

A Study on Constraints Faced by Farmers in Adapting to Climate Change in Rainfed Agriculture

N. Satishkumar¹, Prabhuling Tevari² and Amit Singh¹

¹National Dairy Research Institute, Karnal, Haryana, India

²Agricultural Research Station, Siruguppa, Bellary (D), Karnataka, India

E-mail: ptevari@gmail.com

KEYWORDS Rainfed Agriculture. Constraints. Adaptation. Climate Change

ABSTRACT The present study determines the constraints faced by farmers in adaptability measures to climate change in rainfed region. A sample of 150 farmers was interviewed from Mahaboobnagar, Ranga Reddy and Ananthapur districts of Andhra Pradesh, India. The findings revealed that personal constraints like small size and fragmented landholdings (60%), low literacy level (56%) and inadequate knowledge (45%) of how to cope or build resilience as the major constraints. The poor extension service on climate risk management (72%), non-availability of drought tolerant varieties, lack of access to weather forecasting technology and poor reliability on it, dependence on monsoon (64%) were the major institutional and technological constraints faced by the farmers. The study suggested that improving information access on climate risk management, access of institutional credit on soil and water conservation practices, and capacity building programmes strengthens the farmers' adaptation capacity under changing climate.

INTRODUCTION

Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcing, or to persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC 2012). Changes in the mean and the variability of climate parameters will have essentially influence on agricultural cropping system especially under water limited production such as in the arid and semi-arid regions.

Rainfed agriculture is practiced on 80% of the world's agricultural area and its importance varies regionally. It produces most of food for poor communities in developing countries. About 60% of agriculture in south Asia is under rainfed. In India, rainfed areas currently constitute 55% of net sown area, supporting 40% human population, two-third livestock population and contributing 40% to the food grain production of the country. But rainfed agriculture is risky, vulnerable, diverse, complex and under-

invested (NRAA 2012). A World Bank report of 2005 on drought found that Andhra Pradesh has historically been prone to drought like conditions especially in Rayalseema and Telangana which has been third highest drought prone state after Rajasthan and Karnataka.

Farming is predominant activity in rainfed region, and adaptive capacity brings ability of a farming system to adjust to climate change (including climate variability and other weather based extremes), to moderate potential damages. It helps to take advantages of preventive opportunities and to cope with the consequences. Farmers' generally practice different adaptability measures over the period to mitigate and prevent the effect of climate change in the farming. Barriers to adaptation vary across countries, lack of credit/ savings (Institutional) is observed main constraint. Access to water is another bottleneck for adaption in countries like Africa and South Asia (Kelakar and Bhadwal 2007; World Bank 2008; Glwadys 2009).

Keeping these in view, a field level study was conducted with the objective to study the socio-economic profile of farmers and to rank the constraints faced by the farmers in adapting measures to climatic vulnerability.

Address for correspondence:

N. Satishkumar

Ph. D. Scholar,

National Dairy Research Institute,

Karnal, Haryana, India

E-mail: satishndri18@gmail.com

METHODOLOGY

The study was conducted in Mahaboobnagar, Ranga Reddy and Ananthapur districts of

Andhra Pradesh (A.P.) during 2011-12. The state was purposively selected as it is a typical rainfed state. It has a net irrigated area of 38,81,000 ha constituting 38% of the total cultivated area. The state has a tropical climate with moderate to sub-tropical weather. Humid to semi-humid conditions prevail in the coastal areas, while arid to semi-arid situations are prevalent in the interior parts of the state, particularly Rayalseema and Telangana, the areas covered under the study. The rainfall in the study districts is being received from both the SW monsoon and NE monsoons, predominantly former, but precipitation varies across the region. While Rayalseema region is a zone of scarce to moderate rainfall (400 – 700 mm/ year) and Telangana receives modest rainfall (700 – 1000mm/year). The annual rainfall variability is about 20 to 25% for Telangana and 25 to 30% to Rayalseema. Groundnut, sorghum, pigeonpea, castor, blackgram, green gram and rice are the predominant crops in the study area. More than 50% districts of state are drought prone with high incidence of poverty and unemployment. Most of the districts located in the Rayalseema and Telangana regions of the state suffer from frequent droughts. Droughts and other climatic vulnerabilities make agriculture dependent livelihoods vulnerable to poverty.

Keeping these in mind, the study was conducted in Mahaboobnagar, Ranga Reddy districts of Telangana and Ananthapur district of Rayalseema region of Andhra Pradesh (A.P.).

One *mandal* (a *mandal* is a unit of administration above village and below district level in a state and comprises several villages) from each selected district were chosen randomly for the study. These *mandal* are Mahbubnagar, Pudur, Atmakur of Mahaboobnagar, Ranga Reddy and Ananthapur districts respectively. Randomly 50 household farmers from each of the *mandal* were selected to constitute a total sample size of 150. An open-ended structured interview and Focused Group Discussion (FGDs) was carried out to obtain related information. Data from the study were analysed using descriptive statistics, frequency and percentage.

RESULTS AND DISCUSSION

I. Socio-personal Profile of Rainfed Farmers

The study of socio-personal variables (Table 1) shows that demographic composition was predominantly dominated by middle age group (36-45 years) constituting 46% of surveyed farmers; this was followed by old age group category

Table 1: Socio-personal profile of farmers (n=150)

S. No.	Particulars	Category	Frequency	Percentage
1.	Age	Young (<35)	25	16.7
		Middle (36-45)	69	46.0
		Old (>46)	56	37.3
2.	Education	Illiterate	52	34.7
		Can read and write	27	18.0
		Primary	38	25.3
		High school	16	10.7
		Above high school	17	11.3
3.	Caste	General	45	30.0
		OBC	70	46.7
		SC	20	13.3
		ST	15	10.0
4.	Farming Experience (Years)	Low (up to 15)	15	10.0
		Medium (16-25)	56	37.3
		High (>25)	79	52.7
5.	Family Size (Numbers)	Small (up to 5)	90	60.0
		Medium (6 to 8)	38	25.3
		Large (more than 9)	22	14.7
6.	Family Type	Nuclear family	88	58.7
		Joint family	62	41.3

ry (37.3%) and the rest under less than 35 years age group (16.7%). The study found that 34.7% of respondents were illiterate and 46% of the respondents comprised of Other Backward Classes (OBC) category. The farmers in the region prefer to have small (60%) and nuclear family (58.7%).

The socio-economic profile (Table 2) shows that farming with wage labour (32.7%) was the predominant occupation, followed by farming with dairy (26%) and 15.3% respondents purely depend on farming. The present study found that 69% of cultivated area of respondents falls under rainfed and only 31% comes under irrigation with main sources of irrigation like open wells (65.4%) and bore wells (34.6%). The majority of the farmers fall in low annual income group making them more prone to climate variability. The study found that 60% of respondents were members of one or another community organisation. However participation was passive in SHGs, cooperative societies and Rythu Sangas (farmers' clubs). Strikingly it was noted that majority were not having access to the institutional credit probably due to small sized landholdings, illiteracy, lack of awareness and also laborious work involved to avail the credit from formal institutions.

II. Constrains Faced in Adaptability Measures to Climate Vulnerability in Rainfed Region

Farmers practices different adaptation strategies timely to cope with changing climate. In

this process they face various constraints in adaptation in their field. And these constraints (Table 3) faced by farmers were categorised into personal, institutional and technical constraints.

A. Personal Constraints

1. Small Scale Fragmented Land Holdings: About 60% of respondent farmers expressed that small landholdings (due to nuclear families and low annual income) was the major constraint to adapt various coping measures like soil and water conservation measures, practicing diversified farming, cultivating drought tolerant varieties, utilisation of accessible weather information, etc. The economic profiles of the respondents also indicated that majority of the farmer fall in low annual income group. Daberkow and McBride (2003) showed that given the uncertainty and the fixed transaction and information costs associated with innovation, there may be a critical lower limit on farm size that prevents smaller farms from adapting. As these costs increase, the critical size also increases. It follows that innovations with large fixed transaction and/or information costs are less likely to be adopted by smaller farms.

2. Low Literacy Level: About 56% of respondent farmers expressed that existing low level of literacy was also one of the reason for hindrance to access the information from various sources on mitigating the risks involved with climate change. Ravi Shankar et al. (2013), found that positive relationship between education and

Table 2: Socio-economic profile of farmers (n=150)

S. No.	Particulars	Category	Frequency	Percentage
1.	<i>Occupation</i>	Only farming	23	15.3
		Farming + dairy	39	26.0
		Farming + dairy + labour	28	18.7
		Farming + labour	49	32.7
		Farming + other allied activities	11	7.3
2.	<i>Landholding (acre)</i>	Rainfed	507	69.0
		Irrigated	229	31.0
3.	<i>Source of Irrigation (Numbers)</i>	Open well	68	65.4
		Bore well	36	34.6
4.	<i>Annual Income (In Rs.)</i>	Low (<Rs.21,525)	79	52.7
		Medium (Rs.21,5260-63,500)	41	27.3
		High (>Rs.63,501)	30	20.0
5.	<i>Social Participation</i>		90	60.0
6.	<i>Access to Institutional Credit</i>		63	42.0

adaptation to changing climate. The lower education level limits assess of climate change information available from various sources and poor understanding of it increases these groups more exposure to climate vulnerabilities.

3. *Inadequate Knowledge of How to Cope (or) Build Resilience*: Inadequate knowledge is positively related with illiteracy. The respondents (45%) stated that inadequate knowledge on climate change and their effects will obstruct the farmers to take up the adapting measures. Li et al. (2013) noted that farmers are becoming increasingly conscious of local climate variability issues. However, they have limited understanding of the importance of adaptation to their livelihoods. They also have limited knowledge of where and whom to contact for appropriate climate change adaptation information.

4. *Traditional Beliefs*: About 30% of respondent rainfed farmers were not in the edge to shift their occupation which they were following from generations. The rainfed farmers are least risk oriented due to low income and educational status. And they fall in the last category (laggards) in the adoption of new practices.

B. Institutional Constraints

5. *Extension Services*: In rainfed region, farmers (72%) had poor access to formal state government extension services and informal institutions like private input traders, non-profit organisations etc. The extension services have a deep penetration in India to reach the mass even

though it has faces several constraints to reach the farm community timely and it is more in rainfed regions. Poor understanding of climate risk management and transferring need full information to clientele by the extension personnel's is significant constraint in adaptation.

6. *Access to Information Source*: Poor access to information sources in the area was another constraint expressed by 62% of farmers. Timely and requisite information is necessary to take adaptive measures for mitigating the risk caused by climate change and take advantage of it. The dissemination of weather information like rainfall conditions, credit information, improved varieties and management practices will play an important role in adapting different strategies to climate change. Farmers were facing limitations in adapting to climate change because of lack of information and its access on climate change, lack of suitable adaptation measures and credit, shortage of land were identified by Onyeneke and Madukwe (2010) and Tambo and Abdoulaye (2013).

7. *Non-availability of Institutional Credit*: Institutional credit is one of the important factors which helps the farmers to cultivate land and also for adapting measures to overcome climate change effects, particularly in rainfed region. This is the only way to get credit with lowest interest charges compared to other unorganised lending sectors. In the study region, 52% farmers stated that non-availability of institutional credit was one of the constraints to take adaptability measures. Farmers expressed if they

Table 3: Constrains faced in adaptability measures to climate vulnerability (n=150)

S. No. Particulars	n	%	Rank
<i>A. Personal Constraints</i>			
1. Small size fragmented landholdings	90	60	I
2. Low literacy level	84	56	II
3. Inadequate knowledge of how to cope or build resilience	68	45	III
4. Traditional belief /practice on the concomitant of farming practices	46	31	IV
<i>B. Institutional Constraints</i>			
5. Poor extension service on climate risk management	108	72	I
6. Poor access to information sources	93	62	II
7. Non-availability of institutional credit	78	52	III
<i>C. Technical Constraints</i>			
8. Non availability of drought tolerant varieties (timely)	107	71	I
9. Lack of access to weather forecasting technology and poor reliability on it.	99	66	II
10. Highly dependent on monsoon	96	64	III
11. High cost of irrigation facilities	69	46	IV
12. Difficulties in shifting to different cropping patterns in short duration of time	63	42	V
13. Lack of technical know-how on climate change and its consequences and adaptation strategies	60	40	VI

even availed such facilities, which will be enabled after or middle of cropping season, this is of no use to farmers because any soil and water conservation activities and other farming plans should take place prior to cropping season. It is mainly depends on credit availability for getting needed resources for cultivating land and to take various adaptive measures to climate change. Lack of finance hinders farmers from getting the necessary resources and technologies that facilitate adapting to climate change are costly (Deressa et al. 2008).

C. Technical Constraints

8. *Drought Tolerant Varieties*: The cultivation of drought tolerant varieties is another measure which farmers can adapt to reduce the risk of climate vulnerabilities. It requires additional amount of inputs and credit. The farmers (71%) from rainfed region stated that non availability of drought tolerant varieties in the market was one of the major technical constraints faced making them more prone to climate vulnerabilities.

9. *Lack of Access to Weather Forecasting Information*: Farmers largely rely for weather information on their indigenous knowledge due to it is most reliability they gained from generations and experience (Satishkumar et al. 2013). About 66% of farmers opined that lack of access to information on weather forecasting technology and poor reliability on it were the major obstacles to practice adaptability measures to prevent conditions of change in climate. The findings are in conformity with earlier studies of Ravi Shankar et al. (2011) and Idrisi et al. (2012) who noticed that absence of location specific climate forecasts followed by poor reliability and failure of the climate forecasts, coupled with poor extension service on climate prediction, forecasts in the media not answering operational needs and low conviction of climate prediction were the major problems reported by farmers.

10. *Dependent on Monsoon*: Majority of the farmers depend on monsoons and there is no alternative source of irrigation and only few have open and bore wells for the purpose of irrigation. The farmers (64%) expressed high dependency on monsoons which obstructs in adopting different measures to climate change.

11. *High Cost of Irrigation Facilities*: Being rainfed, the most common source of irrigation in the area includes open and bore wells.

This source at initial stage of establishing adds cost and puts extra financial burden on the poor farmers. About 46% of respondent farmers stated that they were facing constraints in creating irrigation facilities. This was due to the fact that high cost involved in constructing the rain water harvesting structures and for other utilities like micro irrigation structures.

12. *Shifting of Cropping Pattern*: The respondents (42%) expressed that sudden shift in the cropping pattern in a short duration of time due to climate vulnerabilities is very difficult. The shifting from one crop to other involves extra resource in terms of finance and inputs. The shifting of cropping pattern makes the farmers more vulnerable as in the era of globalisation, cropping pattern is decided by the market conditions and farmers had to follow it.

13. *Lack of Technical Know-how*: The study shows that 40% of the farmers lack the technical knowledge on climate change, its consequences and adaptation strategies thereof was the constraint faced by the affected farmers.

CONCLUSION

Changes in the mean and the variability of climate parameters will have essentially influence on agricultural cropping system especially under water limited production such as in the arid and semi-arid regions. Farmers practice different adaptability measures over the period to mitigate and prevent the effect of climate change in the farming. Even though, farmers faced various personal, institutional and technical constraints in the adaptation process. These includes small size fragmented landholdings, low literacy level, inadequate knowledge of how to cope or build resilience, poor extension service on climate risk management, non-availability of drought tolerant varieties, timely lack of access to weather forecasting technology and also poor reliability on it, dependent on monsoon etc. The study suggested that improving information access on climate risk management, access of institutional credit on soil and water conservation practices and capacity building programmes strengthens the farmers' adaptation strategies under changing climate.

REFERENCES

Daberkow SG, McBride WD 2003. Farm and operator characteristics affecting the awareness and adop-

- tion of precision agriculture technologies in the U.S. *Precision Agriculture*, 4:163–177.
- Deressa T, Hassan R M, Alemu T, Yesuf M, Ringler C 2008. Analyzing the Determinants of Farmers' Choice of Adaptation Methods and Perceptions of Climate Change in the Nile Basin of Ethiopia. International Food Policy Research Institute (IFPRI) *Discussion Paper* No. 00798. Environment and Production Technology Division, IFPRI, Washington DC.
- Glwadys, Aymone Gbetious 2009. Understanding Farmers' Perceptions and Adaptation to Climate Change and Variability: The Case of Limpopo Basin, South Africa. International Food Policy Research Institute, *Discussion Paper* 00849, IFPRI, Washington DC.
- Idrisa Y L, Ogunbameru B O, Ibrahim A A, Bawa D B 2012. Analysis of awareness and adaptation to climate change among farmers in the Sahel savannah agro-ecological zone of Borno State, Nigeria. *African Journal of Agricultural Research*, 7(25): 3632-3637.
- IPCC 2001. *Intergovernmental Panel on Climate Change, Climate Change 2001: Impact Adaptation and Vulnerability*. Cambridge: Cambridge University Press.
- Kelkar Suruchi Badwal 2007. South Asian regional study on Climate Change Impact and Adaptation: Implication for Human Development, Paper prepared by TERI for HDR, 2007. *HDR Office Recommended Paper*, 2007/27, UNDP.
- Li Hoa, Le Dang, Elton Johan Bruwer, Ian Nuberg 2013. *Farmers' Perceptions of Climate Variability and Barriers to Adaptation: Lessons Learned from an Exploratory Study in Vietnam. Mitigation and Adaptation Strategies for Global Change*. Netherlands: Springer.
- NRAA 2012. Prioritization of Rainfed Areas in India. *Study Report 4*. National Rainfed Area Authority (NRAA), New Delhi, India.
- Onyeneke R U, Madukwe D K 2010. Adaptation measures by crop farmers in the southeast rainforest zone of Nigeria to climate change. *Science World Journal*, 5(1): 32-34.
- Ravi Shankar K, Nagasree K, Venkateswarlu B, Pochiah Maraty 2011. Constraints and suggestions in adopting seasonal climate forecasts by farmers in South India. *Journal of Agricultural Education and Extension*, 17(2): 153-163.
- Ravi Shankar K, Nagasree K, Maruthi Sankar GR, Prasad M S, Raju B M K, Subbarao A V M, Venkateswarlu B 2013. Farmers' Perception and Adaptation Measures Towards Changing Climate in South India and Role of Extension in Adaptation and Mitigation to Changing Climate. *Extension Bulletin* No.03/2013. Central Research Institute for Dry land Agriculture, Hyderabad, P. 28.
- Satishkumar N, Tevari Prabhuling, Singh Amit 2013. Utilization pattern of different sources and channels of weather information by the rainfed farmers. *Indian Journal of Agricultural Research*, 47(3): 248 – 252.
- Tambo Justice Akpene, Abdoulaye Tahirou 2013. Smallholder farmers' perception of and adaptations to climate change in the Nigerian savannah. *Regional Environmental Change*, 13(2): 375-388.
- World Bank 2005. *Drought in Andhra Pradesh: Long Term Impacts and Adaptation Strategies*. September Issue, South Asia Environment and Social Development Department, The World Bank, Washington DC.
- World Bank 2008. *The World Development Report: Agricultural for Development*. The World Bank, Washington DC.