was carried out from south east towards the northwest direction of Nandyala Gudem village along with the above mentioned key informants covering an area of around 3km during transect each person of the group identified the researchable areas and allied problems corresponding to their respective fields of specialization. While carrying out the transect walk at most care was taken in noting down the land marks of the various natural, social and the other resources present in the area together with the boundary points. The transect walk and transect axis maps were drawn by the farmers is given in Fig 4.27 and 28.

Initiation of transect was from the south marked by residential area of Nandyala Gudem village. This is endorsed with resources like mineral water plant, dairy units, sericulture, agricultural fields, plantations etc. Religious institutions like temples are also present in the area. Other Institution such as KVK office also adds to the resources of the village.

This village is bordered by Nasheempet village in the east, Gattikal in the west, Isthalapuram village in the north and Athmakur in south. Initiation of transect was from the south to east most part of the village marked connecting village to nearby towns like Suryapeta.

The village had been divided into three zones for the purpose of general transect. The first transect covered an area of 1 km, the second one 2.5 km and the third one 1.5 km. the soils were mixed both red (25%) and black (75%) in three different transects.

In terms of vegetation, the number of trees found was more in the first transect. The number of trees found in the last transect was less. The crops were more in middle one, but it was less in second one. Livestock was found in first transect. Bore wells and SRSP canal channel was passed in three zones. One water tank and pond was found in first zone, open wells and farm pond was found in second zone but, but, no water bodies were found in last zone. In the rainy season the bores were recharged and the water table was found to be very

near in second(40 feet) and in third zone it was 50 feet but, it was deep in the first transect (60 feet).

Telangana and A.P. are the states where combination of red and black soil together is found. In Nandyala Gudem village, we observed the same. Red soil was pre-dominant in upland area whereas black soil was predominant in low land area due to alluvial material near the water reservoir.

Red soil being poorly fertile due to low nutrient contents (N, P and K) and low organic matter requires more fertilizers for fulfilling the requirement whereas black soil is deep depth soil and contains high organic matter. The major crops grown here are cotton, red gram and chilli. The peculiar thing was growing cotton in both soils red as well as black. Other crops include vegetables such as cucumber and ridge gourds. Among tress, we could observe Neem, Tamarind, Gulmohar, Pongamia, Palms, Toddy, Almond mango tree etc. the farmers were slowly shifting cultivation from cotton to mulberry cultivation due to low rain fall and getting high income through sericulture.

There was one pond and wells also that aid in irrigation of the crops. The rice cultivation was reduced due to low rainfall, only nearby pond rice cultivation was taken place. Water is either drawn mechanically or pumped into the fields. In upland area, the source of irrigation is either wells or lift irrigation.

The problems were different in different transects. While Water scarcity in summer and labour problem were the problems in first transect. Pest and diseases and labour were the important problems in second transect. Pest and diseases and low water table and labour were reported as important problems in last transect.

Improving the soil moisture conservation measure, labour banks, construction of roads in village construction of godowns had good opportunity in first transect. Labour bank and integrated pest management can be practiced to stop the attack of the pests in three zones.

4.2.3.2 Resource map

Key Informants: N. Krishna Reddy, N. Bhargav and Lakshmaiah

Resource map is a tool that helps us to learn about the community resource base in villager's perspective. This indicates both natural and man-made resources needed for development in agriculture and allied sectors. The map was drawn by the farmers is given in Fig 4.29.

Major crops were cotton, red gram, chilli, sorghum, vegetables like tomato, brinjal, cluster bean, leafy vegetables. Animals, farm implements and transport in the area are represented in this map. Resource map of Nandyala Gudem village gives an idea of various resources such as water sources, irrigation, agricultural implements, chawki center, mulberry sheds, drinking water availability etc. The main source of irrigation for the farmers is the canal system (left) as a part of the Nagarjuna Sagar project which runs in to the village starting from west, flowing through east, but water was not allowed to channels which were passed to the village from Nagarjuna Sagar left canal due to some political issues. Apart from this open wells farm ponds bores, ponds, canals, check dams available all through add to the irrigation source of the village. One water tanks and two hand pump are also present in the village. Some drip irrigation sets motors by farmers for cultivation of different crops. The cropped and village residential areas have predominantly light chalka red soil while near the water reservoir black soil occurs. In the residential area livestock like cattle, goats and poultry were the important resources available with the farmers supplying compost pit, hay Stack, milk, meat, eggs, and bio manure from the cowshed used as a fertilizer etc. The village also has important resources like gas connections, telephone connections (50% farmers), cell phone connections, electric supply, cable connection and TV sets. Mulberry orchards and mango orchard were present. Eucalyptus, coconut, pongamia, prosopis and neem trees are present along the pond bank, along roads and canals. Prosopis trees are the major source of firewood to the villagers while neem trees serve for pest protection. Coconut trees also serve as resources to the farmers. As far as the agricultural machinery is concerned, the farmers of this village were using implements from CHC on hiring basis to do the farm operations. KVK was supplying seed varieties of major crops. However for most crop inputs like fertilizers, pesticides/ fungicides, high quality seeds etc. the farmers are dependent on external sources like shops in neighboring villages.

4.2.2.3 Agro ecology map

Key Informants: N. Krishna Reddy, N. Bhargav and Laxmaiah

Agro ecological map of Nandyala Gudem village was drawn to identify the various agro ecological zones present in the village. Special emphasis was given to mark the various crops, soil types, water bodies, weeds, water sources and irrigation system,

livestock, trees and other aspects related to agro ecology. The map was drawn by the farmers is given in Fig 4.30.

The village can be classified into low land and uplands, dominated by red light chalka soil followed by black sandy loam soil. The main crop grown in this village was cotton. Other crops were intercultivation of cotton with red gram, dual purpose sorghum as contingency measure, chilli, fodder and azolla cultivation. In this village red soils were suitable to cultivation of mulberry orchards, using drip system for irrigation to the mulberry, more than 20 farmers were shifted to sericulture due to getting high income from sericulture. Mango orchard was present in this village. There was also the vegetable growing tract in the village. Mainly the cucurbitaceous crops like Ridge gourd, bottle gourd, pumpkin and cucumber are grown along with other crops. The vegetation was teak, pongamia, eucalyptus, neem, calotropis, and prosopis. As far as dairy sector of the village was concerned, majority of the farmers were maintaining only 3-6 cattle and 5-10 goats mainly on a subsistence basis supplementing the main revenue from crops. Village had a pond which was highly silted and dried. The central area of the pond has calcareous soil. The outer boundary of the pond has clay loam soil. Prosopis occupy most of this area. The major source of water in the village for cultivation and household use is the bore wells, drinking water tanks having Krishna river water. Apart from this many open wells and farm ponds also supply water for various purposes. Pond and canals were dried up, here fish farming was difficult due to low rainfall.

4.2.2.4 Seasonal calendar

Key Informants: N. Krishna Reddy, N. Bhargav, Laxmaiah and Srinivasulus

The seasonal analysis of Peravali village was done to find out the abnormalities in climate that were found to exist with regard to agriculture so that they could be taken care of during the preparation of action plan for the village. The map was drawn by the farmers is given in Fig 4.31. The month wise analysis as reported by the key informants were as follows

January: The temperature was reported to be very low and in case of humidity, it was high.

February, March and April: According to the key informants, temperature was increasing gradually during these three months. In the case of humidity used to go down during these three months.

May: The temperature was reported to be very high in this month, it would be 48oC, had dry season. This was the high temperature period. In the case of humidity, it was very low compared to other months.

June: It was the beginning of rain.

June, July, august, September and October: The rainfall was high in September month followed by June, August, July and October. Erratic distribution of rainfall was occurred during these months. In case of temperature it was used to go down during these months. Humidity was also fluctuating during these months due to erratic rainfall and low temperatures. High humidity was occurred in September compared to other months. These months had rainy season (moisture excess), this was the crop rowing period.

November, December and January: The temperature was used to go down. The relative humidity was in increasing trend during these months. These months had winter with mist with less temperature.

From January to April the farmers harvested red gram, rabi sorghum, balk gram crops and preparation for mulberry nursery. De-warming their animals and did vaccination milk collection was good. Sericulture activities like feeding bed increasing, for doing these activities the labour demand was more in these months. From April to June they did activities like cotton residue incorporation, ploughing, FYM application etc, from June to July they had sown cotton, red gram, and mulberry transplanting and labour demand was also more for doing these activities in these months. From July to august they did intercultivation operations. In the month of August and September they had sown sorghum and rabi crops like black gram etc, in these months the sucking pest attack was more in cotton crop. From October to December they did intercultivation operations in the crops like sorghum and rabi crops, pest attack was more in sorghum crop, did sericulture activities, milk collection was more from cows, they did cotton pickings in these months and in December month they did de-warming and vaccination for their animals. For doing these activities the labour demand was more in these months.

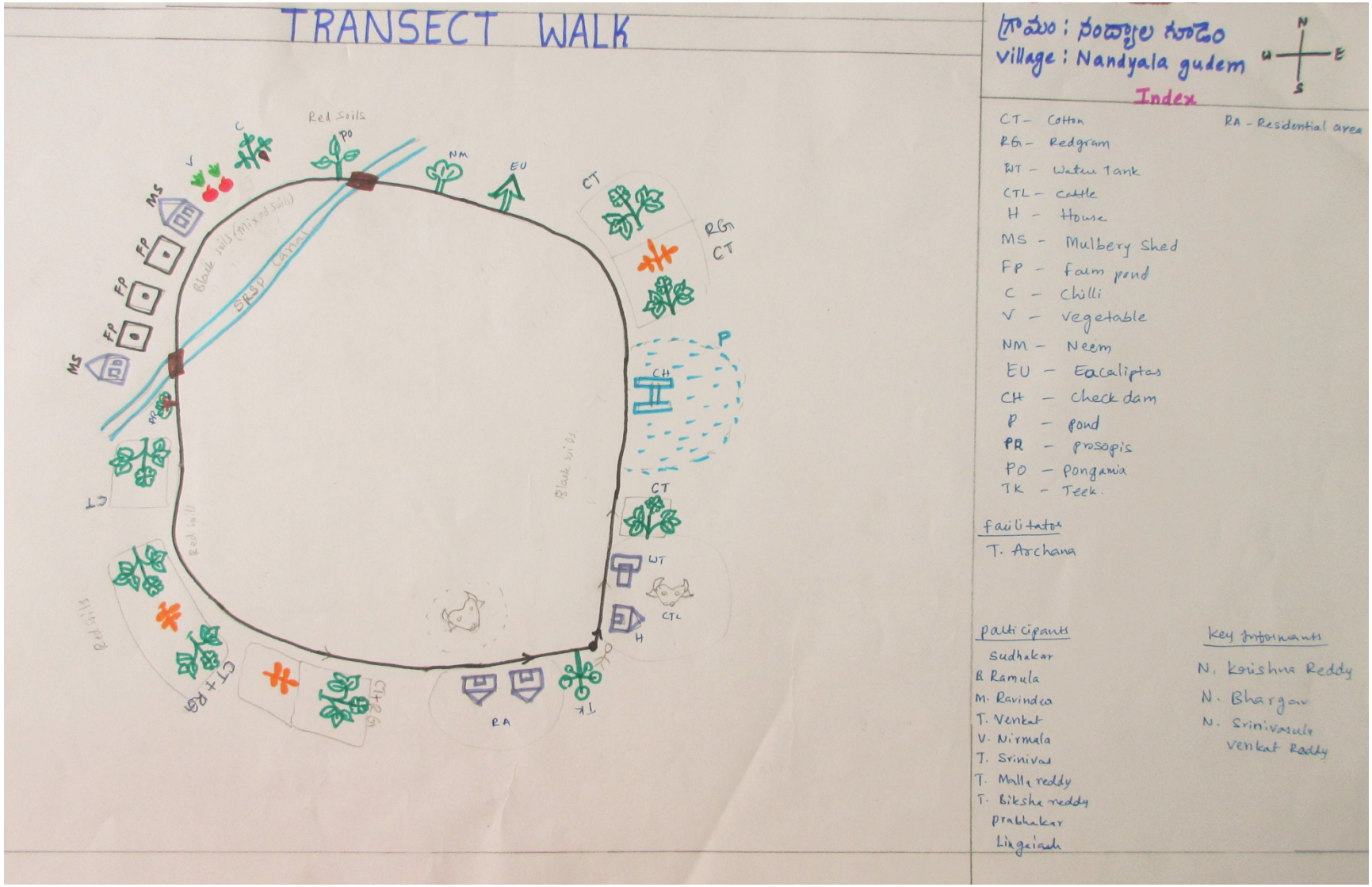


Fig.4.27An illustration of a transect walk of Nandyala Gudem village of Nalgonda district

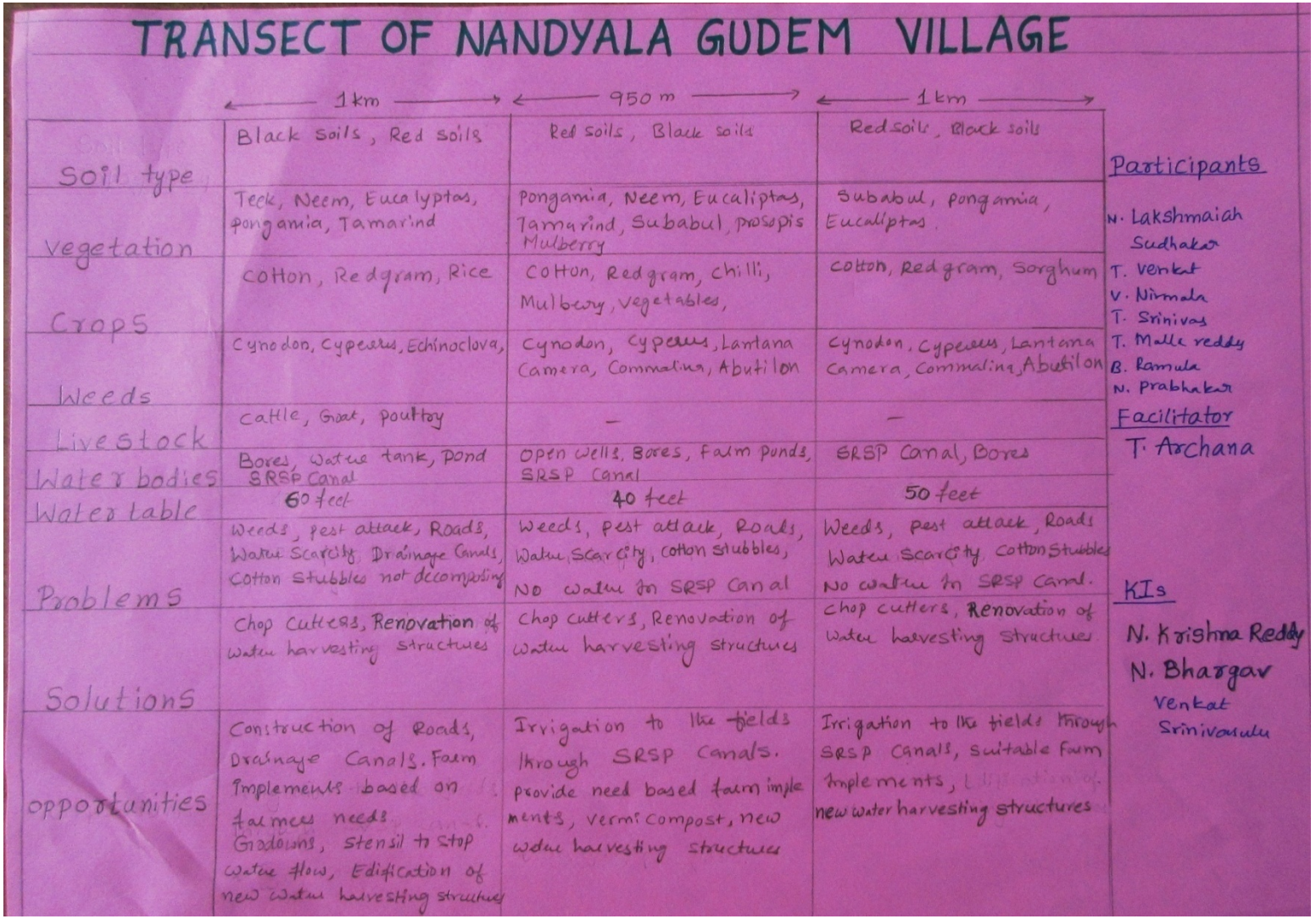


Fig.4.28 An illustration of a general transect of Nandyala Gudem village of Nalgonda district

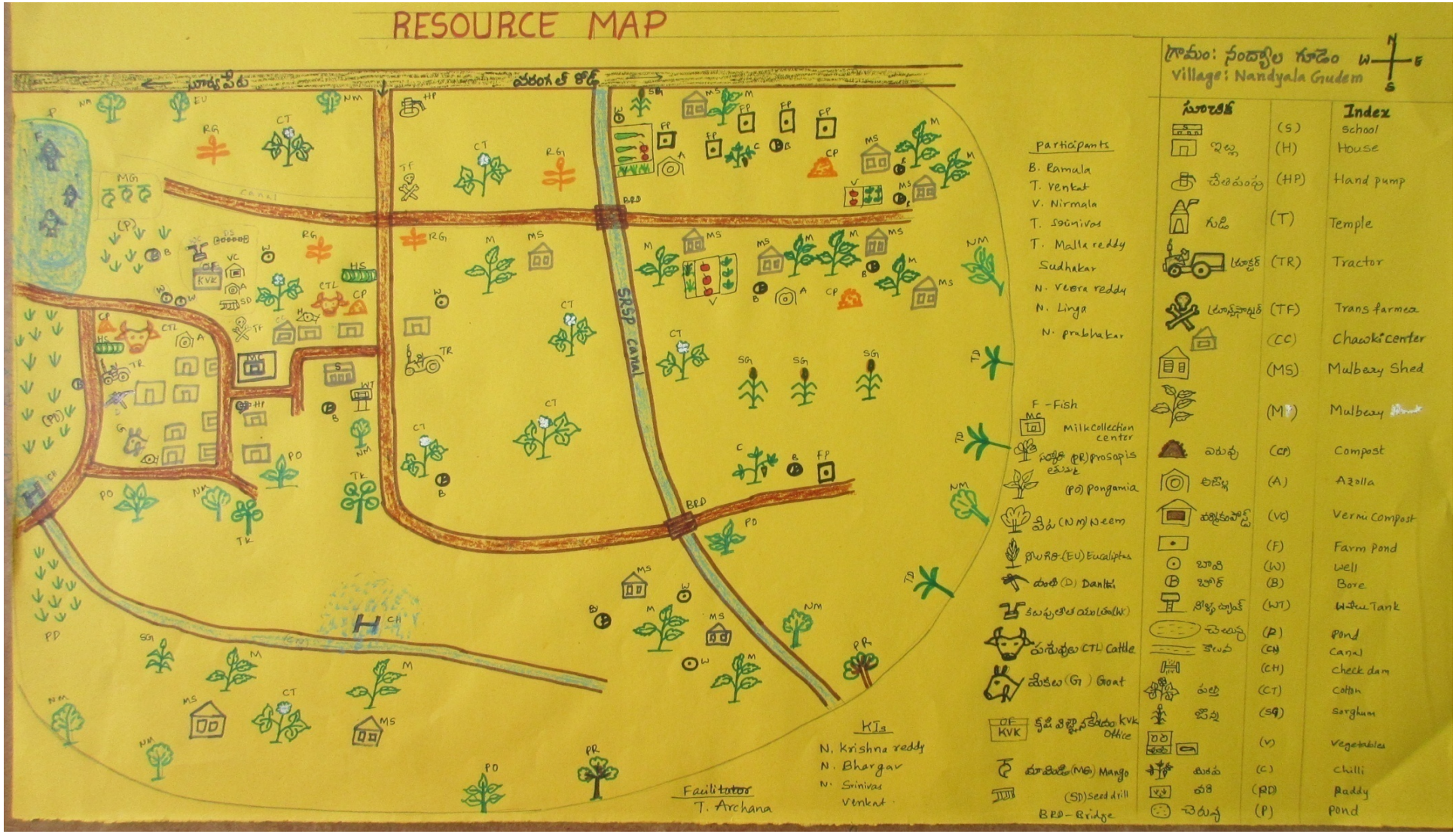


Fig.4.29 An illustration of a resource map of Nandyala Gudem village of Nalgonda district

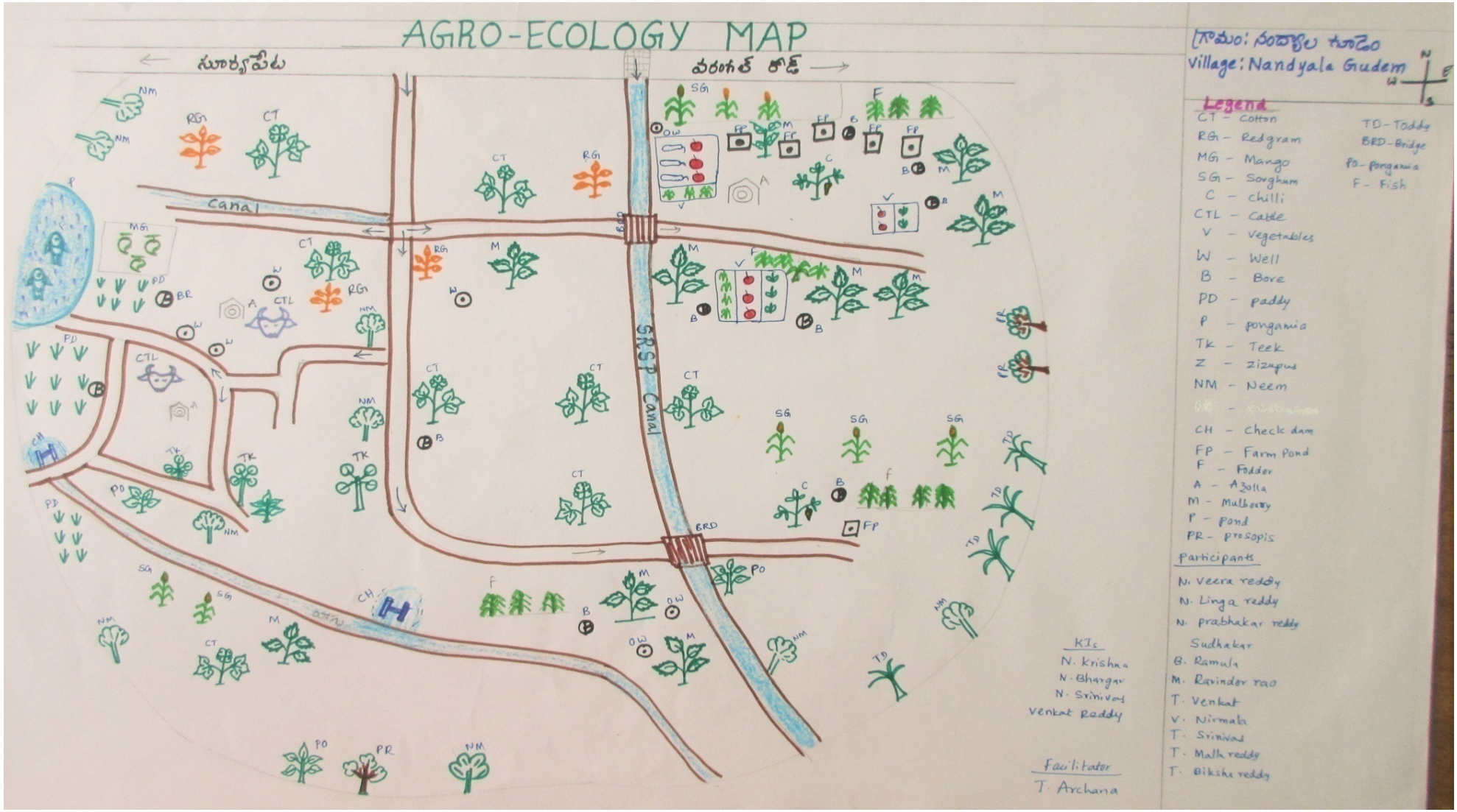


Fig.4.30 An illustration of a agro-ecology map of Nandyala Gudem village of Nalgonda district

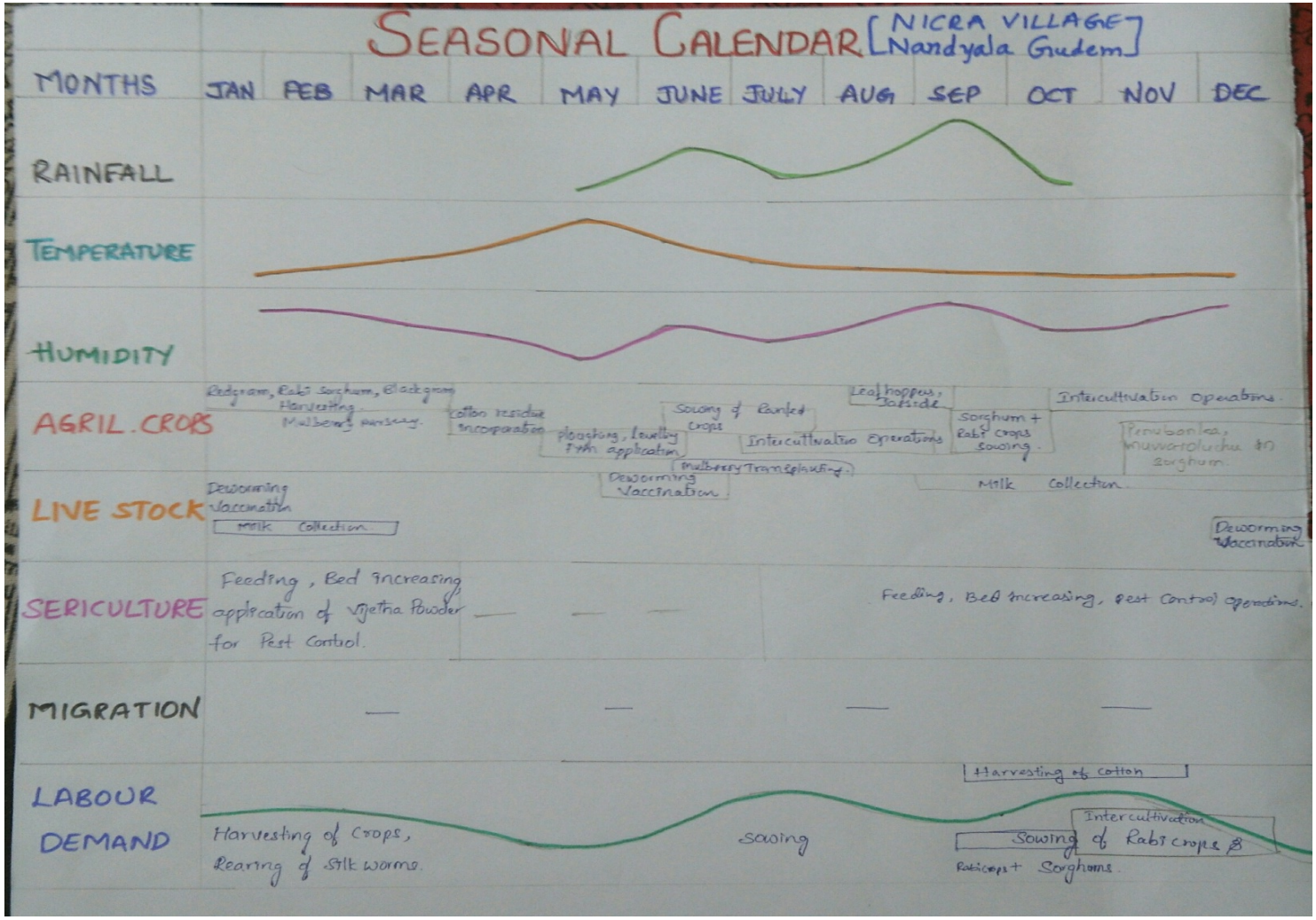


Fig.4.31 An illustration of a seasonal calendar of Nandyala Gudem village of Nalgonda district

4.2.4 The analyzed results of various PRA techniques done in Boring Thanda village in Nalgonda district of Telangana state

4.2.4.1 Village transect

Key Informants: B. Ramesh, B. Chandu, G. Ravi and B. Shekar

The transect walk was carried out from south east towards the north west direction of Boring Thanda village along with the above mentioned key informants covering an area of around 2km during transect each person of the group identified the resources of the village. While carrying out the transect walk at most care was taken in noting down the land marks of the various natural, social and the other resources present in the area together with the boundary points. The transect walk and transect axis maps were drawn by the farmers is given in Fig 4.32 and 33.

Initiation of transect was from the south east marked by farm pond area of Boring thanda village. This village is endorsed with resources like government school, dairy units, agricultural fields, plantations etc. Religious institutions like temples are also present in the area. This village is bordered by Isthalapuram village in the east, Suryapeta road in the west, Kothha Thanda village in the north and Nandyala Gudem village in south. Most part of the village marked connecting the village to nearby town Suryapeta.

The village had been divided into three zones for the purpose of general transect. The first transect covered an area of 500 m, the second one 450 m and the third one 1 km. the soils were mixed both red chalka soils (75%) and black (25%) in three different transects. In terms of vegetation, the number of trees found was more in the second transect. The number of trees found in the first transect was less. The crops were more in first one, but it was less in second one. Livestock was found in first and second transect. Nandyala Gudem canal passed from south in the first zone to last zone. One canal from the pond was passed from first zone to second zone. Bores, open wells, canal, hand pump and farm pond were found in first zone, open wells, bore wells pond and canal was found in second zone but, no water bodies were found in last zone. Water table was found to be deep in first (70 feet) and in third zone (50 feet), but, it was near in the second transect (60 feet).

In Boring Thanda, we observed that red soil was pre-dominant in upland area whereas black soil was predominant in low land area due to alluvial material near the water reservoir. The major crops grown here are cotton, red gram and chilli. Other crops include vegetables such as cucumber and ridge gourds. Among tress, we could observe neem,

toddy, tamarind, gulmohar, pongamia, palms, custard apple, mango tree etc. There was one pond and wells also that aid in irrigation of the crops. The rice cultivation was reduced due to low rainfall, only nearby pond rice cultivation was taken place.

The problems were different in different transects. While water scarcity in summer, drinking water, wild pigs, pest and disease problems were the problems in first transect. Pest and diseases, water scarcity and waste land were the important problems in second transect. Water scarcity and crop wilting as important problems in last transect.

Improving the soil moisture conservation measure, construction of roads, mineral water plant had good opportunity in first transect. Edification of percolation tanks, stencils to stop the water flow and godowns had the opportunities in second zone. Edification of new percolation tanks had the opportunity in third zone. Integrated pest management can be practiced to stop the attack of the pests in three zones.

4.2.4.2 Resource map

Key Informants: B. Ramesh, B. Chandu, G. Ravi and B. Shekar

The map was drawn by the farmers is given in Fig 4.34. Major crop was cotton, red gram and other crops like chilli, sorghum, green gram etc, vegetables like tomato, brinjal, cluster bean, and leafy vegetables. Animals, farm implements and transport in the area are represented in this map. Resource map of Boring Thanda village gives an idea of various resources such as crops, water sources, irrigation, agricultural implements, drinking water availability etc. Apart from this open wells, farm ponds, bores, pond, canals, check dams available all through add to the irrigation source of the village. Two hand pump, two temples were also present in the village. The cropped and village residential areas have predominantly light chalka red soil, while near the water reservoir black soil occurs. In the residential area livestock like cattle, goats, poultry were the important resources available. The village also had important resources like one school, shop, tea and Tiffin centre on road side. Toddy, eucalyptus, pongamia, prosopis, neem trees and calotropis were present along the pond bank, along roads and canals.

4.2.4.3 Agro ecology map

Key Informants: B. Ramesh, B. Chandu, G. Ravi and B. Shekar

The map was drawn by the farmers is given in Fig 4.35.The Boring Thanda village was dominated by red soil followed by black sandy loam soil. The main crop grown in this village was cotton. Other crops were red gram intercultivation with cotton, dual purpose sorghum as contingency measure, chilli and fodder cultivation. Mango orchard was present in this village. There was also the vegetable growing tract in the village. Mainly the cucurbitaceous crops like Ridge gourd, bottle gourd, pumpkin and cucumber are grown along with other crops. The vegetation was Toddy, eucalyptus, neem, calotropis, and prosopis. As far as dairy sector of the village was concerned, majority of the farmers were maintaining cattle and goats mainly on a subsistence basis supplementing the main revenue from crops. Village had a pond which was highly silted and dried. The central area of the pond has calcareous soil. The outer boundary of the pond has clay loam soil. Prosopis occupy most of this area. The major source of water in the village for cultivation and household use is the bore wells. Pond and canals were dried up, here fish farming was difficult due to low rainfall.

4.2.4.4 Seasonal calendar

Key Informants: B. Ramesh, B. Chandu, G. Ravi and B. Shekar

The month wise analysis as reported (Fig 4.36) by the key informants were as follows.

January: The temperature was reported to be very low and in case of humidity, it was high.

February, March and April: According to the key informants, temperature was increasing gradually during these three months. In the case of humidity used to go down during these three months.

May: The temperature was reported to be very high in this month, it would be 48oC, had dry season. This was the high temperature period. In the case of humidity, it was very low compared to other months.

June: It was the beginning of rain.

June, July, August, September and October: The rainfall was high in September month followed by June, August, July and October. Erratic distribution of rainfall was occurred during these months. In case of temperature it was used to go down during these months.

Humidity was also fluctuating during these months due to erratic rainfall and low temperatures. High humidity was occurred in September compared to other months. These months had rainy season (moisture excess), this was the crop rowing period.

November, December and January: The temperature was used to go down. The relative humidity was in increasing trend during these months. These months had winter with mist with less temperature.

From January to March they harvested chilli, cotton, red gram and sorghum etc, in January they did de warming activities for sheeps and labour demand was there for doing these activities. In the month of April they did operations like ploughing and FYM application. In the month of May they had sown vegetable. From June to August they did intercultivation operations for vegetables, had sown cotton, red gram crops, nursery preparation for chilli, from August to October they did vegetable marketing, pest attack was more in cotton, had sown sorghum and rabi crops, transplanted chilli etc., from October to December they did activities like cotton pickings, de-warming of sheeps and mites attack was more in these months. For doing these activities labour demand was more.

4.2.4.5 Gathered information from triangulation of PRA techniques conducted in two NICRA adopted villages (Nandyala Gudem and Boring Thanda) in Nalgonda district

The gathered information from triangulation of PRA techniques which have conducted in two NICRA adopted villages (Nandyala Gudem and Boring Thanda) in Nalgonda, we observed almost same results as these two villages were neighbouring villages. These were community farmers participated in more extension activities as this village adopted by NICRA and implemented through KVK. Farmers were excavated farm pond and constructed check dams with the help of KVK. De silted the check dams and pods with the help of KVK and Mission Kakatiya and applied these silt to the rainfed red chalka soils covering 36 ha as resource conservation measure to improve the drought tolerance, moisture conservation and productivity of cotton. The water level in the bore wells was maximum from October to December (up to 40 feet) on an average each bore well near the vicinity of check dam could irrigated 2-3 acres. These farmers received low rainfall (631 mm) it was less than the normal rainfall (803.6 mm). Some farmers had sown sorghum as contingency crop due to the occurrence of dryspell in the month of July and

august. Other crops like red gram, chilli, green gram etc. and also we observed that crop diversification through vegetables. Fodder (APBN-1) cultivation with supplemental irrigation with drips and also azolla rings in some areas observed. The community farmers of Nandyala Gudem village shifted their paddy cultivation to mulberry by giving irrigation through drip system. And also one chawki center was present for rearing the sericulture worms, KVK office with CHC was located to hire the farm implements to NICRA village farmers, one mineral water plant, resources like azolla rings, vermi compost units, and farm implements were present.

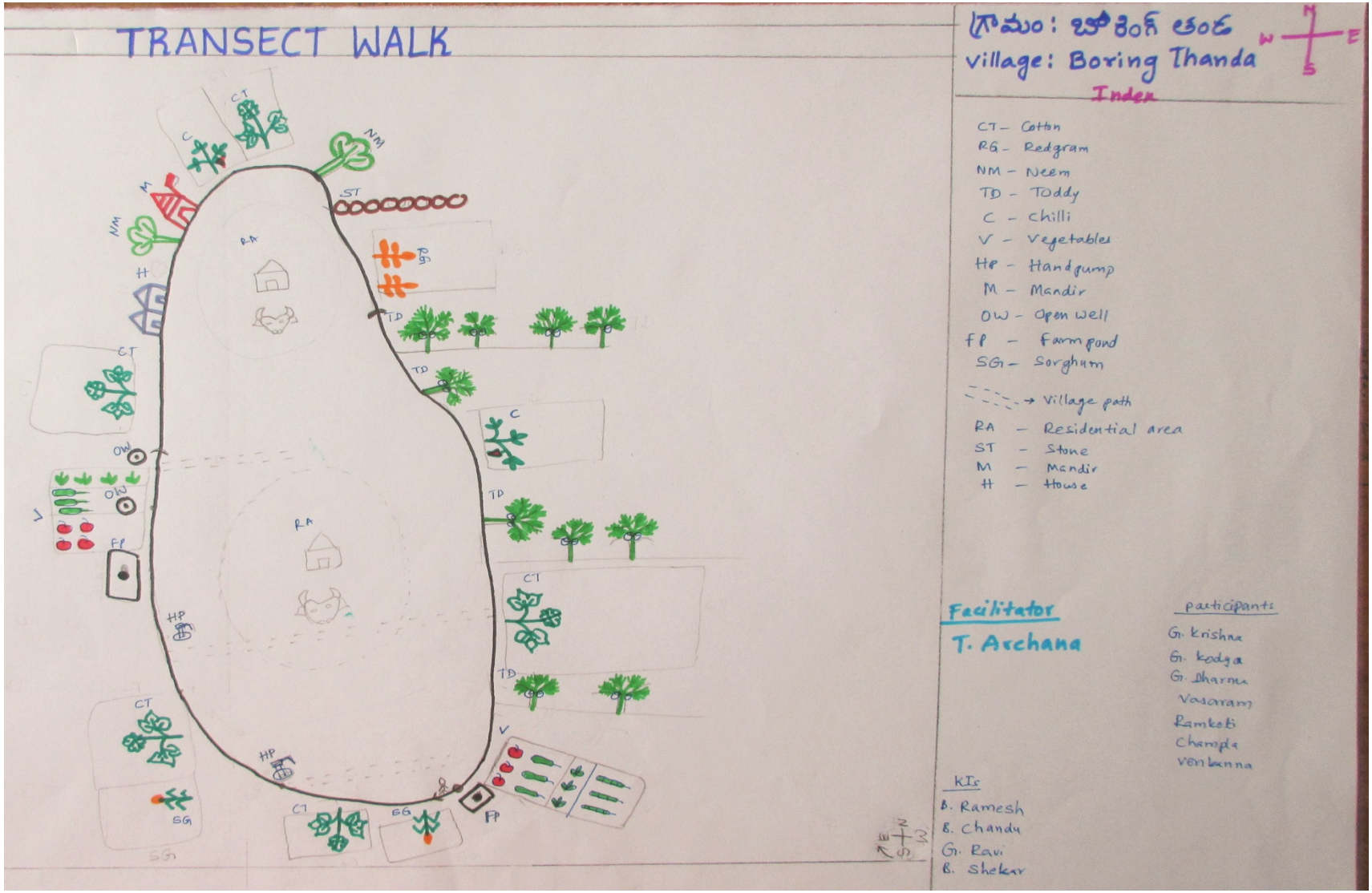


Fig.4.32. An illustration of a transect walk of Boring Thanda village of Nalgonda district

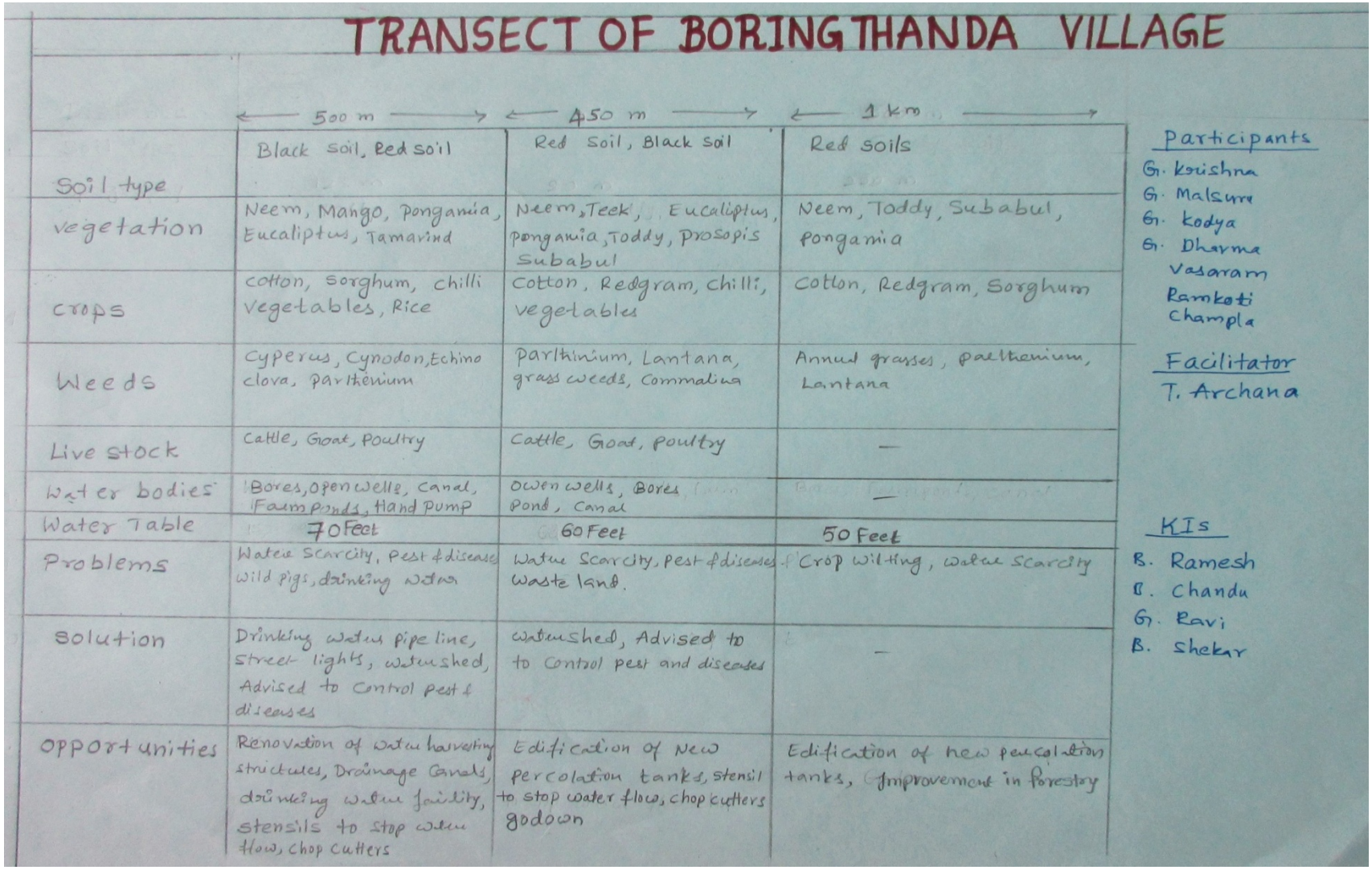


Fig.4.33. An illustration of a general transect of Boring Thanda village of Nalgonda district

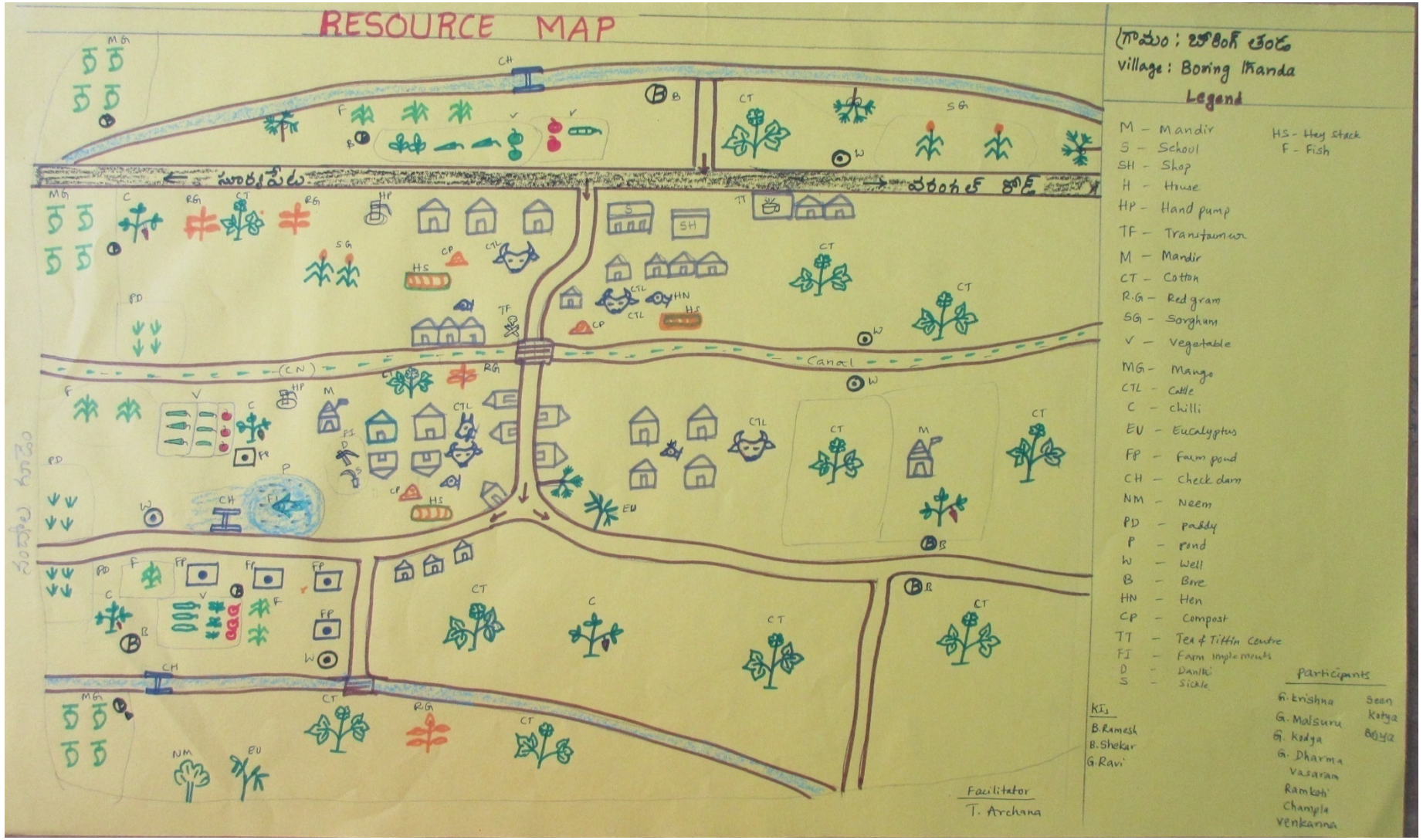


Fig.4.34. An illustration of a resource map of Boring Thanda village of Nalgonda district

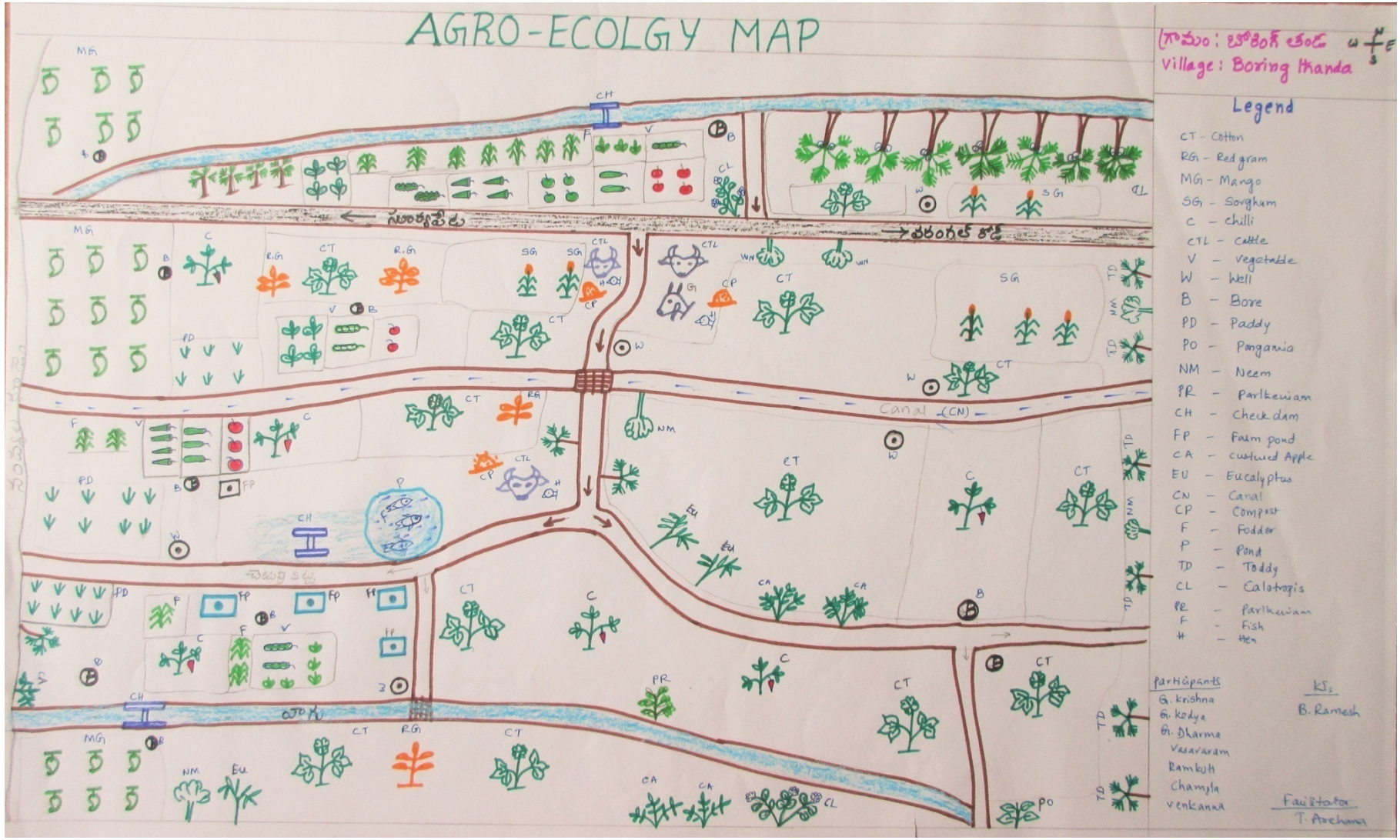


Fig.4.35. An illustration of a agro-ecology map of Boring Thanda village of Nalgonda district

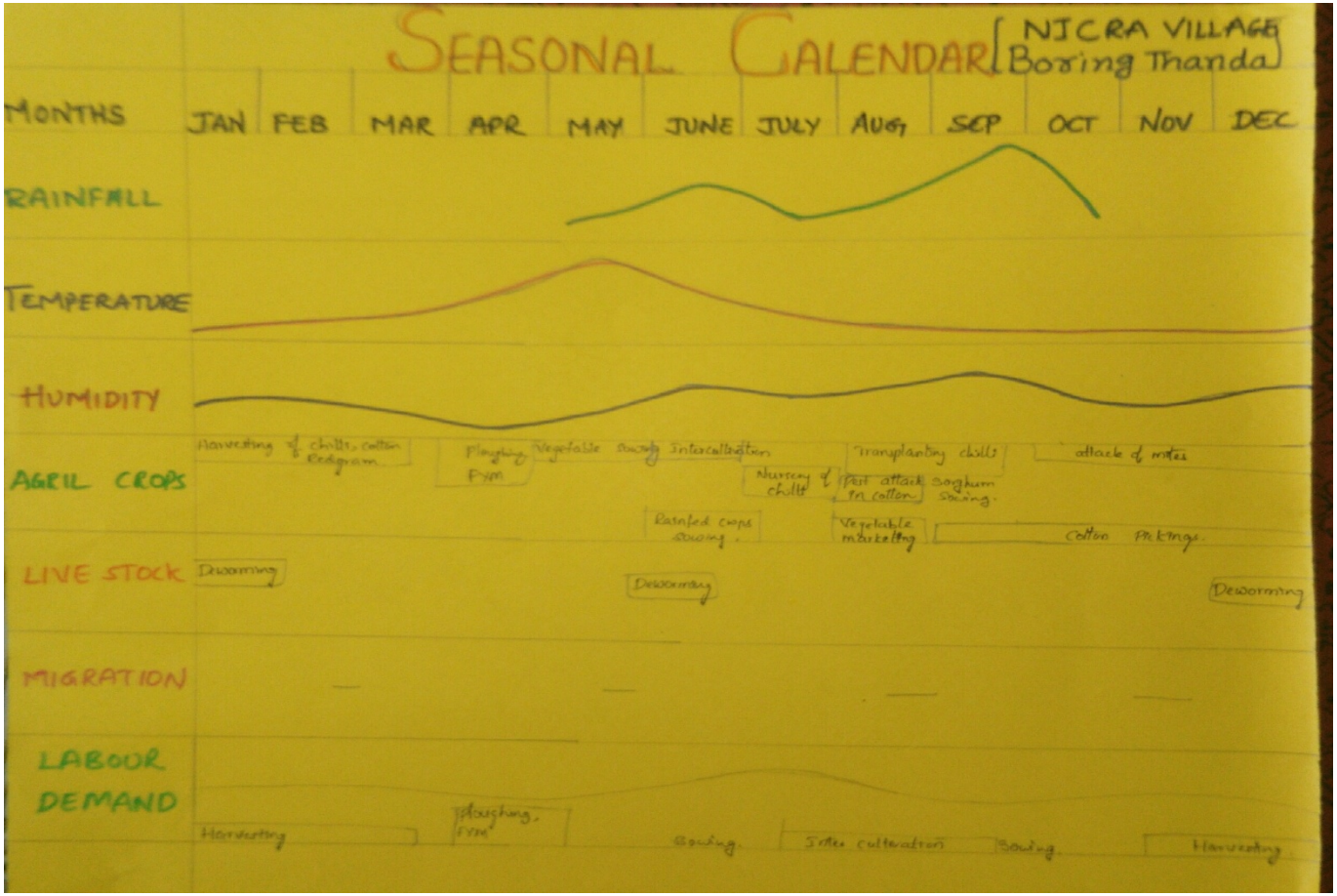


Fig.4.36. An illustration of a seasonal calendar of Boring Thanda village of Nalgonda district

4.2.5 The analyzed results of various PRA techniques done in Nainavari Palii non NICRA village in Ananthapur district of Andhra Pradesh state

4.2.5.1 Village transect

Key Informants: G. Adhi Narayana, M. Sri Ramulu, B. Prsad and G. Mallikarjuna

The transect walk was carried out from south to east towards the north to west direction of Nainavaripalii village along with the above mentioned key informants covering an area of around 6 km during transect each person of the group identified resource and allied problems. While carrying out the transect walk at most care was taken in noting down the land marks of the various natural, social and the other resources present in the area together with the boundary points. The transect walk map and transect axis were drawn by the farmers is given in Fig.4.37.

Initiation of transect was from the south to east marked by bus stop. This village is endorsed with resources like panchayat office, water tank, houses dairy units, agricultural fields, plantations, contour cultivation, contour trenches, temple, percolation tank were also present in the area. This village is bordered by Salkam Cheruvu village in the east, hills in the west, Anandaravu Peta village in the north and Bandarla Palli in south. The village had been divided into three zones for the purpose of general transect. Each transect covered an area of 3 km the soils were mixed with both red and black in three different transects.

In terms of vegetation, the number of trees found was more in the third transect. The number of trees found in the first transect was less. The crops were more in second one, but it was less in firs zone. Livestock was found in first transect. Bore wells, water tank, percolation tank were present in the first zone. Bore wells, check dam, canals, contour trenches and HLC canal, were present in second zone. Water table level was found to be 400 feet in all three transect.

In Nainavari palli village, we observed the same. Red soil was pre-dominant in upland area whereas black soil was predominant in low land area due to alluvial material near the water reservoir.

The major crops grown here are ground nut, red gram, other crops like horse gram, korra, green gram, sorghum as dual purpose. Other crops include vegetables such as tomato, cucumber and ridge gourds, and some leafy vegetables. Orchards like sweet oranges and sapota. Among tress, we could observe neem, eucalyptus, pongamia etc.

The problems were different in different transects. While Water scarcity in summer, labour and drainage canal were the problems, in first transect. Water scarcity, no renovation and repairing of check dam, pest and diseases and labour were the

important problems in second transect. Dried up pond wasan important problems in last transect.

Improving the soil moisture conservation measure, labour banks, construction of roads in village had good opportunity in first transect. There was scope for improvement in agro forestry, excavation of farm pond and renovation of contour trenches in second zone. Integrated pest management can be practiced to stop the attack of the pests in all zones.

4.2.5.2 Resource map

Key Informants: G. Adhi Narayana, M. Sri Ramulu, B. Prsad and G. Mallikarjuna

No of Participants – 30

Resource map is a tool that helps us to learn about the community resource base in villager's perspective. This indicates both natural and man-made resources needed for development in agriculture and allied sectors. The map was drawn by the farmers is given in Fig.4.37.

Major crop was ground nut. Other crops like red gram, green gram, horse gram, and sorghum. Sweet oranges and sapota, watermelon and pomegranate orchards were present. Vegetable like tomato, brinjal, cucurbits were present. Teak, eucalyptus, pongamia, prosopis and neem trees are present along roads and canals. Prosopis trees are the major source of firewood to the villagers. Farmers were keeping stone checks around fields where the slope is occurred to control the runoff and to maintain soil moisture. Animals, farm implements, transport, water sources, irrigation, drinking water availability, one water tank, transformers, temple etc., in the area were represented in this map. Bore wells, canal from the hill side area, percolation tanks available all through ads to the irrigation source of the village. Panchayat office and bus stop were present at entry point of the village. The village has a little area under contour cultivation on hills and contour trenches on around 4 hills. In the residential area livestock like cattle, goats, poultry were the important resources available with the farmers supplying compost pit, hay Stack, milk, meat, eggs, biomanure from the cowshed used as a fertilizer etc. The village also has important resources like gas connections, telephone connections (50% farmers), cell phone connections, electric supply, cable connection and TV sets. KVK was supplying seed varieties of major crops. However for most crop inputs like fertilizers, pesticides/ fungicides, high quality seeds etc. the farmers are dependent on external sources like shops in Ananthapur town.

4.2.5.3 Agro ecology map

Key Informants: G. Adhi Narayana, M. Sri Ramulu, B. Prsad and G. Mallikarjuna

No of Participants – 30

Agro ecological map (Fig.4.37) of the village Nainavari palli was drawn by farmers to identify the various agro ecological zones present in the village. The farmers (KI's) were encouraged to draw the agro ecological map themselves marking the important landmarks. Special emphasis was given to mark the various topographical areas, cropping pattern and crops, soil types, water bodies, water sources and irrigation system, livestock, trees and other aspects related to agro ecology.

Major crop was ground nut and some parts with ground nut + red gram under rainfed and other crops were dual purpose sorghum, black gram, green gram, horse gram, korra. Isolated areas in this zone were under and sweet oranges, sapota, pomegranate and watermelon orchards. Apart from this the farmers were growing vegetables like tomato, brinjal, ladies finger for self consumption, in this area. Trees like teak, neem, prosopis and eucalyptus were present continuously on sides of canal and roads. The residential area of the village mainly consists of houses but all of the livestock i.e. cattle, poultry, goats were also present in this area. Upland area had red soils with shallow depth and low water holding capacity, saline soils were the major soil constraints. Low land area had black soils with soil cracking problem due to low and erratic rain fall, uneven distribution of rain fall, delayed monsoon and early cessation of monsoon. The major source of water in the village for cultivation and household use was the bore wells. In this village water harvesting measures like percolation tanks were excavated, contour cultivation also taken place on hills, contour trenches were dug out on four hills to stop the run off and soil erosion of canal from hill side one check dam was constructed, stone bunds also used around the crops where the soil was having slope to control the soil erosion and to store the soil moisture.

4.5.5.4 Seasonal calendar

Key Informants: G. Adhi Narayana, M. Sri Ramulu, B. Prsad and G. Mallikarjuna

No of Participants – 20

The map was drawn by the farmers is given in Fig.4.37. The month wise analysis as reported by the key informants was as follows.

January: the temperature was reported to be very low and in case of humidity, it was high.

February, March and April: According to the key informants, temperature was increasing gradually during these three months. In the case of humidity used to go down during these three months.

May: The temperature was reported to be very high in this month, it would be 52oC, had dry season. This was the high temperature period. In the case of humidity, it was very low compared to other months.

June: It was the beginning of rain.

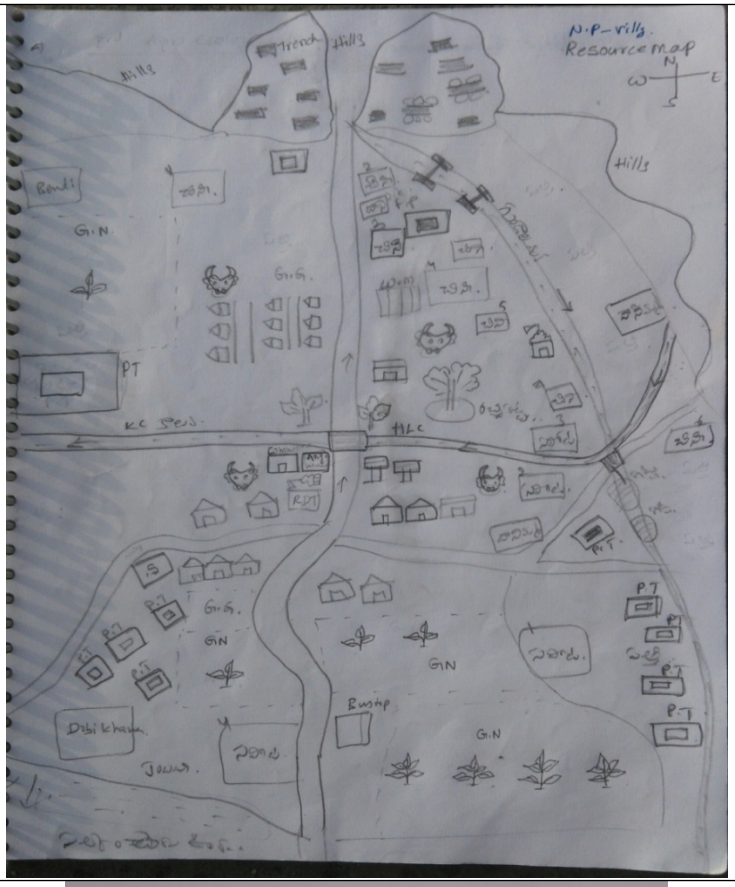
June, July, August, September and October: The rain fall was started in the month of June than go down in July and again in month of august it was increased gradually up to September than used to go down completely in the month of October. In the month of September the highest rainfall was observed by the farmers. The humidity was gradually increasing from June to October. In case of temperature it was used to go down during these months. These months had rainy season (moisture excess), this was the crop rowing period.

November, December and January: The temperature was used to go down. The relative humidity was in increasing trend during these months. These months had winter with mist with less temperature.

In the month January to march farmers did activities like harvesting their crops, only few farmers de-warming their animals, labour demand was less during these days. In the months of May to June they did land preparation and FYM organic manure application. During April and May months they did sheep penning activity to improve the soil fertility. In the months of June to July they had sown rainfed crops ground nut, only few farmers had sown ground nut and red gram as intercrop and also did de-warming their sheeps. From July to September they did intercultivation in crops. In the month of September they had sown sorghum, green gram, cluster bean etc. The pest attack was more during October to December and in the month of December few farmers did de-warming their animals and labour demand was more for doing these activities.



Fig.4.37. Group of farmers participated in PRA techniques in Non NICRA village Nainavari Palli of Anantapur district



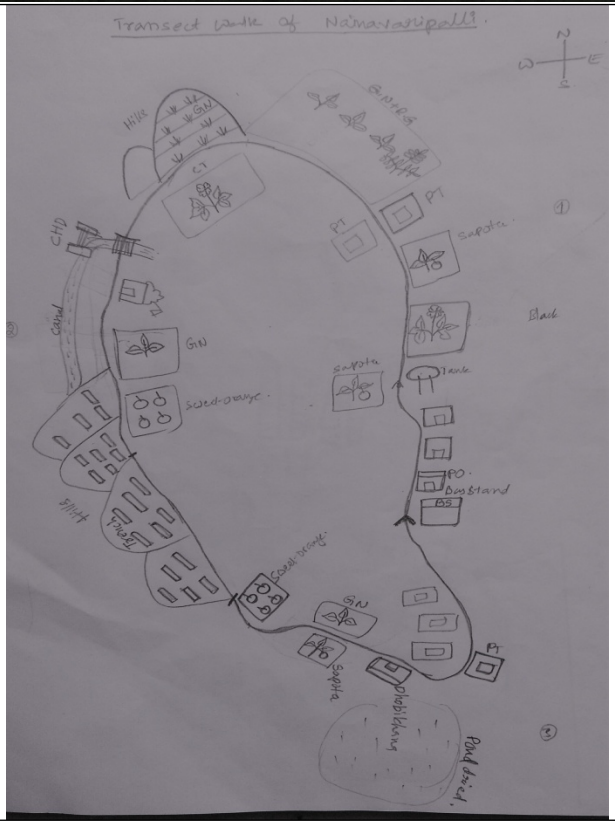


Fig.4.38. PRA maps were drawn by farmers in Non NICRA village Nainavari Palli of Anantapur district

4.2.6 The analyzed results of various PRA techniques done in Salkam Cheruvu on NICRA village in Ananthapur districts of Andhra Pradesh state

4.2.6.1 Village transect

Key Informants: M. Raghava Reddy, E. Srinivasulu, M. Nagendra and M. Adhi Narayana

The transect walk was carried out from north to west towards the south to east direction of Salkam Cheruvu village along with the above mentioned key informants covering an area of around 12 km during transect each person of the group identified resource and allied problems. While carrying out the transect walk at most care was taken in noting down the land marks of the various natural, social and the other resources present in the area together with the boundary points. The transect walk map was drawn by the farmers is given in Fig.4.39.

Initiation of transect was from the north to west marked by gram panchayat office of Sarkam Cheruvu village. This village is endorsed with resources like veterinary dispensary, SBI, rachha katta, temples, BC, SC colonies, School, water tank, transformers, agricultural fields, orchards, contour trenches and percolation tanks etc., were present in the area. This village is bordered by Korivi Palli village in the east, Chinamatla Gondi in the west, Nainavari palli village in the north and Narsapuram in south. The village had been divided into three zones for the purpose of general transect. The first transect covered an area of 5 km, the second one 2 km and the third one 5 km. the soils were mostly (95%) red soils in three different transects.

In terms of vegetation, the number of trees found was more in the second transect. The number of trees found in the first transect was less. The crops were more in first one, but it was less in last zone. Livestock was found in first transect. Bore wells, contour trenches were present in first zone. Pond, Bore wells, percolation tanks and Kuthaleru River was passed around the boarder of village in second zones. Water tank, bore wells, contour trenches were present in the last zone. Water table was found to be 300-400 feet in all three transects. In Sarkam Cheruvu village, we observed the same that red soil was pre-dominant in upland area whereas black soil was predominant in low land area due to alluvial material near the water reservoir.

The major crops grown here are ground nut, other crops like red gram than horse gram, korra, green gram, sorghum as dual purpose. Other crops include vegetables such as tomato, cucumber and ridge gourds and some leafy vegetables. Orchards like sweet oranges and watermelon etc. Among trees, we could observe neem, eucalyptus, Pongamia etc.

The problems were different in different transects. While Water scarcity in summer, pest and diseases, labour and drainage canal were the problems, in first transect. Water scarcity, pest and diseases were the important problems in second and last transect. Renovation of contour trenches, excavation of farm ponds, labour banks, construction of roads, godowns had good opportunity in first transect. Scope for improvement in agro forestry, renovation of percolation tanks were the opportunities in second transect. Labour bank and integrated pest management can be practiced to stop the attack of the pests in all zones.

4.2.6.2 Resource map

Key Informants: M. Raghava Reddy, E. Srinivasulu, M. Nagendra and M. Adhi Narayana.

No of Participants – 35

The map was drawn by the farmers is given in Fig.4.39. Major crop was ground nut. Other crops like red gram, green gram, horse gram, and sorghum. Other than this cotton crop was also cultivated where black soils were present. Sweet oranges and watermelon orchards were present. Vegetable like tomato, brinjal and cucurbits were present. Eucalyptus, pongamia, prosopis and neem trees were present along roads and canals. Farmers were keeping stone checks around fields near hill side area where the slope was occurred. Animals, farm implements and transport, water sources, irrigation, drinking water availability, transformers, water tanks, school, panchayat office, rachha katta, veterinary dispensary, BC, SC colony etc., in the area were represented in this map. The main source of irrigation for the farmers was the Kuthaleru River and one pond but both were dried up due to low rain fall. Apart from this bore wells, percolation tanks available all through ads to the irrigation source of the village. In the residential area livestock like cattle, goats, poultry were the important resources available.

4.2.6.3 Agro ecology map

Key Informants: M. Raghava Reddy, E. Srinivasulu and M. Nagendra

No of Participants – 35

Agro ecological map (Fig.4.39) of the village Salkam Cheruvu was drawn by farmers to identify the various agro ecological zones present in the village. The farmers (KI's) were encouraged to draw the agro ecological map themselves marking the important landmarks. Special emphasis was given to mark the various topographical areas, cropping pattern and crops, soil types, water bodies, weeds, water sources and irrigation system, livestock, trees and other aspects related to agro ecology.

Major crop were ground nut under rainfed and other crops were dual purpose sorghum, black gram, green gram, horse gram, korra. Orchards like sweet oranges, watermelon. Apart from this the farmers were growing vegetables like tomato, brinjal, ladies finger for self consumption, in this area. Trees like neem, prosopis and eucalyptus were present continuously on sides of canal and roads. The residential area of the village mainly consists of houses but all of the livestock i.e. cattle, poultry, goats were also present in this area. The major source of water in the village for cultivation and household use was the bore wells. Kuthaleru River and pond both were dried up. In this village water harvesting measures like percolation tanks were excavated, cultivation of ground nut under rainfed across the slope using with stone check, contour trenches to stop the run off.

4.2.6.4 Seasonal calendar

Key Informants: M. Raghava Reddy, E. Srinivasulu and M. Nagendra

No of Participants – 10

The seasonal calendar was same as like the Nainavari palli village because both were neighboring villages. The map was drawn by the farmers is given in Fig.4.38.The month wise analysis as reported by the key informants were as follows.

January: The temperature was reported to be very low and in case of humidity, it was high.

February, March and April: According to the key informants, temperature was increasing gradually during these three months. In the case of humidity used to go down during these three months.

May: The temperature was reported to be very high in this month, it would be 52oC, had dry season. This was the high temperature period. In the case of humidity, it was very low compared to other months.

June: It was the beginning of rain.

June, July, August, September and October: The rain fall was started in the month of June than it was used to go down in July and again in month of august it was increased gradually up to September than used to go down completely in the month of October. In the month of September the highest rainfall was observed by the farmers. The humidity was gradually increasing from June to October. In case of temperature it was used to go down during these months. These months had rainy season (moisture excess), this was the crop rowing period.

November, December and January: The temperature was used to go down. The relative humidity was in increasing trend during these months. These months had winter with mist with less temperature.

The seasonal analysis results were almost same like Nainavari palli village as these two were neighbouring villages. In the month January to march farmers did activities like harvesting their crops, only few farmers de-warming their animals, labour demand was less during these days. In the months of May to June they did land preparation and FYM organic manure application. During April and May months they did sheep penning activity to improve the soil fertility. In the months of June to July they had sown rainfed crops ground nut, only few farmers had sown ground nut and red gram as intercrop and also did de-warming their sheeps. From July to September they did intercultivation in crops. In the month of September they had sown sorghum, green gram, cluster bean etc. The pest attack was more during October to December and in the month of December few farmers did de-warming their animals and labour demand was more for doing these activities.

4.2.6.5 Gathered information from triangulation of PRA techniques conducted in two non NICRA villages (Nainavari Palii and Salkam Cheruvu) in Anantapur district

The gathered information from triangulation of PRA techniques which have conducted in two non NICRA villages (Nainavari Palii and Salkam Cheruvu) in Anantapur, these farmers were excavated percolation tanks, check dams, contour trenches with the help of watershed and MGNAREGA but the renovations and repairing for these had not properly done by the farmers because the farmers were not showing interest toward this due to low rain fall and poor socio economic status. In these areas ground nut was the predominant crop and predominant soil was red soils with soil salinity. In these villages rainfed crop failure was the common phenomenon due to occurrence of dry spell. In the month of September some farmers had sown sorghum as contingency crop for grain and fodder purpose. In these villages sweet orange, sapota, watermelon and vegetables were grown by giving supplemental irrigation.

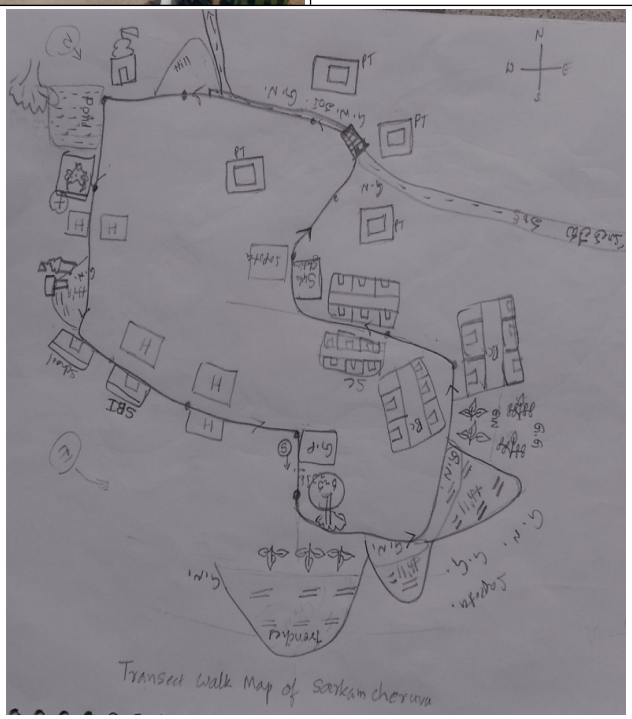












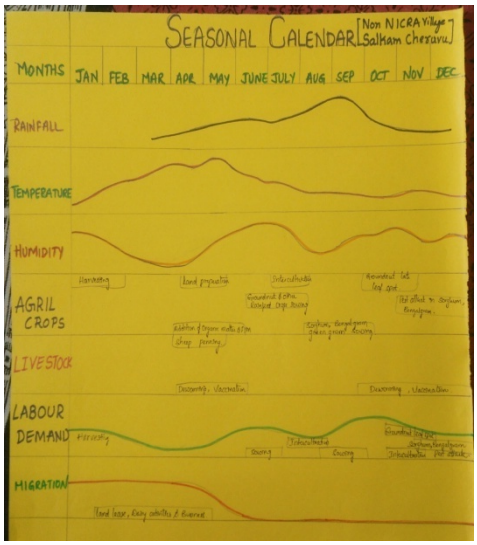


Fig.4.39. Group of farmers participated in PRA techniques in Non NICRA village Salkam Cheruvu of Anantapur district

4.2.7 The analyzed results of various PRA techniques done in Bapuji Thanda village in Nalgonda district of Telangana state

4.2.7.1 Village transect

Key Informants: B. Shankar, B. Jagan, B. Venkanna, B. Panthulu and B.Chandra Shekar

The transect walk was carried out from east north towards the west south direction of Bapuji Thanda along with the above mentioned key informants covering an area of around 4 km during transect each person of the group identified the resources of the village. While carrying out the transect walk at most care was taken in noting down the land marks of the various natural, social and the other resources present in the area together with the boundary points. The transect walk and transect axis maps were drawn by the farmers is given in Fig.4.41.

Initiation of transect was from the east north marked by small bridge with canal of Boring Thanda. This village is endorsed with resources like Sarva Shiksha Abhiyan school, water tank, 2 hand pumps, agricultural fields, etc. this village is bordered by Suryapeta main road in the east, Gattikal in the west, Kothha Thanda village in the north and Nimmikal village in south. The village had been divided into three zones for the purpose of general transect. The first transect covered an area of 1 km, the second one 2 km and the third one 1 km. the soils were mixed both red chalka soils (75%) and black (25%) in three different transects.

In terms of vegetation, the number of trees found was more in the second transect. The number of trees found in the first transect was less. The crops were more in second one, but it was less in first one. Livestock was found in first transect. One canal from the pond was passed in second zone. Bores, 2 hand pumps were found in first zone. Open wells, bore wells, pond and 2 canals were found in second zone. Open wells, bore wells were found in last zone. Water table was found to be deep in first and third zone (up to 120 feet) but, it was near in the second transect (up to 90 feet).

In this village, we observed the same that red soil was pre-dominant in upland area whereas black soil was predominant in low land area due to alluvial material near the water reservoir.

The major crops grown here are cotton and chilli. The peculiar thing was growing cotton in both soils red as well as black. Sorghum as dual purpose and some parts cultivated with cotton+ red gram as intercrop. Other crops include vegetables such as cucumber and ridge gourds. Among tress, we could observe neem, gulmohar, pongamia, palms, toddy etc.

Water scarcity in summer, drinking water, pest and disease problems were the problems in three transects. Improving the soil moisture conservation measure, construction of roads, mineral water plant and integrated pest management can be practiced to stop the attack of the pests had good opportunities in all transects in three zones.

4.2.7.2 Resource map

Key Informants: B. Shankar, B. Jagan, B. Venkanna, B. Panthulu and B. Chandra Shekar

No of Participants – 20

Resource map is a tool that helps us to learn about the community resource base in villager's perspective. This indicates both natural and man-made resources needed for development in agriculture and allied sectors.The map was drawn by the farmers is given in Fig.4.40.

Major crop was cotton. Other crops like red gram, chilli, and sorghum were cultivated. Vegetables like tomato, brinjal and leafy vegetables. Open wells, bore wells, pond, canals, drinking water availability, two hand pumps animals, farm implements, one Sarva Shiksha Abhiyan school and transport in the area are represented in this map. The cropped and village residential areas have predominantly light chalka red soil while near the water reservoir black soil occurs. In the residential area livestock like cattle, goats, poultry were the important resources available with the farmers supplying compost pit, hay Stack, milk, meat, eggs, biomanure from the cowshed used as a fertilizer etc. Gas connections, telephone connections (50% farmers), cell phone connections, electric supply, cable connection and TV sets were present. Toddy, eucalyptus, pongamia, prosopis, neem trees and calotropis were present along the pond bank, along roads and canals. Prosopis trees are the major source of firewood to the villagers. However for most crop inputs like fertilizers, pesticides/ fungicides, high quality seeds etc. the farmers are dependent on external sources like shops in Suryapeta town.

4.2.7.3 Agro ecology map

Key Informants: B. Shankar, B. Jagan, B. Venkanna, B. Panthulu and B.Chandra Shekar

No of Participants – 10

The map was drawn by the farmers is given in Fig.4.39.The Bapuji Thanda was dominated by red soil followed by black sandy loam soil. The main crop grown in this

village was cotton. Other crops were red gram intercultivation with cotton, dual purpose sorghum as contingency measure, chilli. There was also the vegetable growing tract in the village. The vegetation was toddy, eucalyptus, neem, calotropis, and prosopis. As far as dairy sector of the village was concerned, majority of the farmers were maintaining cattle and goats mainly on a subsistence basis supplementing the main revenue from crops. Village had a pond which was highly silted and dried. The central area of the pond has calcareous soil. The outer boundary of the pond has clay loam soil. Prosopis occupy most of this area. The major source of water in the village for cultivation and household use is the bore wells.

4.2.7.4 Seasonal calendar

Key Informants: B. Shankar, B. Jagan, B. Venkanna, B. Panthulu and B. Chandra Shekar

No of Participants – 10

The seasonal analysis of Bapuji Thanda was done to find out the abnormalities in climate that were found to exist with regard to agriculture so that they could be taken care of during the preparation of action plan for the village. The map was drawn by the farmers is given in Fig.4.40.

The month wise analysis as reported by the key informants were as follows

January: the temperature was reported to be very low and in case of humidity, it was high.

February, March and April: According to the key informants, temperature was increasing gradually during these three months. In the case of humidity used to go down during these three months.

May: The temperature was reported to be very high in this month, it would be 48oC, had dry season. This was the high temperature period. In the case of humidity, it was very low compared to other months.

June: It was the beginning of rain.

June, July, August, September and October: The rainfall was high in September month. The rain fall was same in June and August, low rain fall was observed in July and rainfall was used to go down completely in October. Erratic distribution of rainfall was occurred during these months. In case of temperature it was used to go down during these months. Humidity was gradually increasing and fluctuating during these months due to erratic rainfall and low temperatures. High humidity was occurred in September

compared to other months. These months had rainy season (moisture excess), this was the crop rowing period.

November, December, January: the temperature was used to go down. The relative humidity was in increasing trend during these months. These months had winter with mist with less temperature.

From January to March these farmers harvested chilli, cotton and sorghum crops etc, in January only few farmers did de warming activities for sheeps and labour demand was very less for doing these activities. In the month of April only few farmers did operations like FYM application and land preparations for vegetable cultivation for domestic consumption. In the month of May few farmers had sown vegetable. Form June to August they did interctivation operations for vegetables, had sown cotton, nursery preparation for chilli, from August to October pest attack was more in cotton, some farmers had sown sorghum and rabi crops, transplanted chilli etc., from October to December they did activities like cotton pickings, de-warming of sheeps and mites attack was more in these months. For doing these activities labour demand was less because farmers themselves did farm operation for their crops.

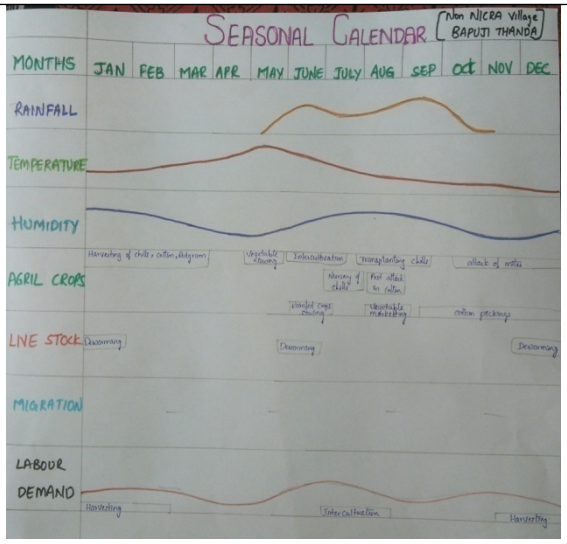


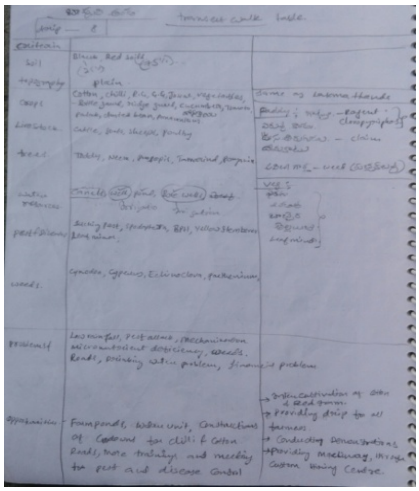


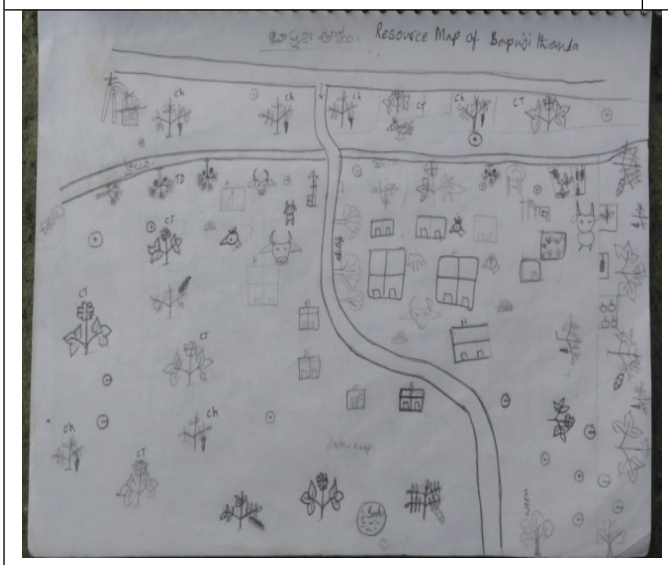




Fig.4.40. Group of farmers participated in PRA techniques in Non NICRA village Bapuji Thanda of Nalgonda district







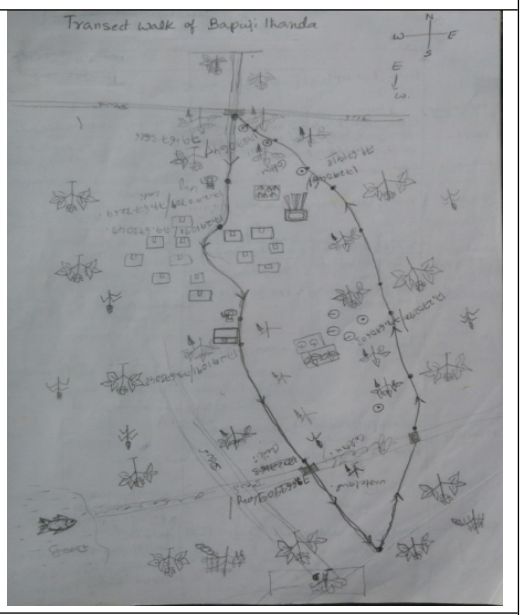


Fig.4.41. PRA maps were drawn by the farmers in non NICRA village Bapuji Thanda of Nalgonda district

4.2.8 The analyzed results of various PRA techniques done in Lakma Thanda village in Nalgonda district of Telangana state

4.2.8.1 Village transect

Key Informants: B. Devula, B. Umla, B. Ravi and B. Somla

The transect walk was carried out from east north towards the west south direction of Lakma Thanda along with the above mentioned key informants covering an area of around 2 km during transect each person of the group identified the resources of the village. While carrying out the transect walk at most care was taken in noting down the land marks of the various natural, social and the other resources present in the area together with the boundary points. The transect walk and transect axis maps were drawn by the farmers is given in Fig.4.43.

Initiation of transect was from the east north marked by chilli crop which was attached to the Bapuji Thanda fields. This village is endorsed with resources water tank, hand pumps, agricultural fields, etc. This village is bordered by Kotha Thanda in the east, Singarm village in the west, Patharla Pahad village in the north and Bapuji Thanda in south. The village had been divided into three zones for the purpose of general transect. The first transect covered an area of 300 m, the second one 700 m and the third one 1 km. the soils were mixed both red chalka soils (75%) and black (25%) in three different transects. In terms of vegetation, the number of trees found was more in the third transect. The number of trees found in the first transect was less. The crops were more in third one, but it was less in first one. Livestock was found in first transect. One canal from the pond was passed in third zone. Bores, hand pump were found in first zone. Open wells, bore wells, canal were found in third zone. Open wells, bore wells were found in second zone. Water table was found to be deep in first and third zone (up to 120 feet) but, it was near in the second transect (up to 90 feet).

The major crops grown here are cotton and chilli. Sorghum as dual purpose and some parts cultivated with cotton+ red gram as intercrop. Other crops include vegetables such as tomato, brinjal and some leafy vegetables. One mango orchard was found near the pond. Among trees, we could observe toddy, neem, gulmohar, pongamia, palms etc.

Water scarcity in summer, drinking water, pest and disease problems were the problems in three transects. Improving the soil moisture conservation measure, construction of roads, mineral water plant and integrated pest management can be practiced to stop the attack of the pests had good opportunities in all transects in three zones.

4.2.8.2 Resource map

Key Informants: B. Devula, B. Umla, B. Ravi and B. Somla

No of Participants – 15

The map was drawn by the farmers is given in Fig.4.42. Major crop was cotton. Other crops like red gram, chilli, and sorghum were cultivated. Vegetables like tomato, brinjal and leafy vegetables. One mango orchard was found near pond. Open wells, bore wells, pond, canals, water tank, hand pump animals, farm implements, and transport in the area are represented in this map. In the residential area livestock like cattle, goats, poultry were the important resources available. Toddy, eucalyptus, pongamia, prosopis, neem trees and calotropis were present along the pond bank, along roads and canals.

4.2.8.3 Agro ecology map

Key Informants: B. Devula, B. Umla, B. Ravi and B. Somla

No of Participants – 15

The map was drawn by the farmers is given in Fig.4.42. The Lakma Thanda was dominated by red soil followed by black sandy loam soil. The main crop grown in this village was cotton. Other crops were red gram intercultivation with cotton, dual purpose sorghum as contingency measure, chilli. There was also the vegetable growing tract in the village. The vegetation was toddy, eucalyptus, neem, calotropis, and prosopis. As far as dairy sector of the village was concerned, majority of the farmers were maintaining cattle and goats mainly on a subsistence basis supplementing the main revenue from crops. Village had a pond which was highly silted and dried. The central area of the pond has calcareous soil. The outer boundary of the pond has clay loam soil. Prosopis and calotropis occupied most of this area. The major source of water in the village for cultivation and household use is the bore wells.

4.2.8.4 Seasonal calendar

Key Informants: B. Devula, B. Umla, B. Ravi and B. Somla

No of Participants – 25

The month wise analysis as reported (Fig.4.43) by the key informants were as follows.

January: the temperature was reported to be very low and in case of humidity, it was high.

February, March and April: According to the key informants, temperature was increasing gradually during these three months. In the case of humidity used to go down during these three months.

May: The temperature was reported to be very high in this month, it would be 48oC, had dry season. This was the high temperature period. In the case of humidity, it was very low compared to other months.

June: It was the beginning of rain.

June, July, August, September and October: The rainfall was high in September month. The rain fall was same in June and August, low rain fall was observed in July and rainfall was used to go down completely in October. Erratic distribution of rainfall was occurred during these months. In case of temperature it was used to go down during these months. Humidity was gradually increasing and fluctuating during these months due to erratic rainfall and low temperatures. High humidity was occurred in September

compared to other months. These months had rainy season (moisture excess), this was the crop rowing period.

November, December and January: the temperature was used to go down. The relative humidity was in increasing trend during these months. These months had winter with mist with less temperature.

In this Lakma Thanda the seasonal activities were same like Bapuji Thanda as these two were neighbouring Thandas. From January to March these farmers harvested chilli, cotton and sorghum crops etc, in January only few farmers did de warming activities for sheep and labour demand was very less for doing these activities. In the month of April only few farmers did operations like FYM application and land preparations for vegetable cultivation for domestic consumption. In the month of May few farmers had sown vegetable. From June to August they did intercultivation operations for vegetables, had sown cotton, nursery preparation for chilli, from August to October pest attack was more in cotton, some farmers had sown sorghum and rabi crops, transplanted chilli etc., from October to December they did activities like cotton pickings, de-warming of sheep and mites attack was more in these months. For doing these activities labour demand was less because farmers themselves did farm operation for their crops.

4.2.8.5 Gathered information from triangulation of PRA techniques conducted in two non NICRA villages (Lakma Thanda and Bapuji Thanda) in Nalgonda district

The gathered information from triangulation of PRA techniques which have conducted in two non NICRA villages (Lakma Thanda and Bapuji Thanda) in Nalgonda, famers had poor infra structural facilities. Only Water tanks and one Sarva Shiksha Abhiyan school were present in these Thanda areas. They were cultivating cotton and chilli crops under rainfed only, due to low rainfall their bore wells also dried up. Some of farmers of this Thanda area got drips but they did not have the knowledge on using this. In the month of September some farmers had sown sorghum as contingency crop for grain and fodder purpose.



Fig.4.42. Group of farmers participated in PRA techniques in Non NICRA village Lakma Thanda of Nalgonda district

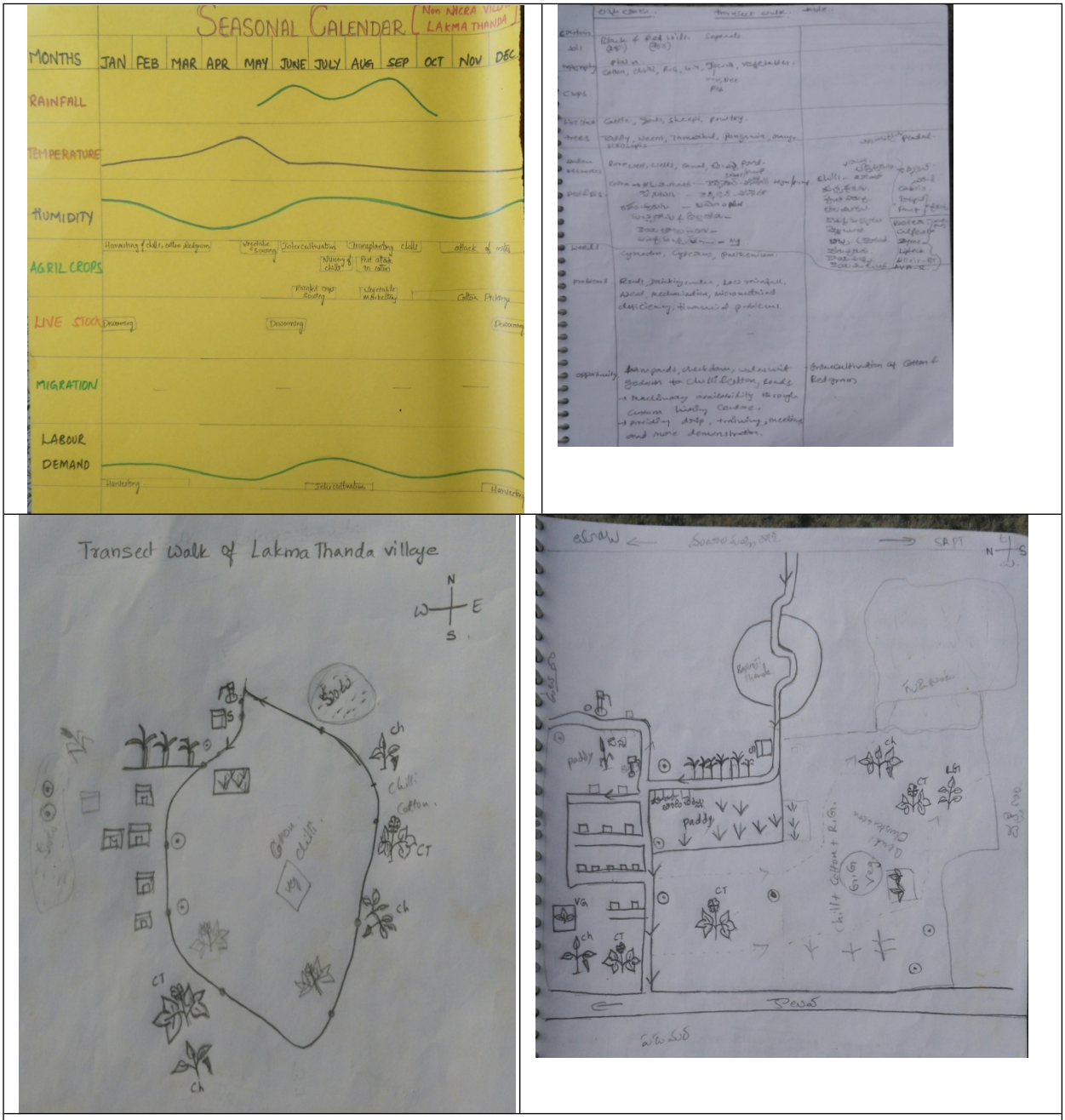


Fig.4.43. PRA maps were drawn by farmers in Non NICRA village Lakma Thanda of Nalgonda district

4.3 Assess the adaptive capacity of farmers in terms of their climate readiness and attitude of respondents towards Climate Resilient Agriculture technologies

Adaptive capacity in the study was assessed through the climate readiness of the farmers and attitude of respondents towards Climate Resilient Agriculture technologies.

4.3.1 Climate readiness

It could be inferred from the Table 4.27 that, majority (70.00%) of the NICRA farmers of Ananthapur district had high followed by medium (20.00%), low (8.33%) and very low (1.67%) climate readiness. While in Ananthapur non NICRA majority

(55.00%) of farmers had medium followed by low (38.34%), similar portion of respondents had high (3.33%) and very low (3.33%) and none of them found to be under very high. In respect to Nalgonda district majority (68.33%) of farmers of NICRA had high followed by medium (13.33%), very high (11.67%), low (6.67%) and none of them found to be under very low. Whereas in Nalgonda majority (70.00%) of the farmers of non NICRA had low followed by very low (16.67%), medium (13.33%) and none of them found to be high and very high.

On the whole the majority (69.17%) of the NICRA farmers had high followed by medium (16.67%), low (7.50%), very high (5.83%) and very low (0.83%) climate readiness, whereas in non NICRA majority (54.17%)of farmers had low followed by medium (34.17%), very low (10.00%) and high (1.67%).

Level of climate readiness of the two groups of farmers was studied based on administration of ten predetermined statements reflecting climate resilience. The analysis has given a clear cut difference between the two groups both NICRA and non NICRA based on their readiness level. The results revealed that majority of NICRA respondents had high climate readiness. The probable reason for this could be NICRA activities by KVK and farmers were ready to follow contingency crop planning, rain water harvesting structures on their field, soil moisture conservation practices, farming systems and engage in non-farm activities. Whereas in non NICRA the majority of the farmers had low climate readiness followed by medium. This might be due to medium climate readiness of Ananthapur non NICRA and low climate readiness of Nalgonda non NICRA lead them to fall under the category of low followed by medium. The probable reason for this might be in Ananthapur non NICRA farmers were ready to follow the NRM technologies, the government was digging out the 100 farm ponds for each village under MGNREGS and providing 100 days wage employment to them in lean period, check dam construction and excavating trenches on hill side areas. In Nalgonda non NICRA farmers were not ready to fallow the climate resilient technologies. Hence, the Department of Agriculture may gear up the efforts to pass on, standardised, valid and reliable technical information to the farmers through training programmes, group discussions, field visits etc., a kind of team spirit also inculcated among the farmers to accrue the benefits of collective decision making and to follow group action to practice the climate resilient agriculture techniques for effective climate readiness.

Table 4.27. Distribution of respondents according to their Climate readiness

S. No	NRM	Climate Readiness											
		Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	F	%
1	Very Low (5-11)	1	1.67	2	3.33	0	0.00	10	16.67	1	0.83	12	10.00
2	Low (12-18)	5	8.33	23	38.34	4	6.67	42	70.00	9	7.50	65	54.16
3	Medium (19-25)	12	20.00	33	55.00	8	13.33	8	13.33	20	16.67	41	34.17
4	High (26-32)	42	70.00	2	3.33	41	68.33	0	0.00	83	69.17	2	1.67
5	Very High (33-39)	0	0.00	0	0.00	7	11.67	0	0.00	7	5.83	0	0.00
	Total	60	100	60	100	60	100	60	100	120	100	120	100

4.3.2 Attitude of respondents towards Climate Resilient Agriculture technologies

4.3.2.1 Attitude towards general concept of Climate Resilient Agriculture technologies

It could be inferred from the Table 4.28 that, majority (66.67%) of the NICRA farmers of Ananthapur district had favorable and rest with the moderately favourable attitude (33.33 %). While in Ananthapur non NICRA majority (66.66%) of farmers had un favourable attitude followed by moderately favourable attitude (31.67%) and favorable (1.67%). In respect to Nalgonda district majority (76.67%) of farmers of NICRA had favorable followed by moderately favourable (21.66%) and un favourable attitude(1.67%). Whereas in Nalgonda majority (78.33%) of the farmers of non NICRA had un favourable and rest with the moderately favourable attitude (21.67%).

On the whole the majority (71.67%) of the NICRA farmers had favorable followed by moderately favourable (27.50%) and un favourable attitude (0.83%). Whereas in non NICRA majority (72.50%) of farmers had un favourable attitude followed by moderately favourable attitude (26.67%) and favorable (0.83%).

Results revealed that maximum number of the NICRA farmers had favourable attitude towards CRA technologies might be due to the benefits of CRA technologies, they got medium food security, medium socio economic status, they were cultivating more than one crop to get the income from the other enterprises in drought conditions due to this their annual income levels has increased, even though the occurrence of drought was once in three years, majority of the farmers fell under the illiterate followed by high school education, semi medium farmers were having medium source

of information utilization, high risk taking ability might have lead them to the favorable attitude.

Higher number of respondents in non NICRA were having un favourable attitude towards the CRA technologies might be due to majority of them had low climate readiness, illiterate, low socio economic state, low source of information utilization, medium risk taking ability, majority of them were not receiving trainings and had medium traditionalism and drought occurred once in two years followed by yearly once. These people were not having the much awareness on benefits of CRA technologies. Most of the farmers had medium farm size and financially weak so they were not able to adopt CRA technologies. Farmers having the fear of crop failure due to low rain fall lead them to fall under un favourable attitude toward CRA.

Table 4.28. Distribution of respondents according to their Attitude towards general concept of Climate Resilient Agriculture

S. No	Attitude	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	F	%
1	Un favorable (11-16)	0	0.00	40	66.66	1	1.67	47	78.33	1	0.83	87	72.50
2	Moderately Favorable (17-22)	20	33.33	19	31.67	13	21.66	13	21.67	33	27.50	32	26.67
3	Favorable (23-31)	40	66.67	1	1.67	46	76.67	0	0.00	86	71.67	1	0.83
	Total	60	100	60	100	60	100	60	100	120	100	120	100

4.3.2.2 Attitude towards specific Climate Resilient Agriculture technologies

It could be inferred from the Table 4.29 that, majority (88.33%) of the NICRA farmers of Ananthapur district had favorable and rest with the moderately favourable attitude (11.67%) towards specific CRA technologies. While in Ananthapur non NICRA majority (76.67%) of farmers had moderately favourable followed by un favourable attitude (23.33%). In respect to Nalgonda district majority (58.33%) of farmers of NICRA had favorable and rest with the moderately favourable attitude (41.67%). Whereas in Nalgonda majority (81.67%) of the farmers of non NICRA had un favourable followed by moderately favourable (18.33%) attitude towards specific CRA technologies.

On the whole the majority (73.33%) of the NICRA farmers had favorable rest with the moderately favourable attitude (26.67%). Whereas in non NICRA majority

(52.50%) of farmers had un favourable attitude followed by moderately favourable attitude (47.50%).

It could be perceived from the results that majority of the NICRA group respondents had favourable attitude towards specific CRA technologies. The probable reason for this might be continuous implementation of NRM activities, it is very easy to perceive the benefits accrued through the NRM activities by way of recharging the ground water, improvement in flora and fauna and the micro climate as a whole. The farmers are slowly realizing the adverse affects due to indiscriminate use of natural resources thereby they felt no one has the right to use natural resources as he/she feels. They also felt to give fresh life to the natural resources by gradual restoration and replenishment in order to minimize the climatic aberration and also to maintain ecological balance. Farmers were practicing contingent crops (sorghum) under delayed monsoon, proper functioning of custom hiring center service, soil moisture conservation methods like dead furrows, cover crops and getting income by practicing crop diversity. With the help of these technologies farmers were getting the income. They had an idea that the resources can be managed effectively through community based organizations. IWMP, DWMA, MGNREGS and KVKs were excavating water harvesting structures and construction of check dams. Through this the NICRA farmers might had favourable attitude towards the CRA technologies.

Whereas in non NICRA group majority of them had un favourable attitude. In respect to Nalgonda non NICRA majority of farmers had un favourable attitude might be due to not getting the benefits of CRA technologies, they were small and marginal farmers, they were getting medium income mostly from the rain fed chilli crop, in this area ground water table was decreased, wells and bore wells dried up, farmers were not giving supplemental irrigation, crop loss due to the drought was common phenomena in this Nalgonda non NICRA village. Some of the farmers were growing contingency crop as multipurpose sorghum, if the moisture availability was there than they get grains from the sorghum, otherwise most of farmers used the sorghum straw to feed their animals.

In Ananthapur non NICRA majority of them had moderate favourable attitude might be due to government programmes (IWMP, DWMA, and MGNREGS)initiated in that villages, they were excavating the water harvesting structure under MGNREGS, constructed check dam under IWMP, utilizing the drip system for horticultural crops, cultivating the drought resistant verities from these the farmers were getting income. The diffusion of CRA technologies from NICRA villages and slowly they were

realising the benefits of these practices due to this they fell under the moderate favourable attitude towards the specific Climate Resilient Agriculture technologies. But still there is a need to come up with strategies for adoption and diffusion of specific CRA technologies in non NICRA villages.

Table 4.29. Distribution of respondents according to their Attitude towards specific Climate Resilient Agriculture technologies

S. No	Attitude	Ananthapur				Nalgonda				(Overall)		(Overall)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=120)		Non NICRA farmers (n=120)	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Un favorable (11-16)	0	0	14	23.33	0	0	49	81.67	0	0	63	52.50
2	Moderately Favorable (17-22)	7	11.67	46	76.67	25	41.67	11	18.33	32	26.67	57	47.50
3	Favorable (23-31)	53	88.33		0.00	35	58.33	0	0.00	88	73.33	0	0.00
	Total	60	100	60	100	60	100	60	100	120	100	120	100

Table 4.30. Distribution of respondents according to their overall Attitude towards Climate Resilient Agriculture technologies

S. No	Over all Attitude	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	F	%
1	Highly Un favorable (27-32)	0	0.00	13	21.70	0	0.00	44	73.30	0	0.00	57	47.50
2	Un favorable (33-38)	1	1.70	41	68.30	1	1.70	15	25.00	2	1.67	56	46.67
3	Moderately Favorable (39-44)	7	11.70	5	8.30	15	25.00	1	1.70	22	18.33	6	5.00
4	Favourable (45-50)	35	58.30	1	1.70	36	60.00	0	0.00	71	59.17	1	0.83
5	Highly favourable (51-56)	17	28.30	0	0.00	8	13.30	0	0.00	25	20.83	0	0.00
	Total	60	100	60	100	60	100	60	100	120	100	120	100

It could be inferred from the Table 4.30 that, majority (58.30%) of the NICRA farmers of Ananthapur district had favourable followed by highly favourable (28.30%), moderately favourable (11.70%) and un favourable (1.70%) attitude towards the CRA technologies. While in Ananthapur non NICRA majority (68.30%) of farmers had un favourable followed by highly un favourable (21.70%), moderately favourable (8.30%) and favourable attitude (1.70%). In respect to Nalgonda district majority (60.00%) of

farmers of NICRA had favourable followed by moderately favourable (25.00%), highly favourable (13.30%) and un favourable (1.70%) attitude, whereas in Nalgonda majority (73.30%) of the farmers of non NICRA had highly un favourable followed by un favourable (25.00%) and moderately favourable (1.70%) attitude towards the CRA technologies.

On the whole the majority (59.17%) of the NICRA farmers had favourable attitude followed by highly favourable (20.83%), moderately favourable (18.33%) and un favourable (1.67%). Whereas in non NICRA 47.50 per cent of farmers had highly un favourable followed by un favourable (46.67%), moderately favourable (5.00%) and favourable attitude (0.83%).

It could be perceived from the results that majority of the NICRA group members had favourable attitude towards the Climate Resilient Agriculture technologies might be due to their favourable attitude towards the general and specific CRA technologies.

While in Ananthapur non NICRA majority of them had highly un favorable followed by un favourable attitude this might be due to the un favourable attitude towards the general Climate Resilient Agriculture technologies and moderately favourable attitude towards the specific Climate Resilient Agriculture technologies.

4.3.3 Adaptive capacity of farmers in terms of their climate readiness and attitude of respondents towards CRA technologies

It could be inferred from the Table 4.31 and Fig.4.37that majority (53.33%) of the NICRA farmers of Ananthapur district had high Adaptive capacity followed by very high (41.67%) and rest with medium (5.00%) adaptive capacity. While in Ananthapur non NICRA majority (55.00%) of farmers had medium adaptive capacity followed by low (35.00%), very low (6.67%) and high (3.33%).

Table 4.31. Distribution of respondents according to their Adaptive capacity in terms of climate readiness and attitude

S. No	Adaptive capacity	Ananthapur				Nalgonda				(Overall)		(Overall)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=120)		Non NICRA farmers (n=120)	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Very Low (32-42)	0	0.00	4	6.67	0	0.00	13	21.67	0	0.00	17	14.17
2	Low (43-53)	0	0.00	21	35.00	1	1.67	40	66.66	2	1.67	61	50.83
3	Medium (54-64)	3	5.00	33	55.00	4	6.67	7	11.67	8	6.66	40	33.33
4	High (65-75)	32	53.33	2	3.33	21	35.00	0	0.00	51	42.50	2	1.67
5	Very High (76-86)	25	41.67	0	0.00	34	56.66	0	0.00	59	49.17	0	0.00
	Total	60	100	60	100	60	100	60	100	120	100	120	100

In respect to Nalgonda district majority (56.67%) of farmers of NICRA had very high Adaptive capacity followed by high (35.00%), medium (6.67%) and low (1.67%), whereas in Nalgonda majority (66.66%) of the farmers of non NICRA had low followed by very low (21.67%) and medium (11.67%) adaptive capacity.

On the whole the nearly half of (49.17%) the NICRA farmers had very high Adaptive capacity followed by high (42.50%), medium (6.66%) and low (1.67%). whereas in non NICRA majority (50.83%) of farmers had low followed by medium (33.33%), very low (14.17%) and high (1.67%).

It could be perceived from the results that majority of the respondents of NICRA had very high adaptive capacity might be due to their high climate readiness, favorable attitude towards CRA technologies, medium adoption CRA technologies and high adoption of coping mechanisms. In respect to non NICRA majority of the farmers had low adaptive capacity might be due to their low climate readiness, highly un favourable attitude towards CRA technologies, low adoption of CRA technologies and low adoption of coping mechanisms. These results were in conformity with findings of Maddison (2006), Joyce *et al.* (2009) and Fakoya *et al.* (2007).

4.3.4 Comparison for Adaptive capacity between NICRA and Non NICRA farmers

Comparison for overall adaptive capacity between respondents of NICRA and Non NICRA using Mann-Whitney U test has shown in Table 4.32 and4.33 The respondents of NICRA and Non NICRA with mean rank 179.34 and 61.66 respectively so here the results were showing the better adaptive capacity by NICRA farmers when

compare to the Non NICRA farmers. Test statistics and its level of significance are represented in Table 4.33 and the results were found to be significant at $p<0.01$ level of significance.

Table 4.32 Overall comparison between Adaptive capacity between NICRA and Non NICRA farmers using Mann-Whitney U test

Ranks				
Group		**N**	**Mean Rank**	**Sum of Ranks**
Non NICRA	0.00	120	61.66	7399.50
NICRA	1.00	120	179.34	21520.50
	Total	240		

Table 4.33 Mann-Whitney U test for adaptive capacity of NICRA and non NICRA farmer groups and its level of significance

Test Statistics	
	Overall
Mann-Whitney U	139.500
Wilcoxon W	7399.500
Z	-13.140
Asymp. Sig. (2-tailed)	0.000

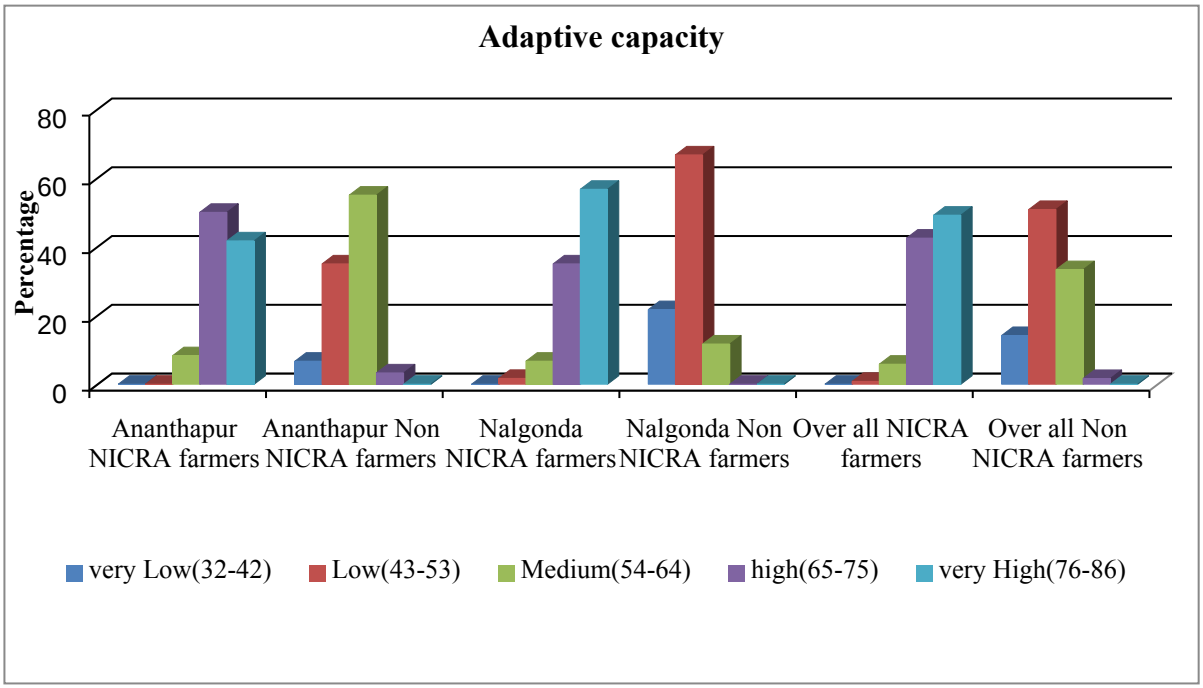


Fig.4.44. Distribution of the respondents according to their Adaptive capacity

4.4 Level of Adoption of Climate Resilient Agriculture (CRA) technologies and coping mechanisms for Climate Resilient Agriculture

4.4.1 Level of adoption of CRA technologies

Level of adoption of CRA technologies studied through four different components like NRM, crop, live stock and institutional interventions.

Table 4.34 Distribution of respondents according to their overall adoption of CRA technologies of both NICRA and non NICRA farmers of Anantapur and Nalgonda

S. No	Overall adoption	Ananthapur				Nalgonda				(Overall)		(Overall)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=120)		Non NICRA farmers (n=120)	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Low (7-22)	0	0	39	65.00	29	48.00	58	97.00	29	24.17	97	81.00
2	Medium (23-38)	24	40.00	21	35.00	31	52.00	2	3.30	55	45.83	23	19.00
3	High (39-54)	36	60.00	0	0.00	0	0.00	0	0	36	30	0	0
	Total	60	100	60	100	60	100	60	100	120	100	120	100

It could be observed from the table 4.34 Fig.4.38 that majority (60.00%) of the NICRA farmers of Ananthapur were belonged to high followed by medium (40.00%) and none of them found to be low adoption. While in Ananthapur non NICRA majority (65.00%) of farmers had low followed by medium (35.00%). In respect to Nalgonda district majority (51.70%) of farmers of NICRA were belonged to low followed by medium (48.30%). Whereas in Nalgonda majority (96.70%) of the farmers of non NICRA were belonged to low followed by medium (3.30%).

On the whole the 45.83 per cent of the NICRA farmers were belonged to medium followed by high (30.00%) and low (24.17%) level of overall adoption of CRA technologies, whereas in non NICRA majority (81.00%) of farmers were belonged to low followed by medium (19.20%) overall adoption.

It could be perceived from the results that majority of the respondents of NICRA had medium followed by high and low over all adoption might be due to medium adoption of NRM technologies, crop related technologies, live stock technologies and high adoption of institutional technologies might be the reason for them to fall under the medium followed by high over all adoption. These results were in conformity with

findings of Khorshed (2015), Simpson and Burpee (2014), Sarkar (2014) and Philip *et al.* (2014).

4.4.1.1 NRM

It could be observed from the Table 4.35 that majority (63.30%) of the NICRA farmers of Ananthapur were belonged to medium followed by high (36.70%) and none of them found to be low adoption of NRM component. While in Ananthapur non NICRA majority (71.70%) of farmers had low followed by medium (28.30%) and none of them found to be high adoption of NRM. In respect to Nalgonda district majority (70.00%) of farmers of NICRA had medium followed by low (16.70%) and high (13.30%). Whereas in Nalgonda majority (100.00%) of the farmers of none NICRA had low adoption of NRM and none of them found to be medium and high.

On the whole the majority (66.67%) of the NICRA farmers had medium followed by high (25.00%) and low (8.33%) level of adoption of NRM. Whereas in non NICRA majority (85.83%) of farmers had low followed by medium (14.17%) and none of them found to be high adoption of NRM technologies.

It can be inferred from the Table 4.35 that the majority of the NICRA farmers had medium adoption of NRM technologies. The probable reason for this adoption of real time contingency crop planning for rainfed red chalka soils, water management through drip irrigation in chillies, renovation of farm ponds, excavation of check dams, recharge of wells and bore wells and de silt tank and tank silt application by NICRA farmers in Nalgonda. Same technologies adopted by NICRA farmers of Ananthapur, not only these technologies but also Soil and moisture conservation measures like stone bunding across the slope to reduce the runoff of water and Contour bunding adopted by the farmers. The farmers are slowly realising both short and long lasting effects of these practices.

In respect to non NICRA majority of farmers had low adoption of NRM technologies. Might be due to the Nalgonda farmers had low source of information utilization, low socio economic status, small farmers, majority of them not receiving any trainings and illiterate. In Ananthapur this could be attributed to the reason that the farmers were not practicing the renovation farm ponds, de silting of check dams, silt application, real time contingency crop planning for rainfed red chalka soils, rain guns/supplemental irrigation through farm ponds in standing crop of ground nut. The farmers are slowly realising both short and long lasting effects of these practices, in addition to this the government is giving financial support to take up various NRM activities like excavation of farm ponds, construction of check dam, excavation of

contour trenches to control the soil erosion and improve the soil moisture capacity under watershed. Through this some wells and bore wells were recharged. Government is offering cent per cent subsidy to take up various NRM activities under watersheds. This finding is in conformity with those of Krishnamurthy (1993), Reddy (1996) and Anil *et al.* (2010).

4.4.1.2 Crop production

It could be observed from the Table 4.35that majority (80.00%) of the NICRA farmers of Ananthapur were belonged to medium followed by high (20.00%) and none of them found to be under low adoption of Crop production component. While in Ananthapur non NICRA majority (56.70%) of farmers had low followed by medium (43.30%) and none of them found to be under high adoption of Crop production technologies. In respect to Nalgonda district majority (78.30%) of farmers of NICRA had medium followed by high (15.00%) and low adoption (6.70%), whereas in Nalgonda majority (68.30%) of the farmers of non NICRA had low followed by medium (31.70%) and none of them found to be under high adoption.

On the whole the majority (79.17%) of the NICRA farmers had medium followed by high (17.50%) and low (3.33%) level of adoption of Crop production technologies. Whereas in non NICRA majority (62.50%) of farmers had low followed by medium (37.50%) and none of them found to be under high adoption of Crop production technologies.

The results revealed that majority of overall NICRA farmers had medium. The probable reason for this in Ananthapur NICRA farmers adopted improved varieties in groundnut, sheep penning on groundnut productivity, crop diversification through castor, soil test based nutrient application in ground nut, intercropping of groundnut and pulses (red gram, horse gram), intercultivation with danthi to control weed and create soil mulch and management of LLS spray in groundnut. In Nalgonda NICRA farmers adopted Soil test based nutrient management in cotton, crop diversification from paddy to jowar and vegetable as a contingent crop, intercropping of cotton and pulses (green gram/ red gram), sucking pest management in cotton, intercultivation with danthi to control weed and create soil mulch. The major reason for all NICRA farmers to fall under medium category was, inspite of construction of check dams and soil moisture conservation measure there is slight improvement in ground water levels, low recharge of bore well and wells due to low and irregular rain fall pattern.

In case of non NICRA majority of them had low adoption of crop technologies. The probable reason for this in Ananthapur farmers had medium source of information

utilization, drought occurred yearly once due to this crop loss was more; majority of them were not received trainings on CRA technologies, water resources were there but wells and bore wells were dried up due to low rain fall, whereas in Nalgonda majority of non NICRA farmers were illiterate, had small holdings, low source of information utilization, low risk taking ability and no training.

Hence, both the research and extension systems should strive hard to develop varieties or technologies which are location specific. These technologies also should reach the farmers in an understandable format for quick adoption. The farmers may be enlightened on the relevance and utility of these technologies in the process of overcoming the climatic adversaries. More method and result demonstrations may be conducted to show the value and relative worth of the new technologies. Training programmes and small group meetings may be organized to generate awareness and to improve knowledge and skills of farmers on these technologies. Apart from all these measures, the government should ensure the necessary critical inputs like seeds of tolerant varieties, organic and biological inputs to maintain soil fertility and to control pest and diseases, plant protection and farm implement and machinery through cooperatives. The Micro Irrigation department has to organise more demonstrations to popularise the usage of micro irrigation in their crops.

4.4.1.3 Live stock

It could be observed from the Table 4.35 that majority (53.30%) of the NICRA farmers of Ananthapur were belonged to medium followed by low (46.70%) none of them found to be under high adoption. While in Ananthapur non NICRA majority (81.70%) of farmers had low followed by medium (18.30%) and none of them found to be high adoption. In respect to Nalgonda district majority (68.3%) of farmers of NICRA had medium adoption of live stock technologies. Almost similar portion of farmers were belonged to high (16.7%) and low (15.00%), whereas in Nalgonda majority (56.70%) of the farmers of non NICRA was belonged to low followed by medium (43.30%) and none of them found to be under high adoption.

On the whole the majority (60.83%) of the NICRA farmers were belonged to medium followed by low (30.83%) and high (8.33%) adoption of live stock technologies, whereas in non NICRA majority (69.17%) of farmers was belonged to low followed by medium (30.83%) and none of them found to be under high adoption of live stock technologies.

The results revealed that majority of NICRA farmers had medium followed by low adoption of live stock technologies might be due to fact that Ananthapur NICRA

farmers were regularly de-warming their animals, not showing interest towards silage making, cultivation of multi cut APBN fodder variety due to drought. Poor availability of azolla to feed their cattle, not maintaining the back yard poultry by the farmers and their medium risk taking ability, lead to medium followed by low level of adoption. While in Nalgonda farmers had high risk taking ability, more number of trainings received, drought occurred once in three years, medium source of information utilization, wells and bore wells recharged. Farmers adopted fodder variety, azolla, de-warming their animals lead them to fall under medium followed by high adoption.

Whereas in non NICRA majority of them had low followed by medium adoption of live stock technologies. The probable reason for this in Ananthapur majority of farmers had not received training programmes, drought occurred yearly once, medium risk taking ability. In Nalgonda majority of the farmers were illiterate, low socio economic status, small farmers, low source of information utilization, low risk taking ability lead them to fall under the low adoption of live stock technologies.

Agriculture alone cannot meet livelihood security of small and marginal farmers in rain fed regions. Need to supplement the income of the farmers though income generating activities like back yard poultry and animal husbandry.

4.4.1.4 Institutional interventions

It could be observed from the Table 4.35 that majority (63.30%) of the NICRA farmers of Ananthapur were belonged to high followed by medium (36.70%) and none of them found to be under low adoption. In respect to Nalgonda district majority (58.30%) of farmers of NICRA were belonged to high followed by medium (41.70%), whereas both in Nalgonda and anantapur majority (100.00%) of the farmers of non NICRA were belonged to low. None of them found to be medium and high adoption.

On the whole the majority (60.83%) of the NICRA farmers were belonged to high followed by medium (39.17%) and none of them found to be low adoption of institutional interventions, whereas in non NICRA cent per cent (100.00%) of farmers were belonged to low adoption of institutional interventions.

The results revealed that majority of NICRA farmers had high followed by medium adoption of institutional interventions technologies might be due to fact that in both the study areas almost all the farmers were adopting machineries for agricultural operations through CHC, CHC in these areas helped the farmers to save around 80 per cent of their labour cost; by this farmers were empowered by timely completion of farm operations. There was a partial adoption of village seed bank and fodder bank might be

due to usage of hybrids seeds and low quality seed, problem of pest and disease attack led to replacing the seeds every year by the farmers.

Table 4.35 Distribution of respondents according to their adoption of CRA technologies of different components

1	NRM												
S.No	NRM	Ananthapur				Nalgonda				(Overall)		(Overall)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=120)		Non NICRA farmers (n=120)	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Low (1-8)	0	0.00	43	71.70	10	16.70	60	100.00	10	8.33	103	85.83
2	Medium (9-16)	38	63.30	17	28.30	42	70.00	0	0.00	80	66.67	17	14.17
3	High (17-24)	22	36.70	0	0.00	8	13.30	0	0.00	30	25.00	0	0.00
	Total	60	100	60	100	60	100	60	100	120	100	120	100
2	crop production												
S.No	Crop production	Ananthapur				Nalgonda				(Overall)		(Overall)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=120)		Non NICRA farmers (n=120)	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Low (4-11)	0	0.00	34	56.70	4	6.70	41	68.30	4	3.33	75	62.50
2	Medium (12-19)	48	80.00	26	43.30	47	78.30	19	31.70	95	79.17	45	37.50
3	High (20-27)	12	20.00	0	0.00	9	15.00	0	0.00	21	17.50	0	0.00
	Total	60	100	60	100	60	100	60	100	120	100	120	100
3	Livestock												
S.No	Livestock	Ananthapur				Nalgonda				(Overall)		(Overall)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=120)		Non NICRA farmers (n=120)	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Low (0-3)	28	46.70	49	81.70	9	15.00	34	56.70	37	30.83	83	69.17
2	Medium (4-7)	32	53.30	11	18.30	41	68.3	26	43.30	73	60.83	37	30.83
3	High (8-11)	0	0.00	0	0.00	10	16.70	0	0.00	10	8.33	0	0.00
	Total	60	100	60	100	60	100	60	100	120	100	120	100
4	Institutional												
S.No	Institutional	Ananthapur				Nalgonda				(Overall)		(Overall)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=120)		Non NICRA farmers (n=120)	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Low (0-1)	0	0.00	60	100.00	0	0.00	60	100.00	0	0.00	120	100.00
2	Medium (2-3)	22	36.70	0	0.00	25	41.70	0	0.00	47	39.17	0	0.00
3	High (4-5)	38	63.30	0	0.00	35	58.30	0	0.00	73	60.83	0	0.00
	Total	60	100	60	100	60	100	60	100	120	100	120	100

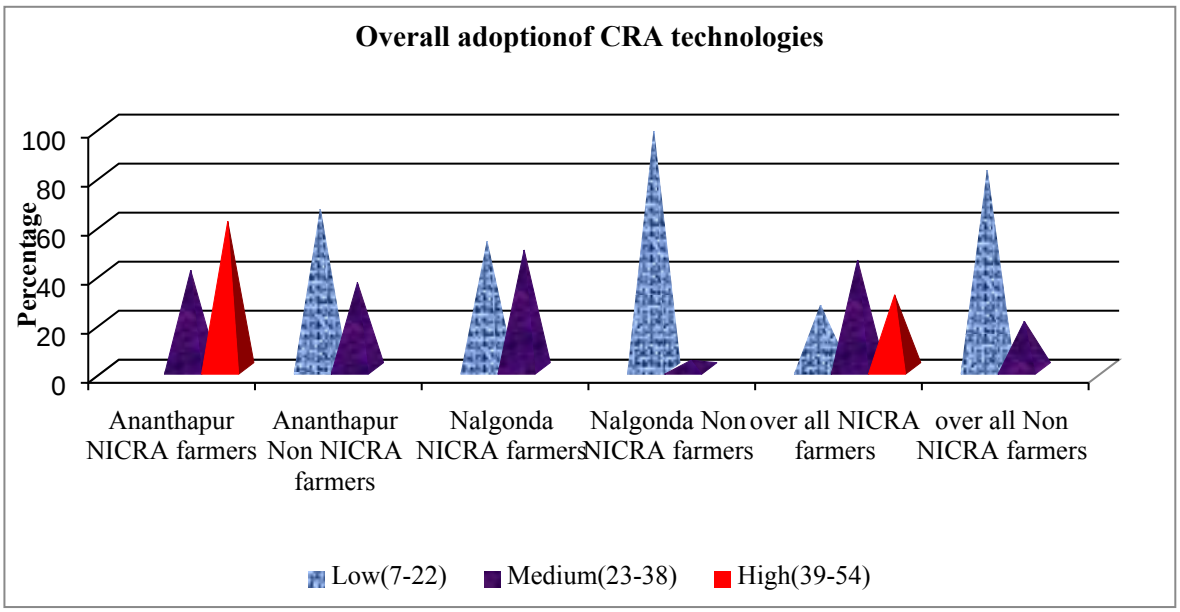


Fig.4.45 Distribution of the respondents according to their Overall adoption of CRA technologies of both NICRA and Non NICRA farmers

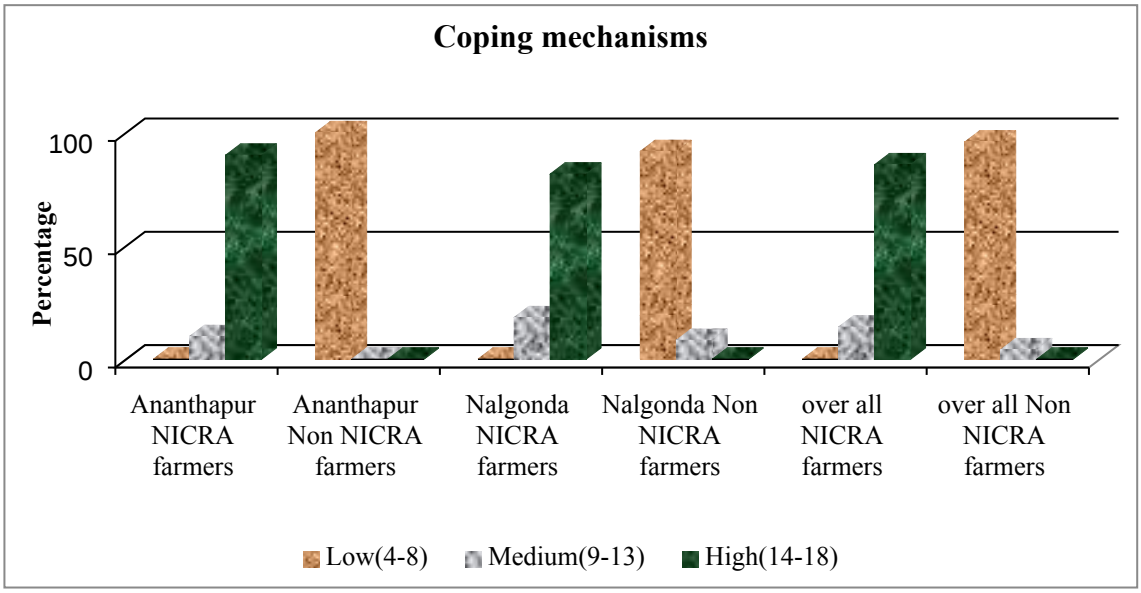


Fig.4.46 Distribution of the respondents according to their Coping mechanisms

4.4.2 Coping mechanisms for Climate Resilient Agriculture

It could be observed from the Table 4.36and Fig. 4.39 that majority (90.00%) of the NICRA farmers of Ananthapur were belonged to high followed by medium (10.00%). While in Ananthapur non NICRA majority (100.00%) of farmers had low and none of them found to be medium and high. In respect to Nalgonda district majority (81.67%) of farmers of NICRA were belonged to high followed by medium (18.33%). Whereas in Nalgonda majority (91.67%) of the farmers of non NICRA were belonged to low followed by medium (8.33%).

On the whole the majority (85.83%) of the NICRA farmers were belonged to high followed by medium (14.17%) adoption of coping mechanisms. Whereas in non NICRA majority (95.83%) of farmers were belonged to low followed by medium (4.17%) adoption of coping mechanisms.

The results revealed that majority of NICRA farmers had high followed by medium adoption of coping mechanisms might be due to high followed by medium adoption by both Ananthapur and Nalgonda NICRA farmers. The probable reason for this in both NCRA areas farmers were adopting non-farm activities, selling assets to get the income, left the land fallow due to lack of rain fall and very less number of farmers were receiving crop insurance.

Whereas in non NICRA majority of them had low adoption of coping mechanisms might be due to low adoption of coping mechanisms by both non NICRA farmers of Ananthapur and Nalgonda. All the farmers were not receiving crop insurance, input subsidies from the government. The probable reason for this the non NICRA farmers belong to illiterate, medium farm size, medium farming experience, medium traditionalism and low source of information utilization lead them to fall under the low category of coping mechanisms. These results were in conformity with findings of Pathak (2012), Gry Synnevag *et al. (*2014) and Nagaraj *et al.*(2013).

Table 4.36 Distribution of respondents according to their level of coping mechanisms for CRA

S. No.	Coping mechanisms	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	F	%
1	Low (4-8)	0	0.00	60	100.00	0	0.00	55	91.67	0	0.00	115	95.83
2	Medium (9-13)	6	10.00	0	0.00	11	18.33	5	8.33	17	14.17	5	4.17
3	High (14-18)	54	90.00	0	0.00	49	81.67	0	0.00	103	85.83	0	0.00
	Total	60	100	60	100	60	100	60	100	120	100	120	100

4.4.3 Level of adoption of Climate Resilient Agriculture (CRA) technologies and coping mechanisms for Climate Resilient Agriculture

Table 4.37. Distribution of respondents according to their level of adoption of CRA technologies and coping mechanisms for Climate Resilient Agriculture

S.No	Level of adoption	Ananthapur				Nalgonda				(Overall) NICRA farmers (n=120)		(Overall) Non NICRA farmers (n=120)	
		NICRA farmers (n=60)		Non NICRA farmers (n=60)		NICRA farmers (n=60)		Non NICRA farmers (n=60)					
		F	%	F	%	F	%	F	%	F	%	F	%
1	Low (13-29)	0	0	39	65.00	0	0	47	78.30	0	0.00	86	71.67
2	Medium (30-46)	17	28.30	21	35.00	19	31.70	13	21.70	36	30.00	34	28.33
3	High (47-63)	43	71.70	0	0.00	41	68.30	0	0.00	84	70.00	0	100
	Total	60	100	60	100	60	100	60	100	120	100	120	100

It could be observed from the Table 4.37 that majority (71.70%) of the NICRA farmers of Ananthapur were belonged to high followed by medium (28.30%) level of adoption of CRA technologies and coping mechanism. While in Ananthapur non NICRA majority (65.00%) of farmers had low followed by medium (35.00%). In respect to Nalgonda district majority (68.3%) of farmers of NICRA were belonged to high followed by medium adoption (31.70%), whereas in Nalgonda majority (78.30%) of the farmers of non NICRA were belonged to low followed by medium (21.70%).

On the whole the majority (70.00%) of the NICRA farmers were belonged to high followed by medium (30.00%) adoption of CRA technologies and coping mechanism, whereas in non NICRA majority (71.67%) of farmers were belonged to low followed by medium (28.33%) adoption of CRA technologies and coping mechanism.

The results revealed that majority of NICRA farmers had high followed by medium adoption of CRA technologies and coping mechanism. The probable reason for this might be the community farmers were adopting NRM measures like excavation and renovations of farm ponds, percolation tanks, constructing check dams, farmers had sown contingency crops like sorghum, green gram, guar crops in the month of second fortnight of August. Almost all the farmers were adopted drought resistant verities and crop diversity through vegetables. Some of the farmers used rain guns to spray the water on crop in critical stages and using drips for supplemental irrigation to the crops. CHC helped the farmers in doing farm operation in timely. To cope up from drought farmers were doing non farming activities selling vegetables, doing business activities

like sheep penning in other farmer fields, salt business, toddy business etc., to get the income from other than farming. Searching for good market, selling their assets, conserving the fodder, but only some of the farmers were getting input subsidies and crop insurance.

In non NICRA majority of them had low adoption of CRA technologies and coping mechanism. The probable reason for this might be these farmers were illiterate, not attended any trainings, no extension contacts and. Due to this most of the farmers had not awareness on the CRA technologies and coping mechanisms. These results were in conformity with findings of Anil *et al.* (2010), Srinivasarao *et al*. (2013) Nagaraj *et al*. (2013).

4.4.4 Comparison of different components of adoption of NICRA and non NICRA farmers of both Anantapur and Nalgonda

Comparison displayed in Table 4.38 and 4.39 on level of adoption of CRA technologies with different components i.e., NRM, crop, livestock and institutional intervention for NICRA and Non NICRA farmers discretely for Ananthapur and Nalgonda districts using Kruskal-Wallis test. With regard to technologies of NRM, NICRA farmers in both Ananthapur and Nalgonda districts showed better adoption with mean rank 88.48 and 90.18 respectively compared with mean rank 32.52 and 30.83 respectively for Non NICRA farmers. With respect to the technologies of crop, NICRA farmers in both Ananthapur and Nalgonda districts showed better adoption with mean rank 89.58 and 62.40 respectively compared with mean rank 31.42 and 58.60 respectively for Non NICRA farmers. In view of technologies relevant to Livestock, NICRA farmers in both Ananthapur and Nalgonda districts showed better adoption with mean rank 84.63 and 83.90 respectively compared with mean rank 36.38 and 37.10 respectively for Non NICRA farmers. In respective of institutional intervention, NICRA farmers in both Ananthapur and Nalgonda districts showed better adoption with mean rank 90.50 and 90.50 respectively compared with mean rank 30.50 and 30.50 respectively for Non NICRA farmers. Test statistics and its level of significance are represented in Table 4.39 and the results were found to be significant at $p<0.01$ level of significance for all the parameters with sample size 60, except crop technologies in Nalgonda.

The results revealed in Table 4.39 that in Ananthapur there was significant difference between the all components of adoption of technologies among NICRA and non NICRA, whereas in Nalgonda there was significant difference between NRM, livestock and institutional interventions among NICRA and non NICRA. But in crop

related technologies there was no significance difference between NICRA and Non NICRA farmers in Nalgonda at level of significance 0.01. The probable reason for this might be almost all farmers were growing drought resistant varieties, jowar and vegetables as a contingent measure, crop rotation, sucking pest management in cotton and Intercropping of cotton and pulses (green gram/red gram). Adoption of these practices may be attributed to the reason that these practices are easy to follow as they do not require much technicalities to understand, and are low-cost and no-cost practices and require low external inputs/ingredients to follow.

Table 4.38 Comparison of different components of adoption of CRA technologies of NICRA and non NICRA farmers of both Anantapur and Nalgonda using Kruskal Wallis Test

Category	Group	N	Ananthapur Mean Ranks	Nalgonda Mean Ranks
NRM	Non NICRA farmers	60	32.52	30.83
	NICRA farmers	60	88.48	90.18
Crop production protection	Non NICRA farmers	60	31.42	58.60
	NICRA farmers	60	89.58	62.40
Livestock	Non NICRA farmers	60	36.38	37.10
	NICRA farmers	60	84.63	83.90
Institutional intervention	Non NICRA farmers	60	30.50	30.50
	NICRA farmers	60	90.50	90.50

Table 4.39 Kruskal-Wallis Test for adoption of different components of CRA technologies of NICRA and non NICRA farmers of both Anantapur and Nalgonda and its level of significance

	Ananthapur NICRA Vs non NICRA				Nalgonda NICRA Vs non NICRA			
Category	NRM	Crop production protection	Live stock	Institutional intervention	NRM	Crop production protection	Live stock	Institutional intervention
Chi-Square	78.088	84.483	60.569	119.000	88.007	0.364	55.701	119.000
df	1	1	1	1	1	1	1	1
Asymp. Sig.	0.000	0.000	0.000	0.000	0.000	0.546	0.000	0.000
P value	<0.01	<0.01	<0.01	<0.01	<0.01	>0.01	<0.01	<0.01

4.4.5 Overall comparison between NICRA and non NICRA respondents for Level adoption of CRA technologies

Comparison between NICRA and non NICRA farmers respective to the overall level of adoption of CRA technologies results as shown in the Table 4.40 and 4.41 with mean rank 225.09 and 61.22 respectively. As per the results shown, NICRA has improved level of adoption (with parameters NRM, crop production, protection, livestock and institutional intervention) compare to the non NICRA farmers. Test statistics and its level of significance are represented in Table 4.41 and the results revealed that there was significant difference between the overall level of adoption of CRA technologies at $p<0.01$ level of significance. The probable reason for this is that there was significant difference between NRM, live stock, institutional intervention in both NICRA and non NICRA farmers of Ananthapur and Nalgonda leading to significant difference in over all adoption CRA technologies among the NICRA and non NICRA at level of significance 0.01. These results were in conformity with findings of Jasna (2015).

Table 4.40 Overall comparisons between NICRA and non NICRA respondents for Level of adoption of CRA technologies using Mann-Whitney U test

Ranks				
Group		**N**	**Mean Rank**	**Sum of Ranks**
Non NICRA	0.00	120	61.22	7346.00
NICRA	1.00	120	225.09	47269.00
	Total	240		

Table 4.41 Mann-Whitney U test for level of adoption of NICRA and non NICRA respondents and its level of significance

Test Statistics	
	NICRA vs Non NICRA
Mann-Whitney U	86.000
Wilcoxon W	7346.000
Z	-15.014
Asymp. Sig. (2-tailed)	.000
P value	<0.01

4.4.5 Overall comparison between NICRA and non NICRA respondents for Level adoption of CRA technologies and coping mechanisms

Comparison between NICRA and Non NICRA farmers respective to the overall level of adoption of CRA technologies and coping mechanism results as shown in the

Table 4.42 with mean rank 179.93 and 61.07 respectively. As per the results shown, NICRA has improved level of adoption (with parameters NRM, crop production, protection, livestock and institutional intervention) and coping mechanisms compare to the non NICRA farmers. Test statistics and its level of significance are represented in Table 4.43 and the results revealed that there was significant difference between the overall level of adoption of CRA technologies and coping mechanisms at $p<0.01$ level of significance. The probable reason for this is as the means ranks were high for overall adoption of CRA technologies in NICRA compare to non NICRA groups and coping mechanisms also high in NICRA compare to non NICRA leading to significant difference in level of adoption CRA technologies and coping mechanisms among the NICRA and non NICRA at level of significance 0.01. These results were in conformity with findings of Jasna (2015).

Table 4.42. Overall comparison between NICRA and non NICRA respondents for Level of adoption of CRA technologies and coping mechanisms using Mann-Whitney U test

Ranks				
Group		**N**	**Mean Rank**	**Sum of Ranks**
Non NICRA	0.00	120	61.07	7328.50
NICRA	1.00	120	179.93	21591.50
	Total	240		

Table 4.43. Mann-Whitney U test for level of adoption of CRA technologies and coping mechanisms of NICRA and non NICRA respondents and its level of significance

Test Statistics	
	NICRA Vs non NICRA
Mann-Whitney U	68.5
Wilcoxon W	7328.5
Z	13.267
Asymp. Sig. (2-tailed)	0.000
P value	<0.01

4.5 Relationship between profile characteristics of respondents and level of adoption of CRA technologies

4.5.1 Relationship between profile characteristics of respondents and level of adoption of CRA technologies by using correlation

In progression to study the nature of relationship between the independent variables and level of adoption of CRA technologies of NICRA and non NICRA

farmers, correlation coefficients (r_i) were calculated and values were presented in Table 4.44 and Table 4.45.

The relationship between the scores of independent variables and level of adoption of CRA technologies of NICRA and non NICRA farmers were tested by relevant null and empirical hypotheses.

Null hypothesis: There will be no relationship between scores of the independent variables viz; age, education, farming experience, farm size, availability of water resources, frequency of occurrence of drought, farming systems, socio economic status, social affiliation, training undergone on CRA, source of information utilization, credit availability, food security, traditionalism, risk taking ability, weather based agro advisory services, community infrastructural facilities and scores of level of adoption of the respondents in both NICRA and Non NICRA. Means the independent variables here mentioned above will not be influence on the dependent variable. Statistically we can denote the null hypothesis by:

$$H_0: \varrho_i = 0 \text{ for correlation coefficients } (i = 1,\ldots,17 \text{ variables})$$

Alternative hypothesis: There will be significant relationship between scores of the independent variables viz; age, education, farming experience, farm size, availability of water resource, frequency of occurrence of drought, farming systems, socio economic status, social affiliation, training undergone on CRA, source of information utilization, credit availability, food security, traditionalism, risk taking ability, weather based agro advisory services, community infrastructural facilities and scores of level of adoption of the respondents in both NICRA and non NICRA. Means the independent variables here mentioned above will be influence significantly on the dependent variable. Statistically we can denote the null hypothesis by:

$$H_0: \varrho_i \neq 0 \text{ for correlation coefficients } (i = 1,\ldots,17 \text{ independent variables})$$

4.5.1.1 Relationship between the independent variables and level of adoption of CRA technologies of farmers of Ananthapur

4.5.1.1.1 Relationship between the independent variables and Level of adoption of CRA technologies of NICRA farmers of Ananthapur

It could be observed from the Table 4.44 that on the whole, the variables availability of water resources (0.456), farming systems (0.565),social affiliation(0.706), training undergone on CRA (0.689), risk taking ability (0.351) had showed positive and highly significantly correlated at $p<0.01$ level of significance, Where as frequency of occurrence of drought (0.277), source of information utilization (0.295) farming experience (0.322) exhibited positive and significant relationship with

adoption of CRA technologies at 5 per cent level of significance. Hence the null hypothesis was rejected and empirical hypothesis was accepted. It could be inferred that there was significant relationship between these independent variables and adoption of CRA technologies of the farmers. While education (0.124), farm size (0.146), socio economic status (0.137), credit availability (0.252), food security (0.109), traditionalism (0.152), weather based agro advisory services (0.179), and community infrastructural facilities (0.058) showed positive and non significant relationship with the adoption. Age (-0.419) found to be negative and non significant relationship with the adoption. Therefore null hypothesis was accepted and empirical hypothesis was rejected. It could be inferred that there was no significant relationship between these variables and adoption of the respondents.

It could be perceived from the results that all the availability of water resources, farming systems, social affiliation, training undergone on CRA, risk taking ability had showed positive and highly significantly relation with the adoption. This could comprehend that as increase in these variable the farmers were improved their knowledge and skills by attending the trainings and risk taking ability to adopt the CRA technologies. The farmers were taking risk only when the water resource was present in rainy season and they were cultivating more than one crops to get income from different enterprises these leads to adopt NRM practices such as drip system, contingency crop measures, crop technologies like drought resistant verities, crop diversity, application of FYM/compost from the livestock to the field, cultivation of fodder to feed their livestock. As increasing social affiliation in community farmers had coherent and synergetic effect and get influenced by each other to understand and perceive the relevance and applicability of the NRM practices.

Farming experience, frequency of occurrence of drought, source of information utilization, exhibited positive and significant relationship with adoption of CRA technologies. The reason might be in Ananthapur NICRA farmers had medium faming experience as increasing this leads to better understanding of the farmers about CRA technologies. The drought occurred yearly once due to this farmers realized the importance of soil moisture conservation measure to control the erosion they motivated highly to adopt the NRM practices and they were showed interest to adopted livestock technologies to get the secondary income from livestock because as they were not getting the income from the rainfed crops due to intermittent dry spells as increasing in occurrence of drought. Farmers also maintained an account in CHC to get suitable farm implements at low cost and they were participating actively in institutional interventions

to overcome risk from drought. The increased level of contacts of the members in a group is crucial for retrieving or acquiring the information from various formal or informal institutional sources and these information rich members definitely inculcate the spirit of understanding the moods and feelings of others and try to share the information among each other for the benefit of the group. This kind of rich contacts helps the farmers to adopt CRA technologies.

4.5.1.1.2 Relationship between the independent variables and level of adoption of CRA technologies of non NICRA farmers of Ananthapur

An overview of the Table 4.44 showed that the selected independent variables such as availability of water resources (0.268), farming systems (0.297), source of information utilization (0.263) had showed positive and significant relation with adoption at $p<0.05$ level of significance. It could be interpreted as those three variables had positive and significant correlation with adoption. Traditionalism (-0.033) had showed negative and significant relation with adoption at at $p<0.05$ level of significance. Hence the null hypothesis rejected and accepted alternate hypothesis. But the remaining variables such as education (0.124), farming experience (0.226), farm size (0.02), frequency of occurrence of drought (0.157), socio economic status (0.111), social affiliation (0.14), training undergone on CRA (0.179), credit availability (0.213), food security (0.154), risk taking ability (0.074), weather based agro advisory services (0.122) and community infrastructural facilities (0.016) were showing positive relation with level of adoption technologies but not significant.Age (-0.207) showed negative and non significant relation with adoption. Therefore null hypothesis was accepted and empirical hypothesis was rejected. It could be inferred that there was no significant relationship between these variables and adoption of the respondents.

It could be perceived from the results that all the availability of water resources, farming systems, source of information utilization (0.263) had showed positive and significant relation with adoption. The reason might be non NICRA framers of Anantapur had the medium source of information utilisation as increase in this the farmers had more number of contacts with the other fellow farmers and The increased level of contacts of the members in a group is crucial for retrieving or acquiring the information from various formal or informal institutional sources and these information rich members definitely inculcate the spirit of understanding the moods and feelings of others and try to share the information among each other for the benefit of the group. In this area MGNREGS and water shed activities were implemented due to this the farmers were having contacts with the officials and they were motivated to adopt NRM

practices like trenches around the contour, excavation of percolation tanks and check dam construction, the framers observed improvement in ground water level and availability of water resource were increased so the farmers adopted some of other crop, livestock technologies to overcome the drought. But the lack of renovations of NRM activities and low rainfall, non availability inputs timely at low cost led them to low adoption of CRA technologies. Hence these variables had positive significant relation with the adoption but not showed highly significant relation.

Table 4.44. Correlation analysis of independent variables with dependent variable of NICRA and non NICRA farmers of Anantapur district

S. No.	Independent variables	Correlation coefficient (r) values	
		Ananthapur NICRA farmers (n=60)	Ananthapur non NICRA farmers(n=60)
1	Age	-0.419	-0.207
2	Education	0.124	0.139
3	Farming experience	0.322*	0.226
4	Farm size	0.146	0.02
5	Availability of water resources	0.456**	0.268*
6	Frequency of occurrence of drought	0.277*	0.157
7	Farming systems	0.565**	0.297*
8	Socio economic status	0.137	0.111
9	Social affiliation	0.706**	0.14
10	Training undergone on CRA	0.689**	0.179
11	Source of information utilization	0.295*	0.263*
12	Credit availability	0.252	0.213
13	Food security	0.109	0.154
14	Traditionalism	0.152	-0.333*
15	Risk taking ability	0.351**	0.074
16	Weather based agro advisory services	0.179	0.122
17	Community infrastructural facilities	0.058	0.016

****. Correlation is significant at the 0.01 level, *. Correlation is significant at the 0.05 level**
(-) negatively correlated and (+) positively correlated

Table 4.45 Correlation analysis of independent variables with dependent variable of NICRA and non NICRA farmers of Nalgonda district

S. No	Independent variables	Correlation coefficient (r) values	
		Nalgonda NICRA farmers	Nalgonda non NICRA farmers
		Overall of adoption CRA technologies	Overall of adoption CRA technologies
1	Age	-0.42	-0.136
2	Education	0.186	0.145
3	Farming experience	0.239	0.176
4	Farm size	0.137	0.102
5	Availability of water resources	0.384**	0.284*
6	Frequency of occurrence of drought	0.459**	0.124
7	Farming systems	0.572**	0.295*
8	Socio economic status	0.213 *	0.068
9	Social affiliation	0.360*	0.105
10	Training undergone on CRA	0.774**	0.019
11	Source of information utilization	0.271*	0.059
12	Credit availability	0.127	0.259*
13	Food security	0.083	0.061
14	Traditionalism	0.201	-0.328*
15	Risk taking ability	0.705**	0.151
16	Weather based agro advisory services	0.069	0.058
17	Community infrastructural facilities	0.125	0.114

****. Correlation is significant at the 0.01 level, *. Correlation is significant at the 0.05 level**
(-) negatively correlated and (+) positively correlated

4.5.1.2 Relationship between the independent variables and level of adoption of CRA technologies of farmers of Nalgonda

4.5.1.2.1 Relationship between the independent variables and level of adoption of CRA technologies of NICRA farmers of Nalgonda

It could be observed from the Table 4.45 that on the whole, the variables availability of water resources (0.384), farming systems (0.572), training undergone on CRA (0.774), risk taking ability (0.705) had showed positive and highly significantly correlated at $p<0.01$ level of significance, Where as socio economic status (0.213), social affiliation (0.360), source of information utilization (0.271) exhibited positive and significant relationship with adoption of CRA technologies at 5 per cent level of significance. Hence the null hypothesis was rejected and empirical hypothesis was accepted. It could be inferred that there was significant relationship between these independent variables and adoption of CRA technologies of the farmers. While education (0.186), farm size (0.137), frequency of occurrence of drought (0.459), food security (0.083), traditionalism (0.21), weather based agro advisory services (0.069), and community infrastructural facilities (0.252) showed positive and non significant relationship with the adoption. Age (-0.42) found to be negative and non significant relationship with the adoption. Therefore null hypothesis was accepted and empirical hypothesis was rejected. It could be inferred that there was no significant relationship between these variables and adoption of the respondents.

It could be perceived from the results that all the availability of water resources, frequency of occurrence of drought, farming systems, training undergone on CRA, risk taking ability had showed positive and highly significantly relation with the adoption. This could be comprehend that as with the increase in the availability of water resources, frequency of occurrence of drought, farming systems, training undergone on CRA, risk taking ability of the NICRA farmers increases which make them aware about the benefits of the CRA technologies because with the training their knowledge level, skills were improved, as with increasing farming systems they get income from at least one enterprise in drought period due to this their socio economic status improved and motivated to take up more CRA technologies. The drought occurred once in three years due to this farmers realized the importance of soil moisture conservation measure to control the erosion they motivated highly to adopt the NRM practices and due to drought there was difficult to get the income from the crops this leads them to showed interest to adopted livestock technologies to get the secondary income from livestock. Farmers also maintained an

account in CHC to get suitable farm implements at low cost and they were participating actively in institutional interventions to overcome risk from drought.

Socio economic status, social affiliation, source of information utilization, exhibited positive and significant relationship with adoption of CRA technologies. The increased level of contacts of the members in a group is crucial for retrieving or acquiring the information from various formal or informal institutional sources and these information rich members definitely inculcate the spirit of understanding the moods and feelings of others and try to share the information among each other for the benefit of the group. This kind of rich contacts helps the farmers to adopt CRA technologies. As increasing social affiliation in community farmers had coherent and synergetic effect and get influenced by each other to understand and perceive the relevance and applicability of the NRM practices.

Age had negative non significant relation with the adoption of farmers. The reason might be as with increasing their age the farmers were not showing any interest towards farming, they were taking rest at their home. Education, farm size, food security, traditionalism, weather based agro advisory services and community infrastructural facilities showed positive and non significant relationship with the adoption. In Nalgonda NICRA group farmers were illiterate but these community farmers they share the information with each other regarding new CRA technologies. As increase in the traditionalism people believe in more traditional aspects, rituals and traditions may not have favourable perception towards modern CRA technologies. This might be the reason for non-significant association.

4.5.1.2.2 Relationship between the independent variables and level of adoption of CRA technologies of non NICRA farmers of Nalgonda

An overview of the Table 4.45 showed that the selected independent variables such as availability of water resources (0.284), farming systems (0.295), and credit availability (0.259), had showed positive and significant relation with adoption at $p<0.05$ level of significance. It could be interpreted as these variables had positive and significant correlation with adoption. Traditionalism (-0.328) had showed negative and significant relation with adoption at at $p<0.05$ level of significance. Hence the null hypothesis rejected and accepted alternate hypothesis. But the remaining variables such as education (0.145), farming experience (0.176), farm size (0.102), frequency of occurrence of drought (0.124), socio economic status (0.068), social affiliation (0.105), training undergone on CRA (0.019), source of information utilization (0.059), food security (0.061), risk taking ability

(0.151), weather based agro advisory services (0.058) and community infrastructural facilities (0.114) were showing positive relation with level of adoption technologies but not significant. Age (-0.136) showed negative and non significant relation with adoption. Therefore null hypothesis was accepted and empirical hypothesis was rejected. It could be inferred that there was no significant relationship between these variables and adoption of the respondents.

It could be perceived from the results that all the availability of water resources, farming systems and credit availabilityhad showed positive and significant relation with adoption. The reason might be as with the increase in these variable farmers get income to adopt CRA technologies. As increase in the water facility farmers able to give irrigation to the field in critical stages and they can adopt more than one crop and rear their livestock. Traditionalism was negatively associated with adoption might be due to the fact that as with increase in this variable the farmers may have more cultural and religious beliefs and they had not any more idea about scientific technologies related to CRA, as these farmers were from non NICRA villages, had no extension contacts and not received trainings.

4.5.2 Relationship between profile characteristics of respondents and level of adoption of CRA technologies of farmers of NICRA and non NICRA

Multiple linear regression analysis was carried out to determine the influence of the independent variables in predicting the overall adoption of climate resilient agriculture technologies of NICRA and non NICRA farmers, regression coefficients (r_i) were calculated and values were presented in Table 4.46.

Null hypothesis: There will be no relationship between scores of the independent variables *viz.,* age, education, farming experience, farm size, availability of water resources, frequency of occurrence of drought, farming systems, socio economic status, social affiliation, training undergone on CRA, source of information utilization, credit availability, food security, traditionalism, risk taking ability, weather based agro advisory services, community infrastructural facilities and scores of level of adoption of the respondents in both NICRA and non NICRA. Means the independent variables here mentioned above will not be influence on the dependent variable. Statistically we can denote the null hypothesis by:

$$H_0: \beta_i = 0 \text{ for regression coefficients } (i = 1,\ldots,17 \text{ variables})$$

Alternative hypothesis: There will be significant relationship between scores of the independent variables *viz.,* age, education, farming experience, farm size, water resources, frequency of occurrence of drought, farming systems, socio economic status, social affiliation, training undergone on CRA, source of information utilization, credit availability, food security, traditionalism, risk taking ability, weather based agro advisory services, community infrastructural facilities and scores of level of adoption of the respondents in both NICRA and non NICRA. Means the independent variables here mentioned above will be influence significantly on the dependent variable. Statistically we can denote the null hypothesis by:

H_0:$\beta_i \neq 0$ *for regression coefficients (i = 1,….,17 independent variables)*

4.5.2.1 Relationship between profile characteristics of respondents and level of adoption of CRA technologies of both NICRA farmers of Ananthapur and Nalgonda

An overview of the Table 4.46 and Figure 4.47 showed that in NICRA group selected independent variables such as age, education, farming experience, farm size, availability of water resources, frequency of occurrence of drought, farming systems, socio economic status, social affiliation, training undergone on CRA, source of information utilization, credit availability, food security, weather based agro advisory services and community infrastructural facilities together explained the variation to the extent of 64.30 per cent. The F value 8.41 was found to be showing significant variation. Farming systems (0.19) and risk taking ability (1.00) were significantly influencing at $p<0.01$ level of significance with calculated t values 2.83 and 2.76 respectively. While Availability of water resources (0.25), frequency of occurrence of drought (0.19), social affiliation (0.76) and training undergone on CRA (0.22) had positive and significant relation with the adoption at $p<0.05$ level of significance with calculated t values 2.09, 2.12, 2.04 and 2.15 respectively. Hence null hypothesis was rejected and empirical hypothesis was accepted.

4.5.2.2 Relationship between profile characteristics of respondents and level of adoption of CRA technologies of both non NICRA farmers of Ananthapur and Nalgonda

An overview of the Table 4.46 and Figure 4.47 showed that in non NICRA group selected independent variables such as age, education, farming experience, farm size, availability of water resources, frequency of occurrence of drought, farming systems, socio

economic status, social affiliation, training undergone on CRA, source of information utilization, credit availability, food security, weather based agro advisory services and community infrastructural facilities together explained the variation to the extent of 32.3 per cent. The F value 1.92 was found to be showing no significant variation. Farming experience, availability of water resources, farming systems had positive and significant relation with adoption at $p<0.05$ level of significance with calculated t values 1.96, 2.19and 2.17respectively. Hence null hypothesis was rejected and empirical hypothesis was accepted.

It could be observed from the Table 4.46 and Figure 4.47 that farming systems and risk taking ability were positive and highly influencing the adoption. The reason for this might be these farmers had more chance to get income in drought period from integrated farming system by taking more risk drought due to this farmer's socio economic status was improved and these farmers were motivated to adopt CRA technologies. Availability of water resources, frequency of occurrence of drought, social affiliation and training undergone on CRA were influencing positively. As with the increasing in water resources there is a more chance to adopt crop related technologies because all crop package of practices are dependent on irrigation facility. As with the increasing in frequency of occurrence of drought there is a chance to adopt NRM technologies to control the erosion, runoff, to store the soil moisture and can harvest the water. With increasing in social affiliation there is improvement in adoption because by maintaining more relations with the officials, scientist and other fellow farmers for knowing the latest information and they can able to take good decisions before adoption. With increasing in trainings there is improvement in their knowledge, skills led them to increase in adoption of CRA technologies. In both overall NICRA and non NICRA groups, Age had negative and non significant relation with the adoption. The reason might be as with increasing their age the farmers were not showing any interest towards farming, they were taking rest at their home. In overall non NICRA, traditionalism had negative association with the adoption, as increase in the traditionalism people believe in more traditional aspects, rituals and traditions may not have favourable perception towards modern CRA technologies.

Table 4.46. Multiple linear regression analysis of independent variables with dependent variable of overall NICRA and non NICRA farmers

S. No	Independent variables	Overall NICRA farmers			Overall non NICRA		
		Std. Error	Regression Coefficient	Calculated t value	Std. Error	Regression Coefficient	Calculated t value
1	Age	0.10	-0.04	0.42	0.07	-0.04	0.53
2	Education	0.11	0.13	1.20	0.09	0.01	0.17
3	Farming experience	0.10	0.03	0.28	0.07	0.07	1.96*
4	Farm size	0.76	0.93	1.22	0.61	0.24	0.39
5	Availability of water resources	0.12	0.25	2.09*	0.23	0.04	2.19*
6	Frequency of occurrence of drought	0.09	0.19	2.12*	0.64	0.10	0.16
7	Farming systems	0.07	0.19	2.83**	0.60	1.30	2.17*
8	Socio economic status	0.76	1.11	1.46	0.78	1.39	1.79
9	Social affiliation	0.37	0.76	2.04*	0.37	0.81	0.18
10	Training undergone on CRA	0.10	0.22	2.15*	0.80	1.30	1.61
11	Source of information utilization	0.27	0.17	0.64	0.20	0.25	1.26
12	Credit availability	0.17	0.05	0.29	0.08	0.02	0.29
13	Food security	0.27	0.25	0.92	0.86	1.11	1.29
14	Traditionalism	0.55	0.98	1.78	0.16	-0.34	2.13*
15	Risk taking ability	0.36	1.00	2.76**	0.26	0.08	0.29
16	Weather based agro advisory services	0.22	0.10	0.43	0.47	0.28	0.60
17	Community infrastructural facilities	0.75	0.86	1.15	0.43	0.14	0.32
F-Value		8.41**			1.92		
R^2 Value(Co-efficient of determination)		0.643			0.323		

****: Significant at 0.01 level of probability, *: Significant at 0.05 level of probability;**

Note: F table value 1.80 (0.05 level of significance) and 2.29 (0.01 level of significance)

4.5 Problems and suggestions elicited by the respondents in adoption of technologies for Climate Resilient Agriculture

4.6.1 Problems and suggestions elicited by the NICRA farmers in adoption of technologies for CRA technologies

4.6.1.1 Problems elicited by the NICRA farmers in adoption of technologies for CRA technologies

The Table 4.47 illustrated the constraints elicited by the NICRA farmers were grouped under three categories namely Technical constraints, Social and personal and Economic and financial. The constraints under each category were ranked based on frequency and percentage

It is pointed out from the Table 4.47 that the major constraints elicited by the NICRA farmers under Technical constraints were lack of Poor renovation of soil and water conservation measures due to lack of rain fall (check dams, contour bunds, trenches,) (93.33%) and Poor availability of required inputs to all the farmers (95.83%). the constraints like lack of Political interference in NRM (60.00%) covered under Social and personal; Inadequate financial support (88.33%) covered under Economic and financial constraints.

Table 4.47. Problems elicited by the NICRA farmers in adoption of technologies for CRA technologies

	Problems of NICRA farmers			N=120
S. No	**Constraints**	**F**	**%**	**Rank**
I	**Technical constraints (technical complexicity, knowledge and skill)**			
A	**Natural resource management**			
1	De siltation activity is irregular (reduced water storage capacity due to low rain fall)	92	76.67	III
2	Poor renovation of soil and water conservation structures due to lack of rain fall (check dams, contour bunds, trenches,)	112	93.33	I
3	Poor maintenance of soil and water conservation structures due to lack of support from the institutions	102	85.00	II
4	Major canal water was not allowed for implementation of NRM activities due to excessive political interference	78	65.00	IV
5	Top down approach is followed in designing and implementing the watershed activities	71	59.17	V
6	Lack of farmers participation in deciding the contribution of resources like land, labour and money to implement the NRM activities	16	13.33	VIII
7	Depletion of ground water and drying up of irrigation bore wells due to low rain fall	52	43.33	VI
8	Lack of enthusiasm among the farmers to implement the NRM activities due to inadequate rain fall	24	20.00	VII

B	Crop and livestock	F	%	Rank
1	Mechanized intercultivation at the field level was not suitable	94	78.33	IV
2	More crop loss (poor yields) even from drought resistant short duration verities due to moisture stress	99	82.50	II
3	Silage making in bags was difficult and time taking	84	70.00	V
4	Practice of dead furrows is not suitable at the field level due to lack of heavy rains (as it occupies more space)	96	80.00	III
5	Cotton stubbles are hard and not decomposing (for crop residue)	64	53.33	VI
6	Poor maintenance of seed at village level (village seed bank)	50	41.67	VIII
7	Poor maintenance of back yard poultry due to risk involved in it	47	39.17	IX
8	Lack of seed treatment	24	20.00	X
9	Dee worming is irregular for sheep and goat	15	12.50	XII
10	Poor usage of organic manure	12	10.00	XIII
11	Using low quality seed	52	43.33	VII
12	Non use of soil test based nutrient management	18	15.00	XI
13	Poor availability of required inputs to the farmers	115	95.83	I
II	**Social and personal**			
1	Lack of confidence among the community members to adopt the new CRA technologies due to fear of failure	22	18.33	VIII
2	Lack of community action for the promotion of CRA technologies	12	10.00	X
3	Lack of support from other social groups (class and caste groups)	55	45.83	III
4	Overriding isolated approach over community spirit	45	37.50	IV
5	Lack of enthusiasm among the community members to work	25	20.83	VII
6	More conflicts and rivalry among the community	38	31.67	VI
7	Group disintegrates easily	42	35.00	V
8	Lack of regular meetings by the community	58	48.33	II
9	Poor participation of weaker sections in community activities	17	14.17	IX
10	Political interference in NRM	72	60.00	I
III	**Economic and financial**			
1	Inadequate financial support	106	88.33	I
2	High investment cost on farm machinery and land development	51	42.50	IV
3	Lack of assets like land, livestock, farm machinery etc.	12	10.00	VII
4	High investment cost on infrastructure adaptation (water storage structures etc)	85	70.83	II
5	Untimely release of funds to take up NRM activities	18	15.00	VI
6	Low annual income of farmers	79	65.83	III
7	Poor management of finance by the local bodies	45	37.50	V

4.6.1.2 Suggestions elicited by the NICRA farmers in adoption of technologies for CRA technologies

The Table 4.48 illustrated the suggestions elicited by the NICRA farmers were grouped under four categories namely Technical constraints, Social and personal, Economic and financial and situational. The constraints under each category were ranked based on frequency and percentage.

It is pointed out from the Table 4.48 that the major suggestions elicited by the NICRA farmers under Technical constraints were Regular de siltation activity should be done by the government to enhance the water storage capacity (80.83%) and Use of high yielding verities in drought conditions (86.67%); Organizing more training programmes by the department of agriculture with irrigation department to inculcate spirit for effective resource management (73.33%) under social and personal category; Increase the financial support from the government (90.00%) under economic category; Improve the extension activities like training programme, exposure visits etc for the farmers for adopting the CRA technologies (82.50%) under others category.

Table 4.48. Suggestions elicited by the NICRA farmers in adoption of technologies for CRA technologies

	Suggestions by NICRA farmers			N=120
S.NO	**Suggestions**	**F**	**%**	**Rank**
I	**Technical suggestions (technical complexicity, knowledge and skill)**			
a	**NRM**			
1	Water harvesting structures should be excavated by government in proper place	91	75.83	II
2	Regular de siltation activity should be done by the government to enhance the water storage capacity	97	80.83	I
3	Timely renovation of water harvesting structures	64	53.33	V
4	Proper utilization of labour for crop production purpose under NAREGA and not for the purpose of NRM activities	52	43.33	VI
5	Monitoring and evaluation by a team of officials and farmers while implementing the NRM activities	68	56.67	IV
6	Farmers participation in deciding the location of NRM activities and contribution of their resources for NRM	44	36.67	VII
7	Increase the number of trainings/ exposure visits to the officials and farmers on improving the suitable innovative NRM practices to local level	85	70.83	III
b	**Crop and livestock**			
1	Intercropping and mixed cropping	36	30.00	VI
2	Use of high yielding varieties suitable for drought conditions	104	86.67	I

b	**Crop and livestock**	**F**	**%**	**Rank**
3	Seed treatment	55	45.83	IV
4	Increase the number of trainings to extension officials and farmers on soil test based nutrient management to apply it at field level	42	35.00	V
5	Need to provide chop cutters to make small stubbles of crop to incorporate them in to the soil for crop residue	76	63.33	III
6	Need to provide more number of new suitable machines by the government	93	77.50	II
II	**Social and personal**			
1	Organizing more training programmes by the Department of Agriculture with Irrigation department to inculcate spirit for effective resource management	88	73.33	I
2	Organize farmer interactions frequently the farmers of nearby watershed area should be brought together to exchange the successful intervention of NRM activities	61	50.83	III
3	Officials should motivate the farmers for involving them in participatory mode to improve their problem solving skills	82	68.33	II
4	The women should be empowered to participate in various NRM activities	27	22.50	V
5	Organizations like youth clubs, and different other associations should work towards NRM consisting of organizational set up of their own in rural areas	55	45.83	IV
III	**Economic**			
1	Strengthening the NRM system by pooling up financial and non financial resources on community mode by government	57	47.5	V
2	The government should use the machines (JCB) to take NRM practices and give support to reduce drudgery of the labour	21	17.50	VI
3	Government and non government co-ordination mechanism for balanced utilization of funds to carry out CRA at village level	62	51.67	IV
4	Low cost water harvesting structures should be designed and advised to the farmer	93	77.50	II
5	Increase the financial support from the government	108	90.00	I
6	The local bodies should be financially empowered to take up some of the location specific, need based and customized NRM activities	75	62.50	III
IV	**Others/ Situational**			
1	Improve the extension activities like training programme, exposure visits etc for the farmers for adopting the CRA technologies	99	82.50	I
2	Recruitment of staff to attend and guide farmers on NRM activities	72	60.00	II
4	The officials should take up more follow up actions after completion of the implementation of NRM activities	42	35.00	IV
5	The local bodies especially groups should support morally, ethically and financially to take up various NRM activities under watershed area.	61	50.83	III

4.6.2 Problems and suggestions elicited by the non NICRA farmers in adoption of technologies for CRA

4.6.2.1 Problems elicited by the non NICRA farmers in adoption of technologies for CRA

The Table 4.49 illustrated the constraints elicited by the non NICRA farmers were grouped under three categories namely Technical constraints, Operational, Social and personal and Economic. The constraints under each category were ranked based on frequency and percentage.

It is pointed out from the Table 4.49 that the major constraints elicited by the NICRA farmers under technical constraints were Lack of more number of need based training on CRA technologies (90.00%); Top down approach is followed in designing and implementing the NRM activities (90.00%) and More crop loss (poor yields) from drought resistant short duration verities due to moisture stress (91.67%) under operational constraints; Overriding isolated approach over farmers spirit (81.67%) under social and personal constraints. High investment cost on farm machinery and land development (88.33%) under Economic constraints.

Table 4.49. Problems elicited by the non NICRA farmers in adoption of technologies for CRA

S. No	**Problems of non NICRA farmers**			N=120
	Constraints	**F**	**%**	**Rank**
I	**Technical constraints (technical complexicity, knowledge and skill)**			
1	Lack of awareness on climate resilient agriculture	24	20.00	VII
2	Poor availability of drought tolerant crop verities	53	44.17	VI
3	Lack of understanding of CRA technology due to more complexity	96	80.00	III
4	Lack of more number of need based training on CRA technologies	108	90.00	I
5	Lack of provision of demand driven technologies to improve the adoption	86	71.67	IV
6	Lack of timely information on weather forecast to plan the agricultural operations	82	68.33	V
7	Lack of knowledge on soil test based nutrient management	102	85.00	II
II	**Operational constraints**			
a	**NRM**			
1	De siltation activity is not regularly to take up enhance the water storage capacity due to low rain fall	78	65.00	IV
2	Poor renovation of soil and water conservation structures due to lack high rain fall (check dams, contour bunds, trenches,)	82	68.33	III
3	Poor maintenance of soil and water conservation structures due to lack of support from the institutions	92	76.67	II
a	**NRM**	**F**	**%**	**Rank**

4	Major canal water was not allowed for implementation of NRM activities due to excessive political interference	52	43.33	V
5	Top down approach is followed in designing and implementing the NRM activities	108	90.00	I
b	**Crop and livestock**			
1	More crop loss (poor yields) even from drought resistant short duration varities due to moisture stress	110	91.67	I
2	Lack of seed treatment	52	43.33	IV
3	Dee worming is irregular for sheep and goat	23	19.17	VI
4	Poor usage of organic manure	58	48.33	III
5	Using low quality seed	47	39.17	V
6	Non use of soil test based nutrient management	102	85.00	II
III	**Social and personal**			
1	Lack of confidence among the farmers to adopt the new CRA technologies due to fear of failure	69	57.50	IV
2	Lack of support from other social groups	86	71.67	III
3	Overriding isolated approach over farmers spirit	98	81.67	I
4	More conflicts and rivalry among the farmers	96	80.00	II
5	Poor participation of weaker sections	42	35.00	V
IV	**Economic and Financial**			
1	Inadequate financial support	92	76.67	III
2	High investment cost on farm machinery and land development	106	88.33	I
3	Lack of assets like land, livestock, farm machinery etc.	48	40.00	VII
4	High investment cost on infrastructure adaptation (water storage structures etc)	98	81.67	II
5	Lack of funds to take up NRM activities	51	42.50	VI
6	Low annual income of farmer	84	70.00	IV
7	Poor management of finance by the local bodies	50	41.67	V

4.6.2.2 Suggestions elicited by the NICRA farmers in adoption of technologies for CRA

The Table 4.50 illustrated the suggestions elicited by the non NICRA farmers were grouped under three categories namely Technical, Economic and situational. The constraints under each category were ranked based on frequency and percentage.

It is pointed out from the Table 4.50 that the major suggestions elicited by the non NICRA farmers under Technical constraints were Farmers participation in deciding the location of NRM activities and contribution of their resources for NRM (70.00%) and use of high yielding verities in drought conditions (79.17%). Increase the financial support from the government (89.17%) under economic category. Increase exposure visits/agritourism for the farmers and

officials to other successful NRM practice areas for better understanding of the technology (68.33%) under others/ situational category.

Table 4.50. Suggestions elicited by the non NICRA farmers in adoption of technologies for CRA

S. No	Suggestions by non NICRA farmers	N=120		
	Suggestions	**F**	**%**	**Rank**
I	**Technical suggestions**			
a	**NRM**			
1	Water harvesting structures should be excavated and renovated by government in proper place	77	64.17	II
2	Regular de siltation activity by the government to enhance the water storage capacity	68	56.67	III
3	Farmers participation in deciding the location of NRM activities and contribution of their resources for NRM	84	70.00	I
b	**Crop and livestock**			
1	Use of high yielding varieties suitable for drought conditions	95	79.17	I
2	Seed treatment	56	46.67	IV
3	Increase the number of trainings to extension officials and farmers on soil test based nutrient management to apply it at field level	88	73.33	II
4	Need to provide more number of new, suitable, low cost farm machines	86	71.67	III
II	**Economic and Financial**			
1	Low cost farm machinery and farm implements should be designed and supplied to the farmer	65	54.17	II
2	Increase the financial support from the government	107	89.17	I
3	The local bodies should be financially empowered to take up some of the location specific, need based and customized NRM activities	12	10.00	III
III	**Others/ situational**			
1	Increase the number of trainings to the officials and farmers for improving the knowledge and skills for proper utilization of the NRM activities	62	51.67	III
2	Improve the public private partnership to give the technical support to farmers	78	65.00	II
4	All line departments should work cooperatively to disseminate the information to the farmers	16	13.33	IV
5	Increase exposure visits/agritourism for the farmers and officials to other successful NRM practice areas for better understanding of the technology	82	68.33	I

4.7 Strategies for transfer of technologies for Climate Resilient Agriculture

Based on the findings of the study including the constraints and suggestions strategies have given to Extension (E), Research (R), Farmers (F) and Government (G) for transfer of CRA technologies. For effective transfer of technologies the Government, extension and research system should work cooperatively with Truth (T) and equal justice (J) and without bias and political interference these two

bodies should communicate, serve the farmers continuously and take feedback from the farmers. Monitoring and evaluation of any agricultural developmental programmes and policies related to CRA etc. then only the farmer may trust (T) the government and extension system.

4.7.1 Strategies for transfer of technologies to the NICRA villages for Climate Resilient Agriculture

Extension:

- More number of trainings, demonstrations, meetings and other extension activities should be taken up in the village only. This can be achieved by maintaining one village school in one central village for every selected five villages (V5 School) to reach to every farmer, through implementation of extension activities.
- Interested youth had to be identified and give them skill training and provide tabs, agricultural kit, knowledge product and also give them training on how to use the mass media like mobile apps down loading related to weather, marketing, pest and disease diagnosis. And also give trainings on computers with internet facilities to search the agriculture web portals and how to interact with scientist by asking queries.
- One information kiosk/V5 school or one ICT initiative/V5 school with interactive portal to communicate with scientist for further queries in V5 School (for five villages) along with one farm care manager, crop doctor and AEO for regular field visits and to solve the farmer's problems. The farm care manager should take care of the all farmers needs. The ICT initiative will give the information to farmers of five villages regarding CRA technologies.
- Computer with one computer operator should be necessary at V5school. In this computer village action plan (VAP) should be placed based on survey of farm holding, existing farming practices, farm size, soil health cards, socio economic status of farmers, availability of water and farm power etc. These all farmers details of five villages should be linked to the projects and developmental programmes which are running in the villages and also link this information to the PACS, cooperative banks/commercial banks and Pradhan Mantri Fasal Bima Yojana (PMFBY), NABARD and reserve bank for facilitating web based monitoring and evaluation of implementation of schemes related to crop insurance, crop loans and subsidies by providing them RUPEE card.
- Documented valued ITKs should be provided in the V5 school computers and share to the farmers of other villages.

Research:

- Research should be in participatory mode to validate climate prediction of ITKs blended with WBAAS and may be diffused through farmer to farmer extension.
- Research should be location specific and need-based research.
- Farmer's decision should be preferred prior to research development which ensures Participatory research development.
- Activities to be taken up for Documentation and validation of ITKs

Farmers:

- Farmers have to use a local contingency plans to cover new and evolving risk scenario due to climate change.
- Farmer should share the ITKs of CRA to the officials.
- Farmers have to get empowered and should form associations for different crops and fix the MSP for their produce with the help of Government and store their farm produce in godowns
- These farmer groups should use the social media to share the information to other farmers and these farmers should use mobile apps related to agriculture
- After cash crops farmers should grow catch crops for better absorption of nutrients from the soil and alternate rows with erosion resisting cover crops. (Ex. Ground nut + red gram followed by pear millet, cover crops like green gram, horse gram etc.)
- Farmers should follow Integrated farming systems. (agrisilvi/tree pastural/plantation grass) and periodic trampling of animal flocks to reduce the over grazing and to decay grass biologically. Through this farmer can minimise the over heat which is generated by sheep penning activity due to poor moisture availability in the soils to decompose manure.

Government:

- One Cooperative bank with one ATM facility and one primary agriculture cooperative society for five villages for easy access of subsidized inputs and crop loans and crop insurance to the farmers by providing them RUPEE cum ATM card.
- Government, NGOs and voluntary organizations' should work together for providing new farm machinery, management and operation of CHC in NICRA villages to reduce the drudgery of the farmers when there is labour scarcity for land preparation to harvesting of crop.
- A number of central/state government projects/schemes on water and soil conservation are running parallel to NICRA. Efforts should be made to converge these schemes with NICRA so as to obtain synergic impact.

- Government micro irrigation project should be converged with NHM, SHM (national and state horticulture mission) for efficient utilization of stored rainwater of farm ponds with micro irrigation.
- Speed up the MGNREGS and IWMP activities and merge these programmes with the NICRA for reducing the repetition and time for the NRM practices.
- In Nalgonda district of Telangana MGNREGS and Mission Kakatiya programmes of GOI can be converged for excavation of ponds and applying tank silt in light textured soils to provide higher moisture retention and improves the soil fertility.
- Inputs, repair shops related to agriculture implements and veterinary dispensary and other important resources should be provided by the Government.
- Provide sufficient fund to registered farmers associations of drought prone areas.
- Government has to bear the burden of marketing of farmers produce by colleting the produce from the godowns of farmers associations because most of the farmers are getting low yields from the rainfed crops and also they are exploited middle men. Government should create online marketing facility through licensed middle man by fixing the minimum support price. Then only the farmer may economically combat to drought and come forward to adopt more CRA technologies.
- In adopted villages de silting of defunct check dams and water harvesting structures are not in time as it is capital and labour intensive thus, can be converged with RKVY, MGNREGA, NHM and IWMP programmes of GOI.
- Empower the farmers by providing financial support to strengthen functioning of custom hiring centers, fodder bank, seed bank and VCRMC and motivate them by granting incentives for best performers.
- Farmers were facing problem to store farm equipments and machineries due to inadequate building facilities. Thus the need is for construction and renovation of building for CHC
- A godown and drying platform should be constructed for every five village.

4.7.2 Strategies for transfer of technologies to non NICRA villages for Climate Resilient Agriculture

STRATEGIES FOR EXTENSION PERSONNEL:

- Encouraging exposure visits for non-NICRA villagers to the NICRA project intervention sites in order to make them aware about climate resilient technologies and to see its benefits.

- Integration of mass media, mobile based information communication technology and other newer information delivery mechanisms to disseminate quick and timely information on aspects related to weather, market and climate resilient practices.
- Sensitization campaigns for judicious use of natural/community resources
- Capacity building of extension professionals in disaster management
- Development of farm literature exclusively for CRA.
- Promotion of early warning system for informed decisions and safe livelihood.
- Farmer-farmer extension strategy to promote awareness and adoption of best practices in CRA
- Use of ICTs such as interment, radio, television and media vans etc, to create awareness, on the CRA technologies
- Formation of Young Farmers Clubs (YFC) to educate and encourage the young farmers to adopt the CRA technologies.
- FFS to promote faster learning by farmers to mitigate and adopt CRA technologies.

STRATEGIES FOR FARMERS:

- Drought prone area farmers should have registered associations under Government to access government funds and MSP for rainfed crops etc
- Farmers should maintain commodity groups for quick dissemination of CRA technologies.
- Farmers should have healthy competition and co-operation among them
- They have to be self motivated and have to be formed as communities for better adoption of CRA technologies
- Share their local technologies with other fellow farmers and with the officials

STRATEGIES FOR GOVERNMENT:

- Youth should be encouraged by providing large area with license to cultivate and also providing facilities like modern new farm implement/machinery and free seeds, advisory services to them by the scientist, to prevent youth migration from drought prone areas.
- Below poverty line farmers have to be provided an amount of Rs.10,000/- before kharif season.
- Rainwater management interventions like water harvesting structures are capital and labour intensive thus, can be converged with RKVY, MGNREGA, NHM and IWMP programmes of GOI.

- Government has to develop an ICT named “e-insure farmer” and merged with weather based crop insurance scheme for government support for proper implementation, to give details about crop insurance and weather report timely to the insured farmers, who lost their crop due to weather aberrations, in this farmers details have to be computerized and bioinformatics has to be used to take farmers finger prints for proper implementation. It has to be utilized for both purposes, information portal cum ATM to facilitate the framers. Through this every farmer can get a chance to take crop insurance.
- Agriculture related to policies such as disaster management, land and water, food security etc should be synergistically converged at the grass root level, so that system becomes more climate resilient.
- Seed village concept programme can be adopted for the production of quality seeds and to ensure its availability.
- NICRA should conduct intensive awareness programmes on climate change and its impact on agriculture in Non NICRA areas also.

4.8 EMPIRICAL MODEL OF THE STUDY

The conceptual model formulated (Fig 2.1) for this study was tested based on the results and empirical model was developed and is presented in Figure 4.47.

The model was hopefully conceived to understand the adoption of farmers towards CRA technologies. This model was tested with the help of multiple regression analysis to find out relationship and extent of variation between selected profile characteristics and dependent variables Farming systems, risk taking ability were positively highly significantly influencing the adoption in overall NICRA, where as in overall non NICRA farming experience, availability of water resources, farming systems were positively significantly influencing the adoption.

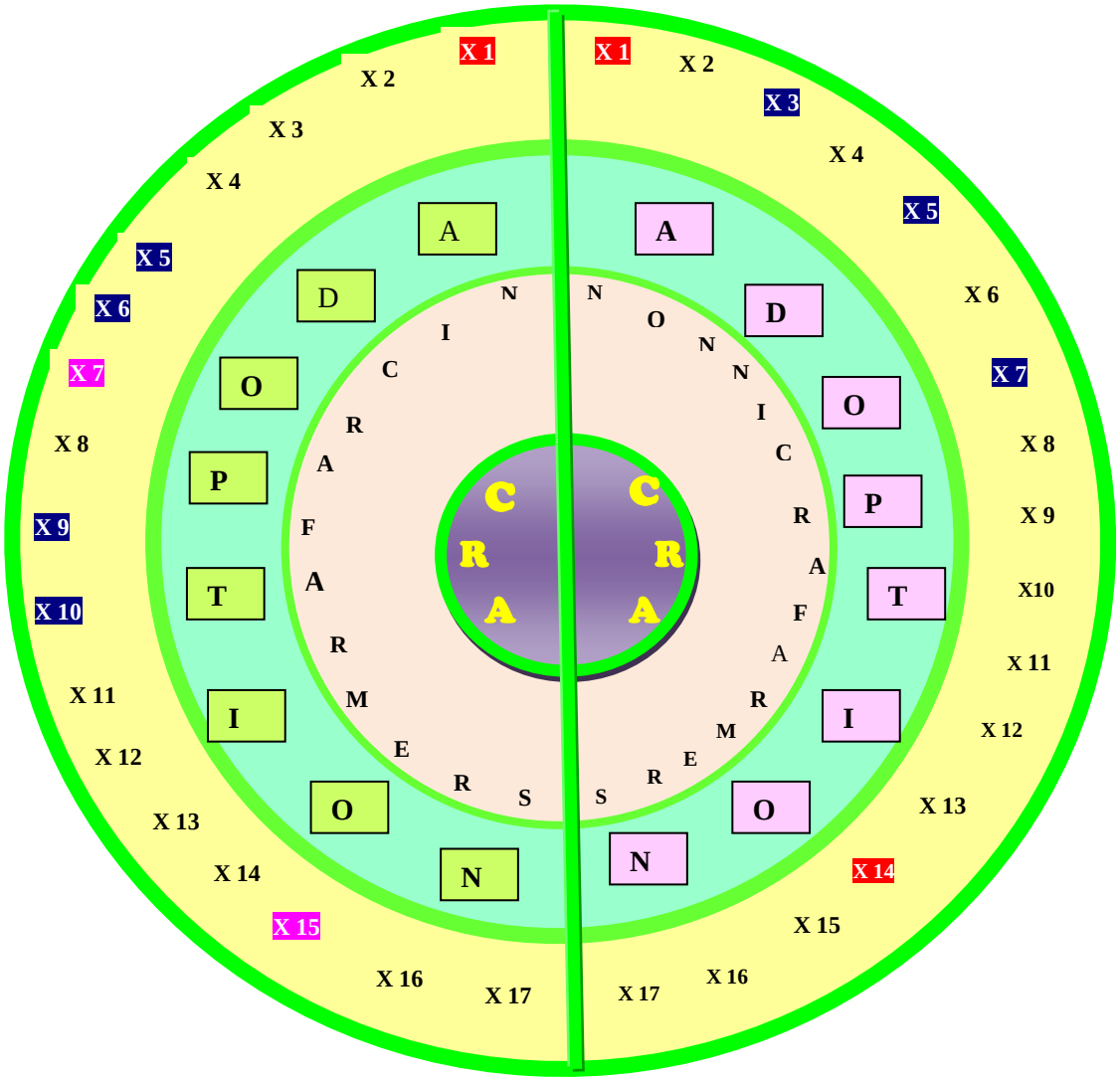


Figure 4.47 Empirical model of the study

Profile Characteristics	
Age	X1
Education	X2
Farming experience	X3
Farm size	X4
Availability of water resources	X5
Frequency of occurrence of drought	X6
Farming systems	X7
Socio Economic Status	X8
Social affiliation	X9
Trainings undergone on CRA.	X10
Sources of Information Utilisation	X11
Credit availability	X12
Food security	X13
Traditionalism	X14
Risk taking ability	X15
Weather based Agro Advisory services	X16
Community Infrastructural facilities	X17

Font colour Represent Correlation

Blue- +ve, significant at 1%, Pink- +ve, significant at 5 %, Red- (-ve)

A-Action

R- Reaction

C- continuous

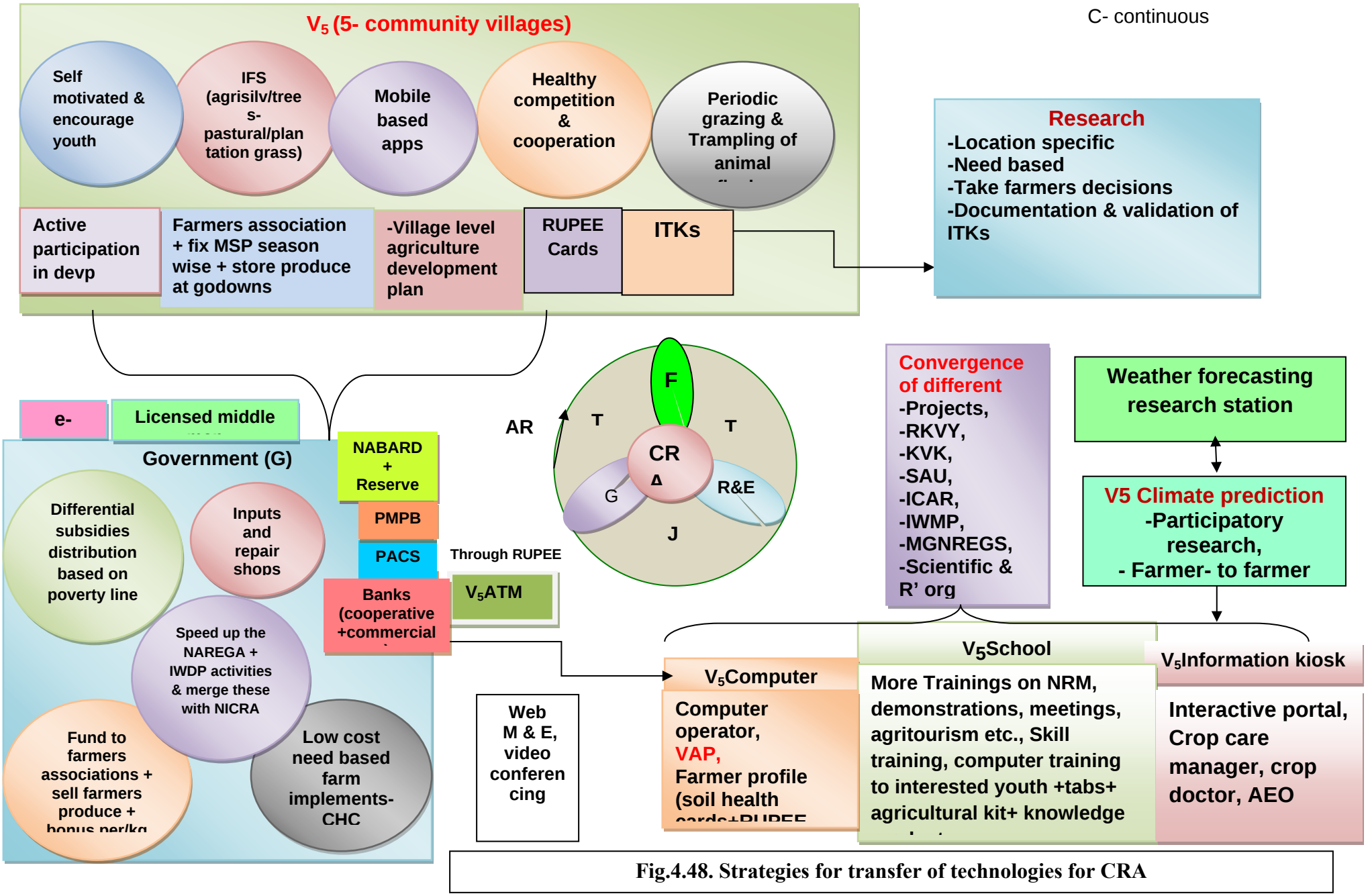


Fig.4.48. Strategies for transfer of technologies for CRA

CHAPTER V

SUMMARY AND CONCLUSIONS

Resilience is the ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions. Planned adaptation is essential to increase the resilience of agricultural production to climate change. Several improved agricultural practices evolved for diverse agro-ecological regions in India have potential to enhance climate change adaptation, if deployed prudently. Management practices that increase agricultural production under adverse climatic conditions also tend to support climate change adaptation because they increase resilience and reduce yield variability under variable climate and extreme events. The isolated approach does not yield expected results whereas community based management derives maximum benefits to the farmers in terms of soil, water and moisture conservation for sustainable use of these resources for better crop production. Keeping this in view the present investigation entitled as "A study on Adaptive capacity and technologies adopted by farmers for Climate Resilient Agriculture in drought prone areas" was undertaken with the following objectives.

5.1 OBJECTIVES OF THE STUDY

1. To study profile characteristics of respondents.
2. To analyze the rural settings on changing climate through participatory approaches.
3. To assess the adaptive capacity of farmers in terms of their climate readiness and attitude of respondents towards Climate Resilient Agriculture technologies.
4. To find out the respondents level of adoption of Climate Resilient Agriculture technologies and coping mechanisms for Climate Resilient Agriculture.
5. To study the relationship between profile characteristics of respondents and level of adoption of Climate Resilient Agriculture technologies.
6. To study the problems and suggestions elicited by the respondents in adoption of technologies for Climate Resilient Agriculture.
7. To suggest strategies for transfer of technologies for Climate Resilient Agriculture.

5.2 METHODOLOGY

Ex-post facto research design was adopted in the present investigation. Nalgonda district from the Telangana state and Anantapur district from the Andhra Pradesh state were selected purposively, as they were covered under NICRA where the CRA technologies introduced. One mandal was purposively selected from each district for the study. Two NICRA adopted villages and two non NICRA villages were selected from each mandal. Thus total four NICRA villages and four NON NICRA villages were selected the study. 30 farmers from each village were selected at random to make a sample of 120 respondents from NICRA adopted villages and 120 respondents from non NICRA villages for the study.

5.3.0 SALIENT FINDINGS

5.3.1 Profile characteristics of respondents

Majority (73.33%) of NICRA farmers belonged to middle age followed by old (14.17%) and young age (12.50%) category. In Non NICRA majority (80.83%) of farmers belonged to middle age followed by young (13.33%) and old age (5.83%) category.

Majority (27.50%) of the NICRA farmers were illiterates followed by primary school education (21.67%), high school education (19.17%), intermediate (15.00), graduation and above (10.00) and upper primary school (6.67). while in case of non NICRA majority (52.50) of farmers were illiterates followed by high school education (19.17), primary school (9.17), graduation and above (7.50) and upper primary school (6.67).

Majority (69.17%) of respondents of NICRA were fell under medium farming experience followed by low (18.33%) and high (12.50%). While in case of non NICRA majority (61.67%) of the farmers were belonged to medium followed by high (21.67%) and low (16.67%).

More number (60.00%) of respondents of NICRA were belonged to semi medium farm size followed by medium (26.67%), small (10.83%), marginal (1.67%) and large (0.83%). Whereas more number (42.50%) of respondents of non NICRA were belonged to medium followed by semi medium (20.83%), small (20.00%), marginal (16.67%) and none of them found to be large farmers.

Majority (97.50%) of the NICRA farmers were belonged to rainfed farmers. Among them about 55 per cent of farmers was giving irrigation to the fields only in critical stages by using mostly bore wells (60.00%). Where as in non NICRA majority (99.17%) of the farmers were belonged to rainfed farmers among them only few farmers (26.67%) were giving irrigation to the fields only in critical stages by using mostly bore wells (65.83%).

Majority (40.00%) of NICRA famers got drought once in three years followed by once in two years (36.67%) and yearly once (23.33%), whereas in non NICRA majority (39.17%) of farmers got drought once in two years followed by yearly once (32.50%) and once in three years (28.33%).

Majority (82.50%) of NICRA farmers had >1 crop (Ag or Horticultural crops) followed by Ag crops + Horticultural crops + AH/poultry / goat (53.33%), Ag+Hort (29.17%) and Ag crops + Horticultural crops + AH/poultry / goat+ mulberry (10.00%). Whereas in non NICRA majority (53.33%) of them had >1 crop (Ag or Horticultural crops) followed by Ag crops + Horticultural crops + AH/poultry / goat (45.00%) and Ag+Hort (37.50%).

Majority (82.50%) of NICRA farmers were belonged to medium socio economic status followed by low (15.00%) and high (2.50%). Whereas in non NICRA majority (60.00%) of them were from low socio economic status followed by medium (40.00%).

Majority (54.17%) of the NICRA farmers had high social affiliation followed by medium (32.50%) and low (13.33%). Whereas in non NICRA majority (60.00%) of farmers had medium followed by low (27.50%) and high (12.50%).

Majority (78.33%) of the NICRA farmers had undergone training programmes followed by 21.67 per cent of respondents not undergone any training programme. Whereas in non NICRA majority (77.50%) of farmers had not undergone any training programme. Only, 22.50 per cent of farmers had undergone training programmes.

Majority (65.83%) of the NICRA farmers had medium sources of information utilisation followed by low (24.17%) and high (10.00%). Whereas in non NICRA majority (67.50%) of farmers had low followed by medium (30.00 %) and high (2.50%).

Majority (60.83%) of the NICRA farmers had received average number of loans followed by less number (36.67%) and 2.50 per cent had taken more number of loans. Whereas in non NICRA majority (45.83%) of farmers had received less number of loans followed by average number of loans (40.83%) and more number of loans (13.33%).

Majority (75.83%) of the NICRA farmers had medium food security followed by high (20.00%) and low (4.17%). Whereas in non NICRA majority (58.33%) of farmers had medium followed by low (37.50%) and high (4.17%).

Majority (85.00%) of the NICRA farmers had low traditionalism followed by medium (13.33%) and high (1.67%). Whereas in non NICRA majority (56.67%) of farmers had medium followed by low (37.50%) and high (5.83%) traditionalism.

Majority (55.00%) of the NICRA farmers had high followed by medium (44.17%) and low (0.83%) risk taking ability. Whereas in non NICRA majority (55.00%) of farmers had medium followed by low (42.50%) and high (2.50%) risk taking ability.

Majority (50.00%) of the NICRA farmers got medium followed by low (43.33%) and high (6.67%) WBAAS. Whereas in non NICRA majority (100.00%) of farmers got low and none of they found to be medium and high WBAAS.

Majority (50.83%) of the NICRA farmers had medium followed by high (49.16%) community infrastructural facilities, whereas in non NICRA majority (85.00%) of farmers had low followed by medium (15.00%) community infrastructural facilities.

5.3.2 Rural settings on changing climate through participatory approaches

The gathered information from PRA techniques which have conducted in two NICRA adopted villages in Ananthapur district was, these farmers excavated more number of percolation tanks, constructed check dams. Farmers had sown ground nut crop in first fort night of July with 20 mm rainfall only. Some farmers had sown sorghum, green gram, korra and guar crop in the month of second fort night of August, as contingent crops. Farmers were also cultivating on the slopes using with stone bunds and contour cultivation and dug out contour trenches on hills. And also one solar plant was present in the village. In case of NICRA villages of Nalgonda, farmers were excavated farm pond and constructed check dams. Some farmers had sown sorghum as contingency crop in the month of September, crop diversification through vegetables. Fodder (APBN-1) cultivation with supplemental irrigation with drips and also azolla rings were present in some areas. The community farmers of Nandyala Gudem village shifted their paddy cultivation to mulberry by giving irrigation through drip system. And also one chawki center was present for rearing the sericulture worms, KVK office with CHC was located to hire the farm implements. One mineral water plant, resources like azolla rings, vermi compost units and farm implements were present.

The gathered information from triangulation of PRA techniques which have conducted in four non NICRA villages of Anantapur was these farmers had done NRM

practices but they did not renovate and repair. In these villages rainfed crop (ground nut) failure was the common phenomenon due to occurrence of dry spell. In the month of September some farmers had sown sorghum as contingency crop. In these villages sweet orange, sapota, watermelon and vegetables were grown by giving supplemental irrigation. In case of Nalgonda, famers had poor infra structural facilities. Only Water tanks and one Sarva Shiksha Abhiyan school were present in these Thanda areas. They were cultivating cotton and chilli crop under rainfed only, due to low rainfall their bore wells also dried up. In the month of September some farmers had sown sorghum as contingency crop for grain and fodder purpose.

5.3.3 Adaptive capacity of farmers in terms of their climate readiness and attitude of respondents towards Climate Resilient Agriculture technologies

Majority (69.17%) of the NICRA farmers had high climate readiness followed by medium (16.67%), low (7.50%), very high (5.83%) and very low (0.83%) climate readiness. Whereas in non NICRA majority (54.17%) of farmers had low followed by medium (34.17%), very low (10.00%) and high (1.67%) climate readiness.

Majority (59.17%) of the NICRA farmers had favourable attitude followed by highly favourable (20.83%), moderately favourable (18.33%) and un favourable (1.67%). Whereas in non NICRA majority (47.50%) of farmers had highly un favourable attitude followed by un favourable (46.67%), moderately favourable (5.00%) and favourable (0.83 %).

On the whole the majority (49.17%) of the NICRA farmers had very high Adaptive capacity followed by high (42.50%), medium (5.83%) and low (0.83%). Whereas in non NICRA majority (50.83%) of farmers had low followed by medium (33.33%), very low (14.17%) and high (1.67%).

Mann-Whitney U test was employed to find out the difference between the adaptive capacity among the NICRA and Non NICRA. The respondents of NICRA and Non NICRA with mean rank 179.34 and 61.66 respectively so here the results were showing the better adaptive capacity by NICRA farmers when compare to the Non NICRA farmers. The results were found to be significant at $p<0.01$ level of significance. Hence there is significant difference between NICRA and non NICRA farmers in their adaptive capacity.

5.3.4 Respondents level of adoption of Climate Resilient Agriculture technologies and coping mechanisms for Climate Resilient Agriculture

Majority (66.67%) of the NICRA farmers had medium followed by high (25.00%) and low (8.33%) level of adoption of NRM. Whereas in non NICRA majority (85.83%) of farmers had low followed by medium (14.17%) and none of them found to be high adoption of NRM technologies.

Majority (79.17%) of the NICRA farmers had medium followed by high (17.50%) and low (3.33%) level of adoption of Crop production technologies. Whereas in non NICRA majority (62.50%) of farmers had low followed by medium (37.50%) and none of them found to be high adoption of Crop production technologies.

Majority (60.83%) of the NICRA farmers were belonged to medium followed by low (30.83%) and high (8.33%) adoption of live stock technologies. Whereas in non NICRA majority (69.17%) of farmers was belonged to low followed by medium (30.83%) and none of them found to be high adoption of live stock technologies.

Majority (60.83 %) of the NICRA farmers were belonged to high followed by medium (39.17%) and none of them found to be low adoption of institutional interventions. Whereas in non NICRA cent per cent (100.00 %) of farmers were belonged to low. None of them found to be medium and high adoption of institutional interventions.

On the whole the majority (44.20%) of the NICRA farmers were belonged to medium followed by high (30.00%) and low (25.80%) level of overall adoption of CRA technologies. Whereas in non NICRA majority (80.80%) of farmers were belonged to low followed by medium (19.20%) level of overall adoption.

Majority (85.83%) of the NICRA farmers were belonged to high followed by medium (14.17%) adoption of coping mechanisms. Whereas in non NICRA majority (95.83%) of farmers were belonged to low followed by medium (4.17%) adoption of coping mechanisms.

Majority (70.00%) of the NICRA farmers were belonged to high followed by medium (30.00%) adoption of CRA technologies and coping mechanism. Whereas in non NICRA majority (71.67%) of farmers were belonged to low followed by medium (28.33%) adoption of CRA technologies and coping mechanism.

Kruskal-Wallis test was employed to find out the comparison of adoption of four components of CRA technologies among NICRA and Non NICRA farmers discretely for

Ananthapur and Nalgonda districts results revealed that there was significant difference between the all components of adoption of technologies among NICRA and non NICRA of Ananthapur at $p<0.01$ level of significance, whereas in Nalgonda there was significant difference between NRM, livestock and institutional interventions among NICRA and non NICRA at $p<0.01$ level of significance. But in crop related technologies there was no significance difference among NICRA and Non NICRA farmers in Nalgonda at $p<0.01$ level of significance.

Mann-Whitney U test was employed to find out the difference between the overall level of adoption of CRA technologies among the NICRA and Non NICRA. Results revealed that there was significant difference between the overall level of adoption of CRA technologies at $p<0.01$ level of significance.

Mann-Whitney U test was employed to find out the difference between the overall level of adoption of CRA technologies and coping mechanisms among the NICRA and Non NICRA. Results revealed that there was significant difference between the overall level of adoption of CRA technologies and coping mechanism among NICRA and Non NICRA at $p<0.01$ level of significance.

5.3.5 Relationship between profile characteristics of respondents and level of adoption of CRA technologies

5.3.5.1 Relationship between profile characteristics of respondents and level of adoption of CRA technologies of NICRA farmers of Ananthapur

Out of 17 independent variables availability of water resources, farming systems ,social affiliation, training undergone on CRA, risk taking ability had showed positive and highly significantly correlated at $p<0.01$ level of significance, Where as frequency of occurrence of drought, source of information utilization farming experience exhibited positive and significant relationship with adoption of CRA technologies at 5 per cent level of significance. While education, farm size, socio economic status, credit availability, food security, traditionalism, weather based agro advisory services, and community infrastructural facilities showed positive and non significant relationship with the adoption. Age found to be negative and non significant relationship with the adoption.

5.3.5.2 Relationship between profile characteristics of respondents and level of adoption of CRA technologies of non NICRA farmers of Ananthapur

Out of 17 independent variables availability of water resources, farming systems, source of information utilization had showed positive and significant relation with

adoption at p<0.05 level of significance. Traditionalism had showed negative and significant relation with adoption at at p<0.05 level of significance. But the remaining variables such as education, farming experience, farm size, frequency of occurrence of drought, socio economic status, social affiliation, training undergone on CRA, credit availability, food security, risk taking ability, weather based agro advisory services and community infrastructural facilities were showing positive relation with level of adoption technologies but not significant.

5.3.5.3 Relationship between profile characteristics of respondents and level of adoption of CRA technologies of NICRA farmers of Nalgonda

Out of 17 independent variables availability of water resources, farming systems, training undergone on CRA, risk taking ability had showed positive and highly significantly correlated at p<0.01 level of significance, Where as socio economic status, social affiliation, source of information utilization exhibited positive and significant relationship with adoption of CRA technologies at 5 per cent level of significance. While education, farm size, frequency of occurrence of drought, food security, traditionalism, weather based agro advisory services, and community infrastructural facilities showed positive and non significant relationship with the adoption. Age found to be negative and non significant relationship with the adoption.

5.3.5.4 Relationship between profile characteristics of respondents and level of adoption of CRA technologies of non NICRA farmers of Nalgonda

Out of 17 independent variables availability of water resources, farming systems, and credit availability, had showed positive and significant relation with adoption at p<0.05 level of significance. Traditionalism had showed negative and significant relation with adoption at at p<0.05 level of significance. But the remaining variables such as education, farming experience, farm size, frequency of occurrence of drought, socio economic status, social affiliation, training undergone on CRA, source of information utilization, food security, risk taking ability, weather based agro advisory services and community infrastructural facilities were showing positive relation with level of adoption technologies but not significant. Age showed negative and non significant relation with adoption.

5.3.5.5 Relationship between profile characteristics of respondents and level of adoption of CRA technologies of both NICRA farmers of Ananthapur and Nalgonda

All the selected 17 independent variables such as age, education, farming experience, farm size, availability of water resources, frequency of occurrence of drought, farming systems, socio economic status, social affiliation, training undergone on CRA, source of information utilization, credit availability, food security, weather based agro advisory services and community infrastructural facilities together explained the variation to the extent of 64.30 per cent. The F value 8.41 was found to be showing significant variation. Farming systems and risk taking ability were significantly influencing at $p<0.01$ level of significance with calculated t values 2.83 and 2.76 respectively. While Availability of water resources , frequency of occurrence of drought, social affiliation and training undergone on CRA had positive and significant relation with the adoption at $p<0.05$ level of significance with calculated t values 2.09, 2.12, 2.04 and 2.15 respectively.

5.3.5.6 Relationship between profile characteristics of respondents and level of adoption of CRA technologies of both non NICRA farmers of Ananthapur and Nalgonda

All the selected 17 independent variables such as age, education, farming experience, farm size, availability of water resources, frequency of occurrence of drought, farming systems, socio economic status, social affiliation, training undergone on CRA, source of information utilization, credit availability, food security, weather based agro advisory services and community infrastructural facilities together explained the variation to the extent of 32.3 per cent. The F value 1.92 was found to be showing no significant variation. Farming experience, availability of water resources, farming systems had positive and significant relation with adoption at $p<0.05$ level of significance with calculated t values 1.96, 2.19 and 2.17 respectively.

5.3.6 Problems and suggestions elicited by the respondents in adoption of technologies for Climate Resilient Agriculture

Major problem elicited by the NICRA farmers were poor renovation of soil and water conservation measures due to lack of rain fall (check dams, contour bunds, trenches) (93.33%), poor availability of required inputs to all the farmers (95.83%), political interference in NRM (60.00%) and inadequate financial support (88.33%).

Major suggestions expressed by the NICRA farmers were regular desiltation activity should be done by the government to enhance the water storage capacity (80.83%), use of high yielding verities in drought conditions (86.67%), organizing more training programmes by the department of agriculture with irrigation department to inculcate spirit for effective resource management (73.33%), increase the financial support from the government (90.00%) and improve the extension activities like training programme (82.50%).

Major problem elicited by the non NICRA farmers were lack of more number of need based training on CRA technologies (90.00%), top down approach is followed in designing and implementing the NRM activities (90.00%), more crop loss (poor yields) from drought resistant short duration verities due to moisture stress (91.67%), overriding isolated approach over farmers spirit and high investment cost on farm machinery and land development (88.33%). Major suggestions expressed by the non NICRA farmers were farmers participation in deciding the location of NRM activities and contribution of their resources for NRM (70.00%), use of high yielding verities in drought conditions (79.17%), increase the financial support from the government (89.17%) and increase exposure visits/agritourism for the farmers and officials to other successful NRM practice areas for better understanding of the technology (68.33%).

5.3.7 Strategies for transfer of technologies for Climate Resilient Agriculture

Taking into cognizance the findings generated on selected objectives of the study, a suitable extension strategy was formulated to both NICRA and non NICRA groups by suggesting possible interventions for the NICRA, NAREGA, IWMP, DWMA, Government, SDA, SAU, individual farmers and local bodies in the state of Andhra Pradesh and Telangana.

5.4 IMPLICATIONS OF THE STUDY

Following are the implications of the investigation by suggesting various measures involving different agencies/organizations/departments by sensing the results accrued from the study to strengthen the NICRA in drought areas in the state of Andhra Pradesh and Telangana.

1) The study shows that majority of the NICRA farmers were middle aged, illiterate, hence there is every need to attract youth by creating more avenues and enterprise based activities in agriculture.

2) Majority of the respondents were semi medium. The CRA technologies should be developed to suit the needs and requirements of these farmers. Especially, the technologies should be user friendly, low cost and compatible.
3) The study proved that the combination of the participatory tools like resource map, agro-ecology amp, transect walk, seasonal calendar are more useful in identifying and prioritizing problems as well as to generate qualitative data instead of using traditional data collection methods which are more time consuming.
4) The study will be useful for assessing the impact of CRA technologies in other parts of the country.
5) The finding of the study will provide feedback to the institutions engaged in dissemination of CRA technologies under NICRA for further redesigning the interventions, in order to improve its output and outcome.
6) The officials of NICRA should sensitize the farmers to understand various kinds of changes happening in the climate and its effects on NRM.
7) The officials of NICRA should instill the spirit of team work among the farmers in attending various activities to derive maximum benefit.
8) The officials of NICRA should strive hard to enhance the adoption quotient of the CRA technologies.
9) A regulatory body must be formed with the officials and farmers to supervise various NICRA.
10) NICRA group farmers should be net worked to share any reliable information on CRA technologies among all the members in the groups.
11) The extent of adoption of the CRA technologies is medium because of financial support provided by the government, where as the maintenance of these technologies is poor. Hence the officials of NICRA should provide continuous technical advice and supportive mechanism to sustain these CRA technologies.
12) The study will be useful for developing the resilience index for further assessing the level of resilience of stakeholders.
13) There is an earnest need to strengthen the coordination among farmers –extension personal and researchers. Farmers should be involved in technology design or modification stages, so that need based technologies appropriate to all socio economic status can be developed.

5.5 POINTS SUGGESTED FOR FUTURE RESEARCH

1. Sample size may be increased by selecting three more districts to generalize the results.
2. The present study was conducted in only two districts in two selected states. Similar studies may be under taken in other districts and in other agro ecosystems across the country to assess the impact of CRA technologies.
3. There is also a need to document and analyse the diffusion of these technologies and the factors associated in diffusion.
4. It is also important to study whether the farmers further refined these technologies to suit to the specific problem situation.
5. The vulnerability of the farmers and other stakeholders as well as their resilience may be studied and documented for the benefit of the researchers and the policy makers to design appropriate strategies.

LITERATURE CITED

Acquah-de Graft, H. 2011. Farmers' perceptions and adaptation to climate change: a willingness to pay analysis. *Journal of Sustainable Development in Africa*. 13(5):150-161.

Agricultural census. 2011. http://agcensus.nic.in

Agwu, A.E., Dimelu, M.U and Madukwe, M.C. 2008. Innovation system approach to agricultural development: policy implications for agricultural extension delivery in Nigeria. *African Journal of Biotechnology*. 7(11):1604-1611.

Ahmed, S. 2013. Factors and constraints for adopting new agricultural technology in Assam with special reference to Nalbari district: An empirical study. Accessed on October 30, 2015 from http://jocipe.com/jocipel .html

Akponikpe, P., Johnston, P and Agbossou, E. K. 2010. Farmers' perceptions of climate change and adaptation strategies in Sub-Sahara West Africa. 2nd International Conference on Climate, Sustainability and Development in Arid Regions, Fartaleza-Ceara, Brazil.

Alam, MR., Sarker, R.I., Hossain, M.D and Islam, M.S. 2000. Contribution of livestock to small farms in Bangladesh. *Asian Australasian Journal of Animal Science.* 13(suppl.):339-342.

Ananta Vashisth, R., Singh, D., Das, K and Baloda, R. 2013. Weather based agromet advisories for enhancing the production and income of the farmers under changing climate scenario. *International Journal of Agriculture and Food Science Technology*. 4 (9): 847-850.

Anil Kumar, R and Indira, H. 2007. Multiple impacts of droughts and assessment of drought policy in major drought prone states in India. Project Report Submitted to: The Planning Commission, Government of India, New Delhi.

Anil, K., Kushwaha, T.S., Singh, Y.K and Rai, D.P. 2010. Adoption of watershed technologies by the farmers in Morena district of Madhya Pradesh. *Indian Research Journal of Extension Education*. 10(2): 58-60.

Anitha, B. 2004. A study on entrepreneurial behaviour and market participation of farm women in Bangalore rural district of Karnataka. *M.Sc. (Ag.) Thesis*. University of Agricultural Science, Bangalore, India.

Antara, D., Goswami, A., Minati Sen and Mazumder, D. 2009. Study on the effect of socio-economic parameters on health status of the Toto, Santal, Sabar and Lodha tribes of West Bengal, India. *Stud Tribes Tribals*. 7(1): 31-38.

Antle, J.M and Diagana, B. 2003. Creating incentives for the adoption of sustainable agricultural practices in developing countries: The role of soil carbon sequestration. *American Journal of Agricultural Economics.* 85(5): 1178-1184.

Apata, T. G., Samuel, K.D and Adeola, A.O. 2009. Analysis of climate change perceptions and adaptation among arable food crop farmers in South Western Nigeria. Contributed paper presented at 23rd Conference of International Association of Agricultural Economists, Beijing, China, August 16-22.

Archana, P. 2012. A study on farmers adaptability to climate variability in Castor in Mahaboobnagar district of Andhra Pradesh. *M.Sc. (Ag.) Thesis*. Acharya N G Ranga Agricultural University, Hyderabad, India.

Awais, M. 2007. Socio-economic status of tribal farmers a case study of the Bhaxa tribe in Bijnor district, U.P. *International Journal of Rural Studies*. 14(1): 1-4.

Baethgen, W.E., Meinke, H and Gimene, A. 2003. Adaptation of agricultural production systems to climate variability and climate change: lessons learned and proposed research approach. Paper presented at Climate.net conference 'Insights and Tools for Adaptation: Learning from Climate Variabilty', 18-20 November, 2003, wasgington, DC.

Barik, K.C., D. Mohanty, S.K. Nath, S.K. Sahoo and Laba Soren. 2010. Assessment of integrated farming system for rainfed agro ecosystem in Deogarh district of Orissa. In: Extended summaries of XIX National Symposium on Resource management approaches towards livelihood security, Bengaluru, Karnataka, Dec. 2-4. pp: 172.

Benhin, J.K.A. 2006. Climate Change and South African Agriculture: Impacts and Adaptation Options. CEEPA Discussion Paper No. 21, Pretoria, South Africa: Centre for Environmental Economics and Policy in Africa, University of Pretoria.

Bhardwaj,G., Barbora, A., Vasanth, T., Praveena, T., Arpita,M., Poonam Rao,J and Usha Kulkerni. 1995. Report of PRA training workshop in Somaghatta vilgae Swathi Water Shed Chilamathur mandal, Ananthapur district of Andhra Pradesh, June 13-18.

Bhaskaran, K and Praveena, C. 1982. Adoption of improved dryland agricultural technology in an Integrated Dryland Agriculture Development Project in Andhra Pradesh. *Indian Journal of Extension Education*. 18:32-39.

Bindu. S. 2001. Participation of tribal women in income generating activities in Ranchi district of Bihar. *M.Sc. (Ag.) Thesis.* Acharya N. G. Ranga Agricultural University, Hyderabad, India.

Blanco, H and Lai, R. 2008. Principles of soil conservation and management. New York: Springer. pp-1-19.

Bradshaw, B., Dolan, H and Smit, B. 2004. Farm-level adaptation to climate climatic variability and change: crop diversification in the Canadian Prairies. *Climatic Change*. 67: 119-141.

Branca, G., McCarthy, N., Lipper, L and Jolejole, M. 2011. Climate-smart agriculture: A synthesis of empirical evidence of food security and mitigation benefits of improved cropland management. Rome, FAO.

Census. 2011. Census of India Ministry of Home Affairs. http://www.censusindia.gov.in/2011-Common/CensusData2011.html

Chakraborty, S., Baksi, A and Verma, A.K. 2012. Rural infrastructure availability and wellbeing. *Journal of Regional Development and Planning*. 1(2):169-179.

Chandrashekhar, S.K. 2007. Analysis of onion production and marketing behaviour of farmers in Gadag district, Karnataka. *M.Sc. (Ag.) Thesis.* University of Agricultural sciences, Bangalore, India.

Chataway, R.G., Doogan, V.J and Strong, W.M. 2003. A survey of dairy farmers practices and attitude towards some aspects of arable land management in Darling down and South Burnett region of Queensland. *Australian Journal of Experimental Agriculture*.43:449-457.

Chidananda, M. 2008. A study on Entrepreneurial behaviour of dryland farmers in Karnataka State. *M.Sc. (Ag.) Thesis.* Acharya N.G. Ranga Agricultural University, Hyderabad, India.

Chinnam Naidu. 2012. A Study on Farming performance and Entrepreneurial behaviour of sugarcane farmers in north coastal zone of Andhra Pradesh. *Ph. D. Thesis*. Acharya N.G. Ranga Agricultural University, Hyderabad, India.

Chitra, B. M. 2010. Study on knowledge and adoption of improved practices in selected farming systems of mandya district. *M.Sc. (Ag.) Thesis.* University of Agricultural Sciences, Bangalore. India.

Conway, R.1987. Rapid Rural Appraisal and Agro Ecosystem Analysis-A case study from northern Pakistan in Khon Kaen University Proceedings of the 1985 International Conference on Rapid Rural Appraisal, Khon Kaen University,Thailand. pp-266-274.

Cumba, R., Muai, G., Vander Valden, M., Vaz, N and Carrilho, L. 2009. Estudo de base. [Baseline Study] for the joint programme on Environmental Mainstreaming and Adaptation to Climate Change in Mozambique. United Nations World Food Programme (WFP), Maputo.

Das, S.K. 2001. Prospect and potentiality for goat farming in north eastern region of India-a review. *Agriculture Review*. 22(3/4): 228-233.

Debbarman, P. 1991. Tribal society in India: A study of Santhals. *Folklore*. 32(3); 82-85.

Deressa, T., Hassan, R., Ringler, C., Alemu, T and Yesuf, M. 2008. Analysis of the determinants of farmers' choice of adaptation methods and perceptions of climate change in the Nile Basin of Ethiopia. IFPRI Discussion Papers No. 798, International Food Policy Research Institute, Washington DC.

Devendra, C. 2000. Animal production and rainfed agriculture in Asia: Potential opportunities for productivity enhancement. *Outlook on Agriculture.* 29:161 -175.

Doli, S. 2006. Sustainability of natural resource management in watershed development project. *Ph.D Thesis*. University of Agricultural Sciences, Dharwad, India.

Economic survey. 2014-2015. Economic survey. Ministry of Finance. Government of India.

Edwards, A. L. 1969. *Techniques of Attitude Scale Construction*. Vakils, Feffer and Simons private ltd. Bombay.

Edwards, A.L and Kilpatrick, F.P. 1948. A Technique for the Construction of Attitude Scales. *Journal of Applied Psychology*. 32(3): 374-384.

Edwards, A.L. 1957. A technique for the construction of attitude scales. *Opinion and personality*. Wiley, Newyork. pp.189.

Egyir, I.S. 2010. Rural Women and Microfinance in Ghana: Challenges and Prospects. Contributed Paper presented at the Joint 3rd African Association of Agricultural Economists (AAAE) and 48th Agricultural Economists Association of South Africa (AEASA) Conference, Cape Town, South Africa, September 19-23. http://ageconsearch.umn.edu.

Esther Shekinah, D.C. Jayanthi and Sankaran, N. 2005. Physical indicators of sustainability - A farming systems approach for the small farmer in the rainfed vertisols of the Western zone of Tamil Nadu. *Journal of Sustainable Agriculture.* 25 (3):43-65.

Eswarappa, G. 1991. An analysis of coordination and some management aspects of watershed development programme in Karnataka. *Ph. D Thesis.* Andhra Agriculture University, Hyderabad, India.

Etwire P.M., Dogbe, W and Nutsugah, S.K. 2013. Institutional credit available to smallholder farmers in the Northern Region of Ghana. *International Journal of AgriScience.* 3(6): 502-509.

Fakoya, E.O., Agbonlahor, M.U and Dipeolu, A.O. 2007. Attitude of women farmers towards sustainable land management practices in South-Western Nigeria. *World Journal of Agricultural Sciences.* 3(4): 536-542.

Farinde, A.J., Soyebo, K.O and Oyedokun, M.O. 2005. Improving farmers attitude towards natural resources management in a democratic and deregulated economy: Honey production experience in Oyo state of Nigeria. *Journal of Human Ecology*. 18(1): 31-37.

Florent, O and Paul,V.M. 2006. Documenting, validating and scaling up local innovations. *Leisa Magazine*. 22(3).

Food and Agriculture Organisation (FAO). 2009. Declaration of the World Summit on Food Security. Rome. http://www.fao.org/fileadmin/templates/wsfs /Summit/Docs/ Final_Declaration/WSFS09_Declaratio n.pdf

Food and Agriculture Organization (FAO) of the United Nations. 2008. Migration, agriculture and rural development: A FAO perspective. www.fao.org.

Ford, D.R and Zelo. 1991. Evaluating PRA, listening to village leaders in Kakyuni location forest trees and people, News Letter No.13. pp 7-13.

Fosu-Mensah, B., Vlek, P and Manschadi, M. 2010. Farmers' perceptions and adaptations to climate change: A Case study of Sekyedumase district in Ghana. A contributed paper presented at World Food Systems conference in Tropentag, Zurich: 14th -16 September.

Gandure, S., Walker, S and Botha, J.J. 2012. Farmers'perceptions of adaptation to climate change and water in A South African rural community. Environment Development. http://dx.doi.org/10.1016/j.endev.2012.11.004.

Gattu, K.C. 2001. Production constraints of turmeric cultivation in Karimnagar district. *M.Sc. (Ag.) Thesis*. Acharya N.G. Ranga Agricultural University, Hyderabad, India.

Gbetibouo, G.A. 2009. Understanding farmers perceptions and adaptations to climate change and variability: The case of the Limpopo Basin, *IFPRI Discussion Paper 00849*. South Africa.

Giller, K.E., Witter,E., Corbeels, M and Tittomell, P. 2009. Conservation agriculture and small holder farming in Africa: The Beritics' view. *Field Crop Research*.114:23-34.

Good Enough W H. 1944. A Technique for Scale Analysis. *Educational Psychological Measurement.* 8(4):179-190.

Goode and Hatt. 1952. *Methods of Social Research.* Macmillan publishers. New York.

Gowda, M.J.C. 1996. Sustainability of rice farming in different ecosystem. *Ph.D.Thesis*. University of Agricultural Science, Banglore, India.

Greg Guest. 2000. Using Guttman Scaling to Rank Wealth: Integrating Quantitative and Qualitative Data. *Field Methods*.12(4): 346–357.

Gry Synnevag., Samwel, J., Kabote., Carolyne, I., Nombo., Delphina Mamiro., Amon, Z and Mattee.2014. Smallholder adaptation to climate change in semi-arid areas of Tanzania: Experiences from Iramba and Meatu districts sustainable intensification to advance food security and enhance Climate Resilience in Africa. pp 467-485.

Guttman L. 1944. A basis for Scaling Qualitative Data. American Sociology *Review*. 7(4):139-150.

Guttman L. 1947. The Cornell Technique for Scale and Intensity Analysis. Educational Psychology Measurement. 7(2): 247-280.

Gwimbi, P. 2009. Cotton farmers vulnerability to climate change in Gokwe District (Zimbabwe): Impact and influencing factors. *Journal of Disaster Risk Studies*. 2(2): 81-92.

Hajjar, R., Jarvis, D.I and Gemmill-Herren, B. 2008. The utility of crop genetic diversity in maintaining ecosystem services. *Agriculture Ecosystems and Environment*. 123: 261-270.

Holland. R.W., Verplanken. B and Knippenberg, A. 2002. On the Nature of Attitude Behavior Relations: The Strong Guide, the Weak Follow. *European Journal of Social Psychology*. 32(2): 869–76.

Hulme, M., Doherty, R., Ngara, T., New, M and Lister, D. 2001. African climate change: 1900–2100. *Climate Research*. 17:145–168.

Hussain, R., Dutta, K.K., Tamuly, D., Deka, R. L and Khanikar, P.G. 2013. Farmers perception of climate change impact and its mitigation in Golaghat district of Assam. *Journal of Agrometeorology*. 15(2):203-208.

Ian Scoones.1994. Browse ranking in Zimbabway, PRA Notes, on special issue on livestock. International Institute for Environmental and Development (IIED), London.

Idris, O.B. 2010. Review of Small Farmer Access to Agricultural Credit in Nigeria. Nigeria strategy support program. Policy Note No. 25. http://www.ifpri.org

Intergovernmental Panel on Climate Change (IPCC). 2001. Climate change 2001: impacts, adaptation and vulnerability. Intergovernmental panel on climate change. Cambridge, UK: Cambridge University Press.

Intergovernmental Panel on Climate Change (IPCC). 2012. Managing the risks of extreme events and disasters to advance climate change adaptation summary for policymakers, special report of governmental panel on climate change. Accessed on 14th March 2015.

Iqbal, M. 1991. A study on the impact of watershed development programme in Nalgonda district of Andhra Pradesh. *M.Sc. (Ag.) Thesis*. Andhra Agriculture University, Hyderabad, India.

Ison, R.L and Ampt, P.R. 1992. Rapid Rural Appraisal: A Participatory Problem Formulation Method Relevant To Australian Agriculture. *Agricultural System*. (38):63-336.

Jaiswal, N.K., Purnadare, A.P and Yadappanwar, A.V. 1985. People's participation in watershed management: A case study. *Journal of Rural Development*. 4(4):460-465.

James, M and Prem Kumar. 1991. A participatory mapping and modeling users notes RRA no 12. International institute for environmental and development (IIED) London.

James, S.J., Zibanani Kahaka and Francis Nathan Okurut. 2013. Farmers' perceptions and adaptations to climate change in Sub-Sahara Africa: A synthesis of empirical studies and implications for public policy in African agriculture. *Journal of Agricultural Science*. 5- 4.

Jasna, V.K. 2015. Impact of climate resilient technologies in rainfed agro-eco system. *M.Sc. (Ag.) Thesis.* IARI. New Delhi.

Jayanthi, C, Balusamy, M., Chinnusamy, C and Mythili, S. 2003. Integrated nutrient supply system of linked components in lowland integrated farming system. *Indian Journal of Agronomy.* 48: 241- 246.

Jayanthi, C,C. Vennila, K., Nalini and Vivek, G. 2007. Physical indicators - on farm farming system for irrigated uplands of Western zone of Tamil Nadu. *Journal of Farming systems Research and Development.* 13(1): 17-25.

Jennifer Coates, Anne Swindale and Paula Bilinsky. 2007. HFIAS (Household Food Insecurity Access Scale) for Measurement of Food Access: Indicator Guide. Version 3. Food and Nutrition Technical Assistance Project (FANTA). http://www.fao.org

Jeyamissie, 2000. Education and use of Dialects for tribal development-A case study of the Nilgiris district. Report submitted to *Department of tribal welfare.*

Jost. C. 2012. Climate Resilient Agricultural Module. CCAFS, FAO, currently discussing collaboration with CARE and IFAD.

Joyce, L.A., Blate, G.M., McNulty, S.G., Millar, C.I., Moser, S., Neilson, R.P and Peterson, D.L. 2009. Managing for multiple resources under climate change: National Forests. *Environmental Management*. 44: 1022–1032.

Justice A. Tambo and Tobias Wünscher. 2014. Building farmers capacity for innovation generation: What are the determining factors? *Paper prepared for presentation at the EAAE 2014 congress on 'Agri-food and rural innovations for healthier societies'*. Ljubljana, Slovenia. 26-29.

Kadam, J.R., Patli, V.G and Haridwar, D.P. 2001. Knowledge and adoption of soil and water conservation practices in watershed development project. *Maharastra Journal of Extension Education*. 20:138-140.

Katz, D and Stotland, E. 1959. A Preliminary Statement to a Theory of Attitude. Structure andChange. In: Koch. *I.S (Ed.), Psychology: A Study of a Science*. McGraw-Hill, New York. 475p.

Kesava Rao, A.V.R., Suhas,P.,Wani, K., Srinivas and Pushpraj Singh. 2013. Assessing impacts of projected climate on pigeon pea crop at Gulbarga. *Journal of Agrometeorology*. 15(2):32-37.

Khorshed A. 2015. Farmers' adaptation to water scarcity in drought-prone environments: A case study of Rajshahi district, Bangladesh. *Agricultural Water Management*. 148(31):196-206.

Kiran, C and P.R. Kanani, 2010. Entrepreneurial Uniqueness of SHG Women in Junagadh District of Gujarat. Agriculture Update. 5(3&4):462-465.

Kiran, S. 2011. A Critical Study on Livelihoods of Tribal Farmers in Andhra Pradesh. *Ph.D Thesis*. The School of Agricultural Science Yashwantrao Chavan Maharashtra Open University Nashik Maharashtra, India.

Krishnamurthy, M. 1993. A study on adoption behaviour of beneficiaries towards recommended practices of watershed development programme in Ananthpur district of Andhra Pradesh. *M.Sc. (Ag.) Thesis*. Andhra Agriculture University, Hyderabad, India.

Krishnaprasad, T. 2005. A study on rural poverty and sustainable livelihoods in Agrarian sector of Andhra Pradesh. *Ph.D.Thesis*. Acharya N.G. Ranga Agricultural University. Hyderabad.

Kruparkar, G. 2001. A Critical analysis of factors leading to death of cotton farmers in Warangal district of Andhrapradesh. *M.Sc. (Ag.) Thesis.* Submitted to Acharya N.G. Ranga Agricultural University, Hyderabad, India.

Kuldip S.C and Anand S.K. 2013. Farmers' indebtedness in Haryana: A case study. *Journal of Rural Development.* 32(4): 347-365. In the Northern Region of Ghana. *International Journal of AgriScience.* 3(6): 502-509.

Kulkarni, R.R and Sangle, G.K. 1993. Socio-economic evaluation of watershed development project and constraints in its execution. *AGRESCO Report*. Department of Agriculture Extension, P.D.K.V, Akola, 12-13th April.

Kumar, K. 2000. Technology blending. Agricultural Extension Review. Directorate of Extension. Ministry of Agriculture, New Delhi. January-February. 26-77.

Kumar, M. 1994. Knowledge and adoption of tribal farmers with respect to Sericulture technologies in Khammam district of Andhra Pradesh. *M.Sc. (Ag.)* Thesis. Andhra Pradesh Agricultural University, Hyderabad, India.

Kumari, M.S.C. 2004. A study on tribal women entrepreneurs in high altitude tribal zone of AndhraPradesh. *Ph.D Thesis.* Andhra Pradesh Agricultural University, Hyderabad,

Kumbhare, N.V., Hansara, B.S., Kalantri, L.B and Padaria, R.N. 2014. House hold food security in Vidarbha region of Maharashtra India. *International Journal of Extension of Education*. 10:168-175.

Kurukulasuriya, P and Mendelson, R. 2006. Crop Selection: Adapating to climate chnage in Africa. IFPRI, Environment and Production Technology Division. Washington, DC: International Food Policy Research Institute.

Lal, M. 2001. Future climate change: Implications for Indian summer monsoon and its variability. *Current Science*. 81(9): 1205.

Lal, R.1987. Managing the soils of Sub-Saharan Africa.Science, New Series, 236(4805):1069-1076.

Lammerink, P.M. 1999. Detailed look at the PAD approach. PLA notes 35. Community and management. IIED, London.

Latha, A. K.L.V., Munisamy Gopinath and Bhat, A.R.S. 2012. Impact of climate change on rainfed agriculture in India: A case study of Dharwad. *Intenational Journal of Environmental Science and Development.* 3:4.

Limpinutana, V. 1987. Conceptual tools for PRA in agrarian society proceedings of the 1985. International conference on PRA than Khone Kaen University Thailand. 154-157.

Lokhande, M.A. 2013. Micro finance for women empowerment - A study of Self Help Groups-Bank linkage programme. *International Center for Business Research.* 2(1): 159-166.

Lyamchai, C.J., Kingamko, M.N., Mowo, J.G and German, L. 2005. Farmers innovations in natural resource management: lessons and challenges from Lushoto. *International Center for Research in Agroforestry.* Tanzania.

Maddison, D. 2006. The perception and adaptation to climate change in Africa. CEEPA Discussion Paper No. 10. Centre for Environmental Economics and Policy in Africa, University of Pretoria, South Africa.

Magombo, T.M., Kanthiti, G., Phiri, G., Kachulu, M and Kabuli, H. 2012. Incidence of indigenous, emerging and innovative climate change adaptation practices for smallholder farmers' livelihood security in Chikhwawa district, southern Malawi. Working Paper No. 63, Nairobi, Kenya: African Technology Policy Studies Network.

Malik, M.S. 2007. Socio-economic upliftment of tribal communities in Jharkand through Agroforestry based farming system. Publication division, Ministry of Information and Broadcasting, Government of India, New Delhi.

Manakar, D.M., Sawant, V.Y and Sahastrabudhe, A.G. 2000. Socio-economic and Psychological Profile of Fishermen. *Maharashtra Journal of Extension Education*. 11: 159-161.

Manasa, G. 2016. A critical study on women empowerment through Self Help Groups (SHGs**).** *P.h.D.(Ag.) Thesis.* PJTSAU, Hyderabad, India.

Manay, S and Farzana, C. 2000. Socio economic characteristics of rural families. *Maharashtra Journal of Extension Education.* 11: 325-328.

Mann, C., Tinsey, J., Tedjo, G and Nwadei, T. 2010. Ghana's rural finance system and climate regime. www.bu.edu

Marenya, P.P and Barrett, C.B. 2007. Household-level determinants of adoption of improved Natural Resources Management practices among smallholder farmers in Western Kenya. *Food Policy*. 32(4): 515-536.

Meena, M.S. 2010. Socio-economic study of organic farming in irrigated north western plain zone of Rajasthan. *Agricultural Science Digest.* 30: 94-97.

Meenakshi, V. 2011. Participation and Empowerment of Rural Women in Self-Help Groups an Analysis. M.Sc. (Ag.) Thesis. Tamil Nadu Agricultural University, Coimbatore.

Mertz, O., Mbow, C., Reenbverg, A and Diouf, A. 2009. Farmers perceptions of climate change and agricultural adaptation strategies in rural Sahel. (Special Issue: Strategies for adaptation to climatic change in developing countries). *Environmental Management*. 43(5): 804-816.

Mohan, K and Ramesh, K.R.P. 2012. Profile characteristics of farmers under tank irrigation commands. *Karnataka Journal of Agricultural Sciences.* 25(3): 359-362.

Mortimore, M .1998. Roots in the African dust: sustaining the sub-Saharan drylands. Cambridge University Press.

Nagaraj, N., Bantilan, M.S.C., Kumar, A.A., Rajan, S., Anusha, R and Haldar, S. 2013. Technological and institutional interventions in enhancing livelihood of farmers in Semi-Arid Tropics (SAT) areas: Experience of ICRISAT HOPE project. *Indian Journal of Agricultural Economics*. (68):3.

Nagasree, K., Ravi Shankar, K., Venkateswarlu, B., Sreenath Dixit, B.M.K., Raju, A.V.M., Subbarao and Vijay Jesudasan. 2013. An Analysis on Use of ICT Tools for

Dissemination of Weather Based Agro Advisories. *Journal of Agrometeorology.*15 (2):110-115.

Neela Mukherjee.1994. Livestock livelyhood and drought: A PRA exercise in Botswana. PRA notes no 20, special issue on livestock, IIED, London.

Neelaveni, S., Rambabu and Punna Rao. 2002. Developmental priorities of farm women in agribusiness management – A case of an adopted village K.B. Palm. *MANAGE Extension Research Review.* 6(3): 74-83.

Nhemachena, C and Hassan, R. 2007. Micro-level Analysis of Farmers' Adaptations to Climate Change in Southern Africa. IFPRI, Environment and Production Technology Division. Washington, DC: International Food Policy Research Institute.

Nirmala, G. 1998. Standardization selected PRA techniques with reference to agriculture. *Unpublished Ph.D. Thesis.* ANGRAU, Hyderabad.

Nirmala, K. 2012. A study on diffusion status and adoption of System of Rice Intensification (SRI) in Mahaboobnagar district of Andhra Pradesh. *M.Sc. (Ag) Thesis.* Acharya N.G. Ranga Agricultural University, Hyderabad, India.

Nyanga, P., Johnsen, F., Aune, J and Kahinda, T. 2011. Smallholder farmers' perceptions of climate change and conservation agriculture: Evidence from Zambia. *Journal of Sustainable Development.* 4(4), 73-85. http://dx.doi.org/10.5539/jsd.v4n4p73

Nzeadibe, T.C., Egbule, C.L., Chukwuone, N and Agu, V. 2011. Farmers' perceptions of climate change governance and adaptation constraints in Niger Delta Region of Nigeria. *African Technology Policy Network*. Pp. 7.

Okojie, C., Monye Emina, A., Eghafona, K., Osaghae, G and Ehiakhamen, J.O. 2010. Institutional environment and access to microfinance by self-employed women in the rural areas of Edo State. NSSP Brief No. 14. Washington. D.C. International Food Policy Research Institute. http://www.iiste.org.

Olgyaiova, K., Pongra,´C.Z.E., Mikkola, T., Radoslav, S., kappa, R and Keiski, R. L. 2005. Attitudes toward Waste Minimization in Finland and Czech Republic barriers and

Drivers. (*In*) *Proceedings of the RESOPT Closing Seminar Waste Minimization and Utilization in Oulu Region: Drivers and Constraints.* Oulu University Press, Oulu. 85–109.

Omid, M. H., Akbari, M., Zarafshani, K., Eskandari, Gh. H and Fami, H. Sh. 2012. Factors influencing the success of water user associations in Iran: A Case of Moqan, Tajan, and Varamin. *Journal of Agricultural Science Technology.* 14: 27-36.

Osondu, C.K and Ibezim, G.M.C. 2013. Determinants of rural-urban migration and its effect on rural farm labour availability in Umuahia North Local Government Area of Abia State, Nigeria. Research Web Publication. 1(3): 29-35. http://www.eajournals.org.

Padmavathi, M. 1996. Role perception and performance of mitra kisans in National Watershed Development Project in Rainfed Areas (NWDPRA) in Chittor district of Andhra Pradesh. *M.Sc. (Ag.) Thesis*. Acharya N.G. Ranga Agricultural University, Hyderabad, India.

Palanisami, K., Meinzendick, R., Mark Giordano., Barbara Van Koppen and Ranganathan, C.R. 2011. Tank performance and multiple uses in Tamilnadu, South India–comparison of 2 time periods (1996–97 and 2009–10). *Irrigation Drainage Systems.* 25:121–134.

Pathak, H., Aggarwal, P.K and Singh, S.D. 2012. Climate change impact, adaptation and mitigation in agriculture: Methodology for assessment and applications. *Indian Agricultural Research Institute*. New Delhi.

Pathak, P and Laryea, K.B. 1995. Soil and water conservation in the Indian SAT; principles and improved practices. *Sustainable development of dryland agriculture in India.* (Ed.) Scientific Publishers, Jodhpur. pp. 83-92.

Philip, A. Augustine Yelfaanibe and Abindaw Bernard, A. 2014. Impact of climate variability on smallholder households and indigenous coping strategies in bongo district. *International Journal of Development Research*. (4)3:693-699.

Policy note. 2010. Agriculture department. Government of Tamil Nadu.

Prabhavathi, A. 2013. A Study on utilisation of eco friendly technologies among sugarcane growers. *M.Sc. (Ag.)Thesis.* Tamilnadu Agricultural University, Coimbattore, India.

Prasad, K. 1990. A study on knowledge and adoption behavior of farmers towards recommended practices in Yerracheruvu model watershed development programme in Anatapur district of Andhra Pradesh. *M.Sc. (Ag.) Thesis*. Andhra Agriculture University, Hyderabad, India.

Prashanth, P. 2011. A study on adoption of organic farming in cotton in Karimnagar district of Andhra Pradesh. *M.Sc. (Ag.) Thesis*. Acharya N.G. Ranga Agricultural University, Hyderabad, India.

Praveen, N. 2014. A study on Indigenous Technical Knowledge of tribal farmers in Telangana region of Andhra Pradesh. *Ph.D.Thesis*. Acharya N.G. Ranga Agricultural University, Hyderabad, India.

Praveena, P.L.R.J. 2010. Crisis management in agriculture by farmers of Andhra Pradesh-A case study. *Ph.D.Thesis.* Submitted to Acharya N.G.Ranga Agricultural University, Hyderabad, India.

Preethi, S and Shashikanta, V. 2008. Women Empowerment through entrepreneurial activities of self help groups. *Indian Research Journal of extension education*. 8 (1): 46-51.

Pretty,J. 1990. Rapid catchment analysis of extension agents. *Kericho training workshop on 'The ministry of agriculture programme'.* International institute for environmental and development (IIED), London.

Priya, Y.D. 2010. Impact of farmers field School on farm women participants in Karnataka community based tank management project. *Ph.D. Thesis.* University of Agricultural Sciences, Bangalore, India.

Putla, A. 1994. Symbiotic adoption behavior of paluadu cotton Lambadi farmers of Guntur district. *M.Sc. (Ag.) Thesis*. Acharya N. G. Ranga Agricultural University, Hyderabad, India.

Pynbianglang Kharumnuid. 2011. A study on perception and adaptation of potato growers to climate change in East Khasi hills district of Meghalaya. *M.Sc. (Ag.) Thesis*. Acharya N.G. Ranga Agricultural University, Hyderabad, India.

Radhamani, S. 2001. Sustainable integrated farming system for dryland Vertisol areas of Western Zone of Tamil Nadu. *Ph.D. Thesis*. Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu.

Raghunandan, H.C. 2004. A study on knowledge and adoption level of soil and water conservation practices by farmers in northern Karnataka. *M.Sc. (Ag.) Thesis.* University of Agricultural Sciences, Dharwad, India.

Rahman, M.Z and Milkuni, H. 1999. Farmers attitude towards sustainable agricultural issues and environmental quality in a selected area of Bangladesh. *American Journal of Alternative Agriculture*. 14(1):22-29.

Rahman, M.Z., Milkuni, H and Rahaman, M.M. 1999. Towards sustainable farming development. The attitude of farmers in a selected area of shimane prefectare, Japan. *Journal of Sustainable Agriculture*. 14(4): 19-33.

Raj, P and Pawan, P. 2008. Religious Beliefs among Tribal of Himachal Pradesh. *Anthropologist.* 10(2): 143-145.

Rajkumar, D.V.K., Sehgal, Shivani Nagar, V. U. M., Rao, B., Bapuji Rao,P., Vijaya Kumar, A. V. M., Subba Rao and Ravi Dupdal. 2013. Impact of drought on spatio-temporal pattern of phenology in Rajasthan. *Journal of Agrometeorology.* 15 (2):58-63.

Raju, A.K. 2002. An anlysis of sustainability of agricuture in watershed environment in Mahaboobnagar district of Andhra Pradesh. *Ph.D.Thesis*. Acharya N.G. Ranga Agricultural University, Hyderabad, India.

Ramachandran, P. 2008. Changing food consumption patterns in India. NFI Bulletin. 29(2):8. http://poshan.nic.in

Ramrao, W.Y., Tiwari S.P and Singh, P. 2006. Crop-livestock integrated farming system for the Marginal farmers in rained regions of Chhattisgarh in Central India. *Livestock Research for Rural Development.* 18(7): 23-30.

Rani Saxena, Gupta, K.C and Prasoon Mathur. 2015. Economic impact analysis of weather based agromet advisories on crops under climate change scenario. *Journal of Progressive Agriculture.* 6(1): 100-102.

Rao, D. 1988. Impact of improved dryland agricultural technology in Chevella and Potuulabogunda model watershed development project in Jogipet taluk of Medak district in Andhra Pradesh. *M.Sc. (Ag.) Thesis*. Acharya N.G. Ranga Agricultural University, Hyderabad, India.

Rao, M K., Balakrishna, N., Arlappa, N., Laxmaiah, A and Brahmam, G.N.V. 2010. Diet and Nutritional Status of Women in India. *Journal of Human Ecology*. 29(3): 165-170.

Rao, P.P. 1993. A study on adoption of improved agricultural technology by the tribal farmers in high altitude and tribal zone of Andhra Pradesh. *Ph.D. Thesis*. Andhra Pradesh Agricultural University, Hyderabad, India.

Rao,V.U.M. 2013. Climate change: Risk management through weather insurance. In: Adaptation and mitigation strategies for Climate Resilient Agriculture. Central Research Institute for Dryland Agriculture, Hyderabad – 500 059, India. pp. 312-318.

Ratnakar, R. 1990. Impact of Integrated tribal development agency (ITDA) on the tribal farmers of Khammam district of Andhrapradesh. *Ph.D.Thesis.* Andhra Pradesh Agricultural University, Hyderabad, India.

Ravi, K. 2004. Integrated farming: Boon for small and marginal farmers. *Kurukshetra.* 47 (9): 22-23.

Reddy, C.V.G. 1996. An analysis of people participation in watershed development programme in Andhra Pradesh. *Ph.D. Thesis*. Acharya N.G. Ranga Agricultural University, Hyderabad, India.

Reddy, M.K.V. 2001. People participation in watershed development programme implemented by government and non- government organization- A comparitive analysis. *M.Sc. (Ag.) Thesis*. University of Agricultural Sciences, Dharwad, India.

Reddy, N. 2005. A study on knowledge, extent of participation and benefits derived by the participating farmers of the watershed development programme in Raichur district of Karnataka state. *M.Sc. (Ag.) Thesis*. University of Agricultural Sciences, Dharwad, India.

Reddy, Y.V.R and Walker, T.S. 1987. Impact of watershed programme on adoption and economics of technology and the economic conditions of rural people. *CRIDA Annual Report*. Hyderabad.

Robin Mearns*.,* Shombodon, D., Narangerel, G., Turur, Enkhamagulan, A., Myagmarzhav, B., Bayanjargal and Baksurem, B. 1994. Natural resources mapping and seasonal variations and stresses in Mongolio notes no 20, special issue on livestock.

Sabarathnam, V.E and Vennila, S. 1996. Estimation of technological needs and identification of problems of farmers for formulation of research and extension programmes in agricultural entomology. *Experimental Agriculture*. 32(1):87-90.

Sabaratnam,V. S. 1987. A Study on the Process of Development and Dissemination of Dry land Agriculture Technology (Identification, Measurement, Prediction and Effect). *Ph. D. Thesis.* Acharya N.G.Ranga Agricultural University. Hyderabad.

Saha. 2010. Livelihood diversification persued by farmers in West Bengal. *Indian Research Journal of Extension Education*. 10(2).

Sam Joseph. 1992. Participatory Rural Appraisal in identifying major illness, health care providers and costs PRA notes 16. International Institute for Environment and Development (IIED), London. pp.53.

Samantha, R.K. 2001. Reorienting extension in changing global agricultural perspective. In R.K. Samantha (eds.) *Globalising Indian Agriculture: policies and strategies*. Concept publishing company, New Delhi.

Sankara Rao, A.B. 1995. A study on flow of Agricultural information and its utilization pattern among the tribal farmers of International Fund for Agricultural Development (IFAD) areas of Andhra Pradesh. *Ph.D.Thesis (Ag)*. Andhra Pradesh Agricultural University, Rajendranagar, Hyderabad, India.

Santhosh, K.H. 2014. A study on rural-urban migration among youths: Social work perspective. *Indian Streams Research Journal*. 4(1): 1-3.

Sarnoff, I. and Katz, D. 1954. The Motivational Basis of attitude change. *Journal of Abnormal Psychology*. 49(3):115- 124.

Satish Kumar, G.D. 1998. Knowledge level and extent of adoption of recommended practices for cotton crop by farmers. *Madras Agricultural Journal*. 89 (4-6): 293-296.

Savita. 2011. Impact of community based tank management project on socio economic status of beneficiary farmers in Bidar District. *M.Sc.(Ag.)Thesis.* University of Agricultural Sciences, Dharwad, India.

Schierre, J.B., Ibrahim, M.N.M and Van Keulen, H. 2002. The role of livestock for sustainability in mixed farming: Criteria and scenario studies under varying resources allocation. *Agriculture Ecosystem Environment.* 90:139-153.

Sharma, A., Adita Sharma and Amita Saxena. 2012. Socio economic profile and information seeking behaviour of fisher women- A Study in Uttarakhand. *Journal of Communication Studies.* 30: 40-45.

Sharma, R.K. 2007. Access to credit- A study of Hill farms in Himachal Pradesh. *Journal of Rural Development*. 26(4): 483-501.

Shinde, P.S., Vaidya, V.R and Satpute, S.K. 2000. Identification and Adoption of Indigenous Agricultural Practices by Dryland Farmers. *Maharashtra Journal of Extension Education.* 11: 259-263.

Shiv kumar, N. 2009. Impact Assessment of Agriculture Interventions in Tribal Areas in Madhya Pradesh Final report. July 2009. Catalyst Management Services Pvt Ltd. Bhopal. 44.

Shivani, R., Singh, D., Rajan, K., Ray P.K and Singh, S.S. 2010. Resource management in vegetable based integrated farming system for marginal fanners of Bihar. In: Extended summaries of XIX National Symposium on Resource management approaches towards livelihood security, Bengaluru, Kamataka. 2-4: 176.

Simpson, B. M and Burpee, C.G. 2014. Adaptation under the new normal of climate change: the future of agricultural extension and advisory services. *MEAS* Discussion paper 3, Urban, II. Accessed on 3rd January 2015 from http://agrilinks.org/ sites/default/files/resources/files/MEAS%20brief%203%20%20Climate%20Change %20and%20BAS%20-%202014_05_07. pdf.

Singh B.K and Bhagat R. 2002. Socio-economic infrastructural correlates of commercial vegetable cultivation. *Indian Journal of Extension Education*. 38(1&2): 9-56.

Singh, G. (2008). Challenges of climate change and options to overcome them. *Intensive Agriculture*, pp.9-16.

Singh, G.D and Kumar, K. 2004. Adoption of improved menthe cultivation. *Indian Journal of Extension Education*. 40(3&4): 40-43.

Singh, K. 1991. Determinants of people's participation in watershed development and management. An exploratory study. *Indian Journal of Agricultural Economics*. 39:47- 49.

Sitaula, B.K. 2008. Natural resources and watershed management in South Asia: A comparitive evaluation with special reference to Nepal. *The Journal of Agriculture and Environment*. 9:72.

Situation Assessment Survey (SAS) of Farmers. 2003. Indebtedness of Farmer Households. NSS 59th Round, (January–December 2003), National Sample Survey Organization.

Sivamurugan, A.J.P. 2001. Sustainable farming system under irrigated upland situation. *Ph.D.Thesis*. Tamil Nadu AgriculturalUniversity, Coimbatore, Tamil Nadu.

Smith, M.B., Burner, J.S. and White, R.W. 1956. *Opinions and Personality*. Wiley, New

York, 174p.

Sofoluwe, N., Tijani, A and Baruwa, O. 2011. Farmers' perception and adaptations to climate change in Osun Satte, Nigeria. *African Journal of Agricultural Research*. 6(20): 4789-4794.

Soni, S.N., Pathak, R.K and Kashikar, R.R. 2000. Socio-economic study to analyzed constraints in the adoption of modern technology by various groups in Dianci Sagar, Madhya Pradesh. *Crop Research Hissar.*19(2).

Sreenivasa, Rao.I and Sireesha, D. 2013. Farmers innovation development process- critical analysis and comprehensive strategy for scaling up of farmer innovation. Paper presented at National seminar on Futuristic Agricultural Extension for livelihood improvement and sustainable development. 19-21 January 2013. 110-117.

Sridhar, K. 2002. An evaluative study of Watershed programme in Pavagada taluk of Tumkur district in Karnataka. *M.Sc. (Ag.) Thesis*. University of Agricultural Sciences, Dharwad, Karnataka, India.

Srinivasa Rao, Ch and Gopinath, K.A. 2016. Resilient rainfed technologies for drought mitigation and sustainable food security. *Mausam.* 67(1):169-182.

Srinivasa, Rao, Ch., Venkateshwarlu,B., Rattan Lal., Singh, A.K and Kundu, S. 2013a. Sustainable management of soils of dryland ecosystems of India for enhancing agronomic productivity and sequestering carbon, in: *Advances in Agronomy.* (Ed.Donald L.Sparks), Academic Press, Burlington, 121, 253-329.

Srinivasa, Rao, Ch., Vijay, S., Jakkula, Sumanta Kundu, Sudhanshu, S. Kasbe, R., Veeraiah, S., Rammohan, S., Dixit, M., Dinesh Babu and Venkanna, K. 2013b. Management of intermittent droughts through on-farm generation of organic matter: Participatory experiences from rainfed tribal districts of Andhra Pradesh. *Journal of Agrometeorology.* 15 (2):140-145.

Subramanyam. 2003. Ecology, technology and resources management among the tribes of Eastern ghats: an Anthropological study. *Conference on 'Livelihood strategies among forest - related tribal groups of south India'.* Mysore, October, 17-19.

Sujit, S. 2014. Climate change vulnerability and adaptive behavior of farmers Himalayan and arid ecosysytems. *Ph.D.Thesis*. Indian Agricultural Research Institute. New Delhi.

Swathi, G. 2012. A study on Agro-biodiversity in Tribal region of Visakhapatnam district of Andhra Pradesh. *M.Sc. (Ag.) Thesis*.ANGRAU, Hyderabad, India.

Swati, B.D., Bardhan and Avadhesh Kumar. 2013. Strengthening credit services to livestock sector for inclusive rural growth. *Journal of Rural Development*. 32(4): 367-381.

Swetha, M. 2013. A study on empowernment of women entreprenuers in Medak district. A.P. *M.Sc. (Ag.) Thesis*.Acharya N G Ranga Agricultural University, Hyderabad, India.

Swift, J and Umar, A.N. 1994. The problem and solution game. PRA notes on 20. Special issue on livestock, sustainable agriculture programme. IIED, London.

Tabi, F.O., Adiku, S.G.K., Ofori, K., Nhamo, N., Omoko, M., Atika, E and Mayebi, A. 2002. Perceptions of rainfed lowland rice farmers of climate change, their vulnerability and adaptation strategies in the Volta region of Ghana. *Technical report presented to START*. University of Ghana.

Tagel Gebrehiwot and Anne van der Veen. 2013. Farm level adaptation to climate change: The case of farmers in the Ethiopian highlands environmental management.52(1):29-44.

Takon, Takon, J., Amalu., Titus, E., Okpara and Daniel, E. 2013. Assessment of local people's attitude towards natural resource conservation in Boki local government area of cross river state, Nigeria. *Research Journal in Organizational Psychology and Educational Studies.* 2(2):60-66.

Tarhule, A and Lamb, P.J.2003. Climate research and seasonal forecasting for West Africans: perceptions, dissemination, and use. Bull Am Meteorol Soc. 84:1741–1759.

Thaddeus Chidi Nzeadibe Chukwudumebi, L., Egbule Nnaemeka, A., Chukwuone Victoria Chinwe Agu. 2011.Climate change awareness and adaptation in the Niger Delta Region of Nigeria. African Technology Policy Studies Network Working Paper Series | No. 57.

Thanrongwarangkul, A. 2001. Annual report on sustainable community development for good livelihoods and environmental project. Khon Kaen University, Thailand.

Thirukumaram, K 2002. Whole farm approach for sustainable dryland production. *Ph.D. Thesis*. Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu.

Todd, R and Sharma, M. 2010. Innovations in Rural and Agriculture Finance. International Food Policy Research Institute. www.ifpri.org.

Tompkins, E.L and Adger, W. N. 2003. Building resilience to climate change through adaptive management of natural resources Tyndall Centre for Climate Change Research Working Paper 27. Accessed on 23rd January, 2013 fromhttp://www.tvndall.ac.uk/ sites/default/files/wp27.pdf.

Tschopp, R., Aseffa, A., Schelling, E and Zinsstag, J. 2010. Farmers' perceptions of livestock, agriculture and natural resources in the rural Ethiopian highlands. *Mountain Research and Developmen*t. 30(4):381-390.

Ugmimba, C.O.A., Okoh, R.N., Ike, P.C*,* Nnabuife, E.L.C and Orji, E.C. 2010. Integrated farming system and its effect on farm cash income in Awka south agricultural zone of Anambra state, Nigeria. *American-Eurasian Journal Agricultural & Environmental Science.* 8(1): 1-6.

Vairavan, K., Kannan, S., Ganache C and Swaminathan, G. 2000. Farming in dryland and wasteland situation. *The Hindu*. 27 April.

Van Biakel, M. L., Morales, E. J., Turingruang, *D* and Little *D.* C. 2003. Livelihood improving functions of pond based integrated agriculture and aquaculture systems.

MRC Fisheries Programme (FP). Institute of Aquaculture, University of Stirling, Scotland, UK.

Veerendranath, G. 2000. A critical study on flow utilization and source credibility of agricultural information among rainfed castor growing farmers of Nalgonda district of Andhra Pradesh. *Ph.D.Thesis.* Acharya N.G. Ranga Agricultural University, Hyderabad, India.

Venkata Ramana Reddy. 1971. A Study on Some Personal and Situational Factors Influencing Choice of Communication Media by the Agericultural Extension Personnel in Hyderabad District. *M.Sc. Thesis.* Acharya N.G. Ranga Agricultural University. Hyderabad.

Venkatesh, H., Savita, B., Nashi, J.R., Hiremath, V.B., Nargund and Kulkarni, S.N. 2013. Adoption of weather forecasts – A precursor towards adaptation to climate change. *Journal of Agrometeorology.* 15(2):1-5.

Venkateswarlu, B., Singh, A.K, Prasad, Y.G, Ravindra Chary, G., Srinivasa Rao, Ch., Rao, K.V, Ramana, D.B.V and Rao, V.U.M. 2011. District level contingency plans for weather aberrations in India. Central Research Institute for Dryland Agriculture, Natural Management Division, Indian Council of Agricultural Research, Hyderabad – 500 059, India. Pp. 136.

Venkatramaiah, P 1983. Revised 1990. Devolopement of socio economic status scale for farm families of Northern Karnataka. *Ph.D. Thesis.* University of Agricultural Sciences, Bangalore.

Verma, A.R., Rajput, A.M and Srivastava. 2004. Economic evaluation of National Watershed Development Programme for Rainfed Agriculture in Indore district of Madhya Pradesh. *Indian Journal of Agricultural Economics.* 59(3): 368-369.

Waman, G.K., Patil, P.S and Patil, P.G. 1998. Adoption of onion production technology and its correlates. *Journal of Maharashtra Agricultural University*. 23:2

Yadav,R.K., Kalia,P., Singh, S.D and Varshney, R. 2012. Climate change impact, adaptation and mitigation in agriculture: Methodology for assessment and application. Division of Environmental Sciences, Indian Agricultural Research Institute, New Delhi - 110012. Accessed on 23rd February, 2015 Available at:http7/%20Adaptation%20and%20 Mitigation%20Print.pdf.

Yesuf, M., Di Falco, S., Deressa, T., Ringler, C and Kohlin, G. 2008. The impact of climate change and adaptation on food production in low-income countries: Evidence from the Nile Basin, Ethiopia, EDRI.

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"A STUDY ON ADAPTIVE CAPACITY AND TECHNOLOGIES ADOPTED BY FARMERS FOR CLIMATE RESILIENT AGRICULTURE IN DROUGHT PRONE AREAS"

INTERVIEW SCHEDULE

Respondent Number : Name of the Mandal:
Household No: Name of the District:
Name of the respondent : Name of the village:

PART- I
INDEPENDENT VARIABLES
PROFILE CHARACTERSTICS OF THE RESPONDENTS

1. **Age (At the time of interview):**
2. **Education:** Please state your educational level on one of the following items applicable

S.No	Educational Status
1.	Illiterate
2.	Primary school (up to 5 thclass)
3.	Upper Primary school (6th to 7 th class)
4.	High School (8, 9 & 10 th class)
5.	Intermediate
6.	graduation and above

3. **Farming experience**:----------
4. **Farm size:**

Sl.No	Category
1.	Marginal (<1 acres)
2.	Small (1-2 acres)
3.	Semi medium (2-4 acres)
4	Medium (4-10 acres)
5	Large (>10 acres)

5. Availability of water resources

A) Rainfed **Yes/No**

B) Irrigated **Yes/ No**

If irrigated, indicate source

S. No	Source of irrigation	Yes	No
1	Open wells		
2	Bore wells		
3	Tanks/water house		
4	Canals		

6. **Frequency of occurrence of drought**

S. No	Frequency of occurrence of drought
1	Once in 4 years
2	Once in 3 years
3	Once in 2 years
4	Yearly once

7. **Farming system (IFS)**

S. No	Farming system
a.	Single crop
b.	>1 crop (Ag or Horticultural crops)
c.	Ag crops + Horticultural crops
d.	Ag/Hort+ AH/poultry/goat
e.	Ag crops + Horticultural crops + AH/poultry / goat
f.	Ag crops + Horticultural crops + AH/poultry / goat+ mulberry +sericulture

8. **Socio Economic Status**

a) **Family size**

S. No	Category
1	Small(1 to 4 members)
2	Medium(4 to 6 members)
3	Large (>6members)

b) **Occupation**

S.No	Occupation	
1	Farming/Agriculture	
2	Labour + Agriculture	
3	Subsidiary + Agriculture	
4	Labour + Subsidiary + Agriculture	

c) **Annual income:----------**

d) **Socio-political participation**

Please state your social political participation in the following

a) No official Membership in any organization ( )

b) Membership in one organization or group ( )

c) Official position in social and political committee ( )

d) Fund raising or financial contribution for common work ( )

e) Office bearer ( )

9) Social Affiliation

S.No	Statements	A	UD	DA
1	It is very useful to maintain relationship with higher officials			
2	One should behave friendly/ help other farmers in crisis			
3	One has to consult the household before making any decisions			
4	One should maintain relationship with the elders for getting traditional information			
5	One should feel good about meeting other people			
6	One should maintain cordial relation with group members			

10) Trainings undergone on CRA

a) Did you attend any training programme? **Yes / No**

b) The content of training programme related to

1) integrated Farming systems
2) soil moisture conservation measures
3) Organic farming
4) Water harvesting technologies
5) Demonstration on Silage making
6) Micro irrigation techniques
7) Any others specify

11) Sources of Information Utilisation

a) Individual contact: PleasementionFrequency ofcontact with the following persons for agriculture purpose

S. No	Source	Regular	Occasional	Never
1	AdarshaRythu			
2	Agricultural Extension Officer / MAO			
3	Scientists of Agricultural Universities			
4	Input Agencies/ Dealer			
5	NGO personnel			
6	Neighbors/ Friends			
7	Any other			

b) **Mass Media Exposure:** Please mention the frequency of exposure to the different Group & mass media sources for agriculture purpose

S. No	Source	Extent of exposure		
		Regular	Occasional	Never
1	Radio			
2	Television			
3	News paper			
4	Magazines/Books on agriculture and allied fields			
5	Mobiles			
6	Computers			
7	Others			

12) Credit Availability : If you are in need of money from where will you take credit? Please tick the source-

a) If yes, how many times?----------

b) From where the credit is available to you

S.No	Source
1.	Private Money Lenders
2.	Banks
3.	Relatives and Friends

13) Food Security

Food security information of the household

S. No	Statements	Response		
		Regular	Occasional	Never
1.	In the past four weeks did your house hold get enough food?			
2	In the past four weeks, were you or any household members able to eat the kind of foods you preferred			
3.	In the past four weeks, did you or any household members have a variety of foods?			
4.	In the past four weeks, were you or any household members havea full meals that is needed for you?			
5.	In the past four weeks, did you or any members have enough meals (three meals per day)			

14) Traditionalism

S.No	Statements	DA	UD	A
1.	The blessing of god/goddess are responsible for higher crop production			
2.	Animal sacrifice is essential at the time of harvest to please the god			
3.	To select the seed one has to follow an advice of local religious priests			
4.	Dusting and spraying of insecticides is not desirable as it irritates the god			
5.	One should not go for applying chemical fertilizers as it irritates god			
6.	One should not develop by adopting the new technology as some people with super natural powers may harm you			

15) Risk taking ability

A set of statements on risk taking ability of farmers are given below. Please State your response to each statement against Agree, Undecided and Disagree. May bring negative incidents

S. No	Statement	Response		
		A	UD	DA
1	A farmer should grow large 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 risks when he knows his chance of success is high			
4	It is better for a farmer not to try new farming methods unless most other farmers have used them with success			
5	Trying an entirely new practice in farming by a farmer involves risk and wasting of resources			

16) Weather Based Agro Advisory Services (WBAAS)

S. No	Services	Always	Sometimes	Never	Undecided
1	Are you receiving WBAAS's forecast in time to plan the agricultural operations				
2	Are you getting farmers bulletin?				
3	Do you follow the WBAAS's				
4	Do you seek information on Special weather forecast for extreme events?				
5	Are you getting benefit of the SMS service of IMD?				
6	Do you seek information in local language?				
7	Do you believe that who followed the AAS are getting high crop yield				
8	Do you think that information of AAS is trustworthy and credible?				
9	Did you receive any warning about the drought before it happened?				

17. Community Infrastructural facilities

S. No	Facility	Yes	No
1	Hand pumps		
2	Water tank/ Farm ponds		
3	Public taps		
4	Market yards		
5	Storage facilities		
6	Internet café		
7	Custom hiring centres		
8	Processing facilities		
9	Fair price shops		
10	Flour mill		
11	All weather roads		
12	House hold electricity		
13	General electric supply		

PART-II

DEPENDANT VARIABLES

I) ADAPTIVE CAPACITY

A) Climate readiness of respondents for managing climate change

Following are the statements on readiness for managing climate change kindly go through all the statements and respond on four point continuum

S.No	Statements	Always	Sometimes	Rarely	Never
1	Do you follow ITK's to predict climate?				
2	Have you planned contingency crop planning for managing climate change based on forecast?				
3	Did you gather more organic manures (FYM) for application in view of upcoming harsh climate?				
4	Have you taken up diverse enterprises like agriculture, horticulture poultry, cattle etc, to with stand crop failure?				
5	Have you planned to take up/do you have rain water harvesting structures (farm ponds, percolation tanks etc) on your field?				
6	Have you planned to irrigate the crop through/do you have micro-irrigation technologies? (Eg. Sprinkler and drip)				
7	Were you ready to take up recommended schedule of pest and diseases control measures in view of pest/diseases flare up?				
8	Would you like to engage in non-farm activities (small business to compensate the low farm income due to climate variability?				
9	Instead of cultivating crop, are you ready to do labor work in view of upcoming drought?				
10	Have you planned to take up soil moisture conservation practices (mulching, dead furrows check dams etc.,)				

B) ATTITUDE

Attitude of respondents towards Climate Resilient Agriculture technologies

S. No	Statements	AG	UD	DA
A	**Attitude of respondents towards general concept of Climate Resilient Agriculture technologies**			
1	In my view drought is not a doomed fate but there are strategies to minimize its effects.			
2*	In my view there is no need to spend money on CRA technologies			
3*	I observed that small farmers are not able to receive full benefit of improved CRA technologies			
4	Due to the adoption of CRA technologies there is substantial improvement of crop yields in my area during adverse drought situation.			
5	I strongly feel that food security can be achieved by adopting climate resilient technologies			
6	CRA technologies have come as a real boon for the farmers for managing drought conditions.			
7*	In my view it is simply waste of time to practice climate resilient technologies			
8	CRA technology develops self – reliance among dry land farmers			
9*	The use of CRA technology is less profitable in relation to the cost involved			
B.	**Attitude of respondents towards specific Climate Resilient Agriculture technologies**			
1*	There is no improvement in soil moisture retention levels by adopting the moisture conservation methods (dead furrows, mulch, cover crops, etc.)			
2	Irrigation with sprinkler/drip had helped my crop in mitigating the soil moisture stress			
3*	In my view construction of rain water harvesting structures are very costly and risky			
4	I observed that Performance of contingent crops under delayed monsoon is good			
5	I observed that the Performance of climate resilient varieties is good in drought areas			
6	In my view composting of organic waste would upgrade soil quality			
7*	I feel that there is no improvement in crop yield due to crop diversification			
8*	In my view farm operations are delayed due to improper functioning of custom hiring centers			
9*	I strongly feel that there is no recharge of bore wells in the vicinity of percolation ponds			

'*' Indicate that statement is negative

2) Level of adoption of CRA Technologies and Coping mechanisms for CRA

A) Level of adoption of Technologies

i) Adoption of CRA Technologies in Nalgonda

Have you adopted the following in order to cope up climate change?

S. No	Technologies	Adopted	Partially Adopted	Never
A	**Natural resource managemnet (NRM)**			
1	In-situ moisture conservation technologies in Cotton and red gram (dead furrows)			
2	Water management through drip irrigation in Chillies			
3	Real time contingency crop planning for rainfed red chalka soils			
4	Reclamation of low fertile and saline soils			
5	Excavation of check dam			
6	Renovation of farm ponds			
7	Edification of farm percolation ponds			
8	Recharge of wells and bore wells–farm ponds			
9	Rain guns/Supplemental irrigation through farm ponds in cotton			
10	De silt tank and tank silt application			
11	Deep ploughing			
B	**Crop Production and Protection**			
1	Soil test based nutrient management in cotton			
2	Use of vermicompost in chillies			
3	Crop diversification from paddy to jowar and vegetable as a contingent crop			
4	Inter cropping of cotton and pulses (green gram/ red gram)			
5	Sucking pest management in cotton			
6	Use of magnesium on improvement of productivity in cotton			
7	Preparation of traditional compost			
8	Spraying of leaf extracts to manage pest or diseases in late sown crop			
9	Crop rotation			
10	Crop residue incorporation with rotavator			
11	Inter cultivation with Danthi to control weed and create soil mulch			
C	**Live Stock and Fisheries**			
1	Back yard poultry			
2	Silage making in bags			
3	Fodder varieties (multi cut fodder APBN-1)			
4	Azolla production			
5	De-worming program for sheep and goat			
D	**Institutional Intervention**			
1	Custom hiring center/VCRMC			
2	Village level seed bank			
3	Fodder bank			

ii) Adoption of CRA Technologies in Anantapur

S. No	Technologies	Adopted (2)	Partially Adopted (1)	Never (0)
A	**Natural resource managemnet (NRM)**			
1	Desilting and widening of feeder channels			
2	Renovation of percolation ponds/farm pond			
3	Edification of new percolation ponds			
4	Desilting of check dams, silt application			
5	In-situ moisture conservation technologies in groundnut and red gram by sub soiling with chisel plough			
6	Real time contingency crop planning for rainfed red chalka soils			
7	Reclamation of low fertile and saline soils			
8	Excavation of check dams			
9	Soil and moisture conservation measures like stone bunding across the slope			
10	Trench cum bund			
11	Contour bunding			
12	Deep ploughing			
13	Recharge of well and bore well			
14	Rain guns/Supplemental irrigation through farm ponds in standing crop of ground nut			
B	**Crop Production and Protection**			
1	Mechanized intercultivation in groundnut			
2	Improved varieties in groundnut			
3	Sheep penning on groundnut productivity			
4	Management of LLS spray in groundnut			
5	Crop diversification through castor			
6	Preparation of traditional compost			
7	Seed treatment in ground nut			
8	Crop rotation			
9	Spraying of leaf extracts to manage pest or diseases in late sown crop			
10	Soil test based nutrient application in ground nut			
11	Crop residues incorporation			
12	Intercropping of groundnut and pulses (red gram, horse gram)			
13	Inter cultivation with Danthi to control weed and create soil mulch			
C	**Live Stock**			
1	Back yard poultry			
2	Silage making in bags			
3	Fodder varieties (multi cut fodder APBN-1)			
4	Azolla production			
5	De-worming program for sheep and goat			
6	**Institutional Intervention**			
1	Custom hiring center/VCRMC			
2	Village level seed bank			
3	Fodder bank			

ii) Have you adopted the following coping mechanisms in order to cope up climate change

S. No.	Coping Mechanisms	Many times (2)	Some times (1)	Never (0)
1	Selling assets			
2	Sending children to work			
3	Non-farm activities like….			
4	Crop insurance			
5	Searching for good market for getting higher price for produce			
6	Conserved fodder by rationalized use			
7	Left a portion of land fallow			
8	Borrowed money from money lenders/micro finance institutions for family expenditure			
9	Minimized household consumption			
10	Availing Government compensations or subsidies			

PART- III

Problems and suggestions elicited by the respondents in adoption of technologies for Climate Resilient Agriculture

1. What problems you are facing in adoption of CRA technologies to combat the impact of climate change.

-
-
-
-
-

2. Please give suggestions to overcome the problems elicited by you

-
-
-
-

PHOTOS TAKEN DURING PARTICIPATORY EXERCISES



Key informants participating in transect walk at Peravali village of Anantapur district



Farmers participating in group discussion and collecting solutions from them for general transect at Peravali village of Anantapur district



A group of men and women participating in drawing village resource map at Peravali village of Anantapur district



A group of men and women participating in drawing agro ecology map at Peravali village of Anantapur district



Participation of key informants in transect walk at Chakraya Peta village of Anantapur district



A group of men and women participating in drawing village resource map at Chakraya Peta village of Anantapur district



A group of men and women participating in drawing agro ecology map at Chakraya Peta village of Anantapur district



A group of men and women participating in drawing the general transect axis at Nandyala Gudem village of Nalgonda district



A group of men and women participating in drawing village resource map at Nandyala Gudem village of Nalgonda district







A group of men and women participating in drawing agro ecology map at Nandyala Gudem village of Nalgonda district



A group of men and women participating in drawing seasonal calendar at Nandyala Gudem village of Nalgonda district



A group of men and women participating in transect walk at Boring Thanda of Nalgonda district



A group of men participating in drawing village resource map at Boring Thanda of Nalgonda district



A group of men and women participating in drawing agro ecology map at Boring Thanda of Nalgonda district



A group of men and women participating in drawing seasonal calendar at Boring Thanda of Nalgonda district



A group of men and women participating in group discussion at Boring Thanda of Nalgonda district