



Farmer's Perception on Climate Change and Integrated Farming Systems as Adaptation Measure Towards Changing Climate

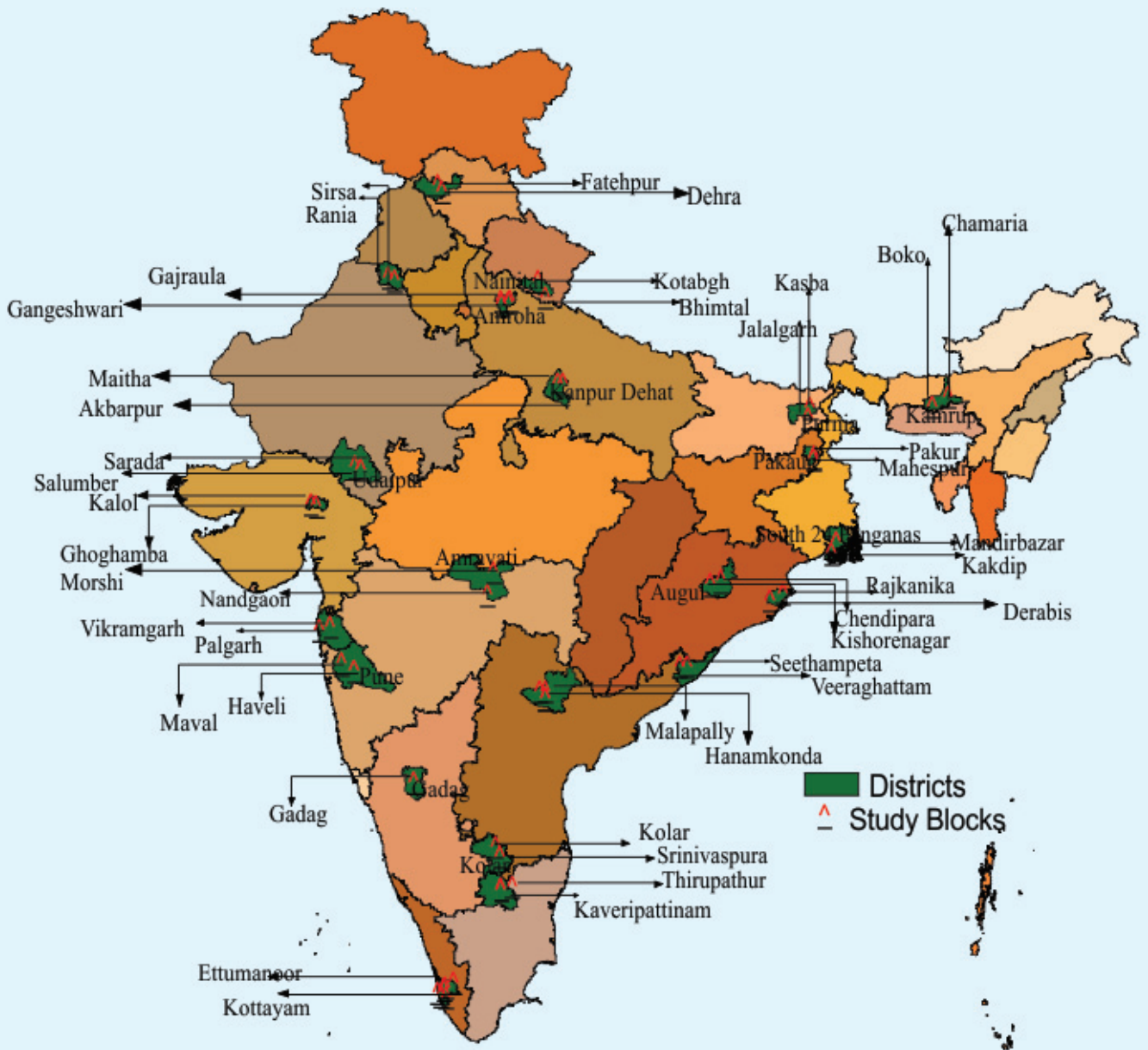
(Series 1)

M. Shamim B. Gangwar
N. Ravisankar Kamta Prasad



AICRP on Integrated Farming Systems
ICAR-Indian Institute of Farming Systems Research
Modipuram, Meerut- 250 110 (Uttar Pradesh)

Blocks and districts covered to study On-Farm Research farmer's perception on climate change and Integrated farming systems as adaptive measures towards changing climate



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**AICRP on IFS: On Farm Research
Farmer's Perception on Climate
Change**



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FOREWORD

The negative consequences of the changing climate on agriculture are being witnessed globally, but developing countries like India are more vulnerable in view of the fact that more than 60 % population are depending on agriculture. Rainfed agriculture is likely to be impacted severely in view of its' high dependency on monsoon as the distribution of the rainy days drastically reduced from the normal number of rainy days in a particular agro-climatic region, resulting in increased number of extreme weather events like flash floods, drought etc. Frequency of untimely heavy rains and terminal heat stress during *rabi* seasons are increased which will change the food security of the country. Frequent and heavy occurrence of hail storms emerged as great disaster for horticultural crops threatening the nutritional security of the nation, while global warming creating avenues for new insect, pest and diseases, hence reducing the greenhouse gas emissions holds key in addressing the problem. The only way to profit from natural resources is to take them into account and understand them in a better way. Adopting effective agricultural practices at the farms is the utmost need to stabilize the productivity through nullifying the negative consequences of the climate change. As climate change and adaptation measures, both are continuous process, farmers have wealth of informations in relation to adaptive measures towards changing climate. Perception of the farmers especially experienced persons is very important in planning the formative combative measure against change in climate and implementation of adaptive measures. Integrated Farming Systems is considered to be one of the tools to reduce the climate/weather related risks in agriculture. Under the aegis of AICRP on Integrated Farming Systems, On-farm research is being carried out at 32 districts in 14 agro-climatic regions. An effort was made to document the perceptions of the On Farm Research (OFR) farmers on changing climate and adaptive measures in various components of farming systems such as field crops, horticulture, livestock and fisheries. I congratulate the efforts of the team for bringing this valuable compilation and synthesis of data for all India. I hope the document will be helpful to researchers, educationalists and policy makers associated with climate change.



Modipuram
03 December, 2015



(J.P. Singh)
Director (Acting)



INTRODUCTION

India is home to an extraordinary variety of climatic regions, ranging from tropical in the south to temperate and alpine in the Himalayan north. Indian Council of Agricultural Research categorized the Indian climate in to 127 Agro climatic zones on the basis of soil, climate, physiography, water availability, crops and administrative boundary for proper agricultural planning and development. The informational aspect of climate, where past, present and future data can be potentially used to make optimal decisions with respect to economic, social and financial alternatives. Agricultural production is for a large part still dependent on weather and climate despite the impressive advances in agricultural technology over the last half a century. An agricultural decision-maker can either be at the mercy of these natural resources or try to benefit from them. The only way to profit from natural factors is to take them into account and learn them in a better way. Climate Resource Information of a particular region, in practice mainly climatological data, is essential in planning agricultural production for better land use and management, selecting crop varieties and animal breeds, crop production practices (irrigation, pest and disease control).

The changing climate of the world which has proved itself as real and attracted attention of thinkers from almost all fields, is threatening to have significant and far reaching impacts on the human society. It has differential impact on different parts of the globe. A consensus has thus emerged that developing countries are more vulnerable to climate change than developed countries, because of the predominance of rain-fed agriculture in their economies, the scarcity of capital for adaptation measures, their warmer baseline climates and their heightened exposure to extreme events (Nzeadibe et al, 2011). This poses a challenge of developing innovative technologies to improve rural livelihoods and environmental conservation and ensuring adoption of such technologies (Kalinda, 2011). The natural resources (climate, soil, biodiversity etc.) highly influence agriculture as the agricultural activities are very sensitive to climate and weather factors. Hence, agriculture has been a major concern in the discussions on climate change. Studies show that without adaptation climate change is generally detrimental to the agricultural sector; but with adaptation, vulnerability can largely be reduced (Sahu and Mishra, 2013). The adaptive capacity is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damage, to take advantage of opportunities, or to cope with the consequences.

Adaptation is widely recognized as a vital component of any policy response to climate change. It is revealed under many studies that without adaptation, climate change is generally detrimental to the agriculture sector; but with adaptation, vulnerability can largely be reduced (Gbetibouo, 2009). Adaptation to climate change requires that farmers first notice that the climate has changed, and then identify useful adaptations and implement them. The adaptation of feasible adaptive measures may be at household,



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local, regional or global level. To approach the issue appropriately, one must take into account local communities' understanding of climate change, since they perceive climate as having a strong spiritual, emotional, and physical dimension. It is therefore assumed that these communities have an inborn, adaptive knowledge from which to draw and survive in high-stress ecological and socio-economic conditions. Thus, the human response is critical to understanding and estimating the effects of climate change on production and food supply for ease of adaptation. Accounting for these adaptations and adjustments is necessary in order to estimate climate change mitigations and responses (Apata et al., 2009).

Research at the community- and household-level has provided insight into particular adaptation strategies and impacts but it remains unclear to what extent these strategies and impacts are generalizable. Though adaptation is a household-level property that depends on a myriad of context-specific factors, understanding factors associated with patterns in farmlevel changes across multiple regions is important because policies aimed at facilitating adaptation will typically be implemented at scales greater than the individual household and community (Wood et al., 2014).

Traditional farming systems were sustainable, but diverse challenges and constraints as growing population, increasing food, feed, fodder and fuel needs, natural resource degradation, climate change, marginal growth rate in farmer's income and new global trade regulations demand a paradigm shift in shaping future agricultural research programmes in a sustainable and climate resilient integrated farming systems mode. Development of climate resilient farm practices for enhanced soil health and resource use efficiencies under diverse farming situations and farm categories will be of paramount importance. In this endeavor, the present study adopts the bottom up approach as this approach explores the possible adaptation strategies in a particular household level and climatic set-up. To investigate the farmers perception about the changing climate and the adaptive measures are being taken by them to grow the important enterprises of the farming systems, sixty farmers from On Farm Research (OFR) centers running under aegis of AICRP on Integrated Farming Systems, representing a particular NARP zone of the country were interviewed.

It is expected that the analytical approach presented in this document will prove to be useful for the researchers, policymakers and stakeholders to address the future challenges for growth and development of the agricultural sector under changing climate scenario. Further, this will also ensure food and nutritional security, livelihood improvement and sustainable environment with human touch.



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Perception of Farmers on Climate Change and Adaptive Measures Towards Changing Climate in India

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Sixty responsive farmers from the each twenty five on farm research (OFR) centers were interviewed regarding their perception about the changing climate and the adaptation measures are being taken by them to raise the important components of the farming systems prevailed in the districts. Ten farmers were interviewed from each village and three villages were selected from one block. Two blocks were selected from each district. Data regarding perception and adaptation towards changing climate was collected using a pre-tested interview schedule. Adaptation index (AI) for individual farm component was developed considering the adopted adaptation measures where more than 50 per cent farmers were adopting such adaptation measure to coup up the ill effect of climate change using formula as below

$$AI = \frac{\text{Number of adopted adaptation measures by } >50\% \text{ farmers}}{\text{Total number of adaptation measures}} \times 100$$

Per cent analysis, correlation coefficients and adaptation index were used for analyzing the data. General characteristics analysis of the surveyed population revealed that 33 per cent population are between 41-50 years of age and about half of the population (42%) has secondary level of education. More than half of the population (67%) has less than one hectare holding size. The family size of 82 per cent of the population was 4-8 members and 75 per cent farmers earn less than one lakh in a year (Fig. 1). Ranking of the results was done to know the major finding from the survey.

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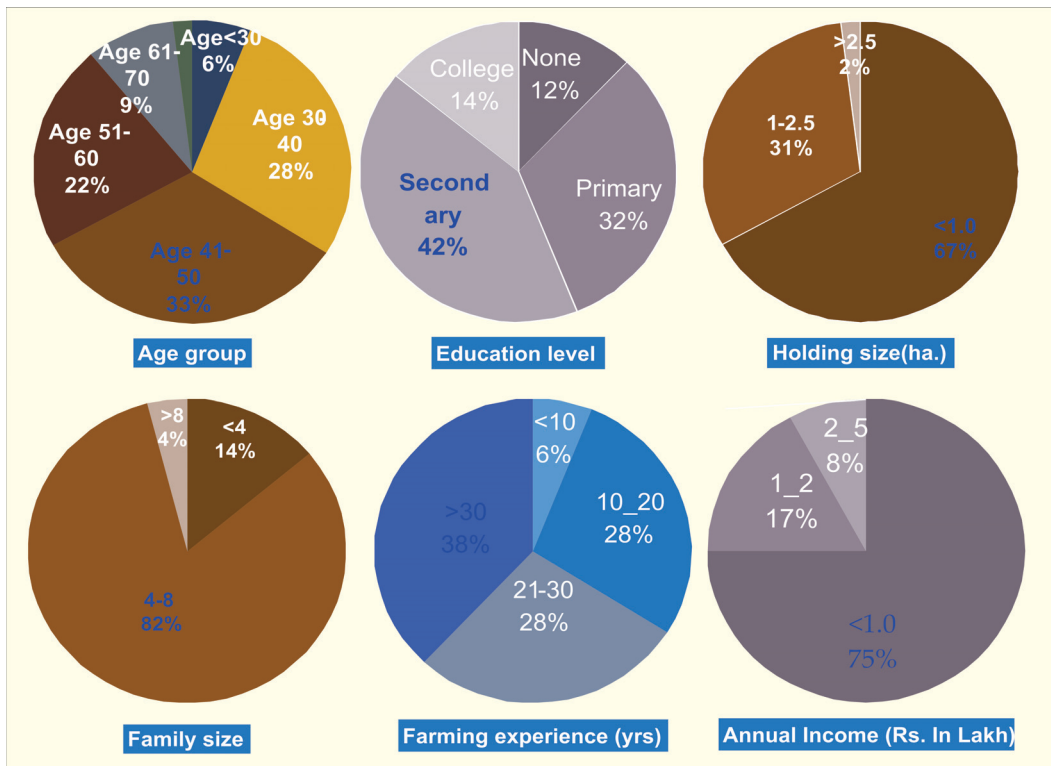


Fig. 1: General characteristics of the survey population

Farmer's perceptions regarding changing climate

Total 17 weather parameters pertaining to changing climate were taken in the questionnaire. The results revealed that increase in day time temperature was major perception of the farmers (91%) about the changing climate. Late onset of monsoon and decrease in rainfall amount were given 2nd and 3rd rank by the farmers. Increased frequency of frost and cold wave were not supported by the farmers and both of these were given least point (Table 1).



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Table 1: Farmer's perceptions regarding climate change

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Day temperature increased | 91 | 1 |
| Late onset of monsoon | 87 | 2 |
| Decrease in rainfall amount | 80 | 3 |
| Water table decreased | 79 | 4 |
| Both day and night temperature increased | 76 | 5 |
| Night temperature increased | 76 | 6 |
| Erratic distribution of rainfall there by, affecting length of growing season | 70 | 7 |
| Frequency of drought increased | 64 | 8 |
| Frequency of heat wave increased | 64 | 9 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 57 | 10 |
| Terminal heavy rains | 50 | 11 |
| Crop lodging due to high wind velocity increased | 48 | 12 |
| Frequency of flood increased | 27 | 13 |
| Frequency of cold wave increased | 23 | 14 |
| Frequency of frost increased | 18 | 15 |
| Frequency of hail storm increased | 14 | 16 |
| Early onset of monsoon | 10 | 17 |

Farmer's perceptions and adopted measures regarding growing of major field crops

Results about farmer's perceptions regarding growing of major field crops under changing climatic condition of the study area revealed that incidence of pest and diseases are increasing on the farmer's field whereas infestation of new weeds and insect pest infestation are also an emerging important constraint for higher farm productivity. Incorporation of the crop residue on the farmers field are still practiced by only 38 per cent of the farmers. Farmers perception corroborated the statement of increasement in acreage of rice and wheat crops and also improvement in their productivity at small and marginal farms. Out of seven adaptation measures towards changing climate, change in planting dates of major crops and intercropping/ mixed cropping adopted by 65 and 53 per cent of the population. Adoption of mulching as soil moisture conservation techniques was found least adopted measures to nullify the negative effect of the changing climate (Table 2).



Table 2: Farmers' perceptions and adopted measures regarding growing of major field crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Incidence of pest and diseases increased | 82 | 1 |
| Infestation of new weeds/ insect pest increased | 70 | 2 |
| Cropping pattern changed | 57 | 3 |
| Availability of irrigation water decreased | 56 | 4 |
| Residue recycling increased | 38 | 5 |
| Growing area of rice increased | 36 | 6 |
| Productivity of rice increased | 36 | 6 |
| Productivity of maize increased | 25 | 7 |
| Growing area of maize increased | 24 | 8 |
| Growing area of wheat increased | 21 | 9 |
| Productivity of wheat increased | 12 | 10 |
| Adaptation measures adopted towards changing climate | | |
| Change in planting dates of major crops | 65 | 1 |
| Intercropping/mixed cropping adopted | 53 | 2 |
| Changed to short, drought resistant varieties | 46 | 3 |
| Soil moisture conservation techniques adopted | 23 | 4 |
| Rain water harvesting/Water harvesting structures made | 21 | 5 |
| Have insurance | 16 | 6 |
| Mulching adopted as soil moisture conservation techniques | 14 | 7 |

Farmer's perceptions and adopted measures regarding growing of horticultural crops

The potential increment in water requirement of horticultural crops is witnessed by the farmers and it came out as first indicator of changing climate scenario in terms of horticultural component of the farming systems. Increased insect pest infestation problems and change in taste/flavour of fruits were observed by 69 and 44 per cent of the farmers respectively. Early onset of the flowering in the fruit and plantation crops also came in to picture due to effect of changing climate. About 70 per cent farmers are adopting plant protection measures against major insect-pest infestation and 49 per cent farmers witnessed that the change in planting dates of vegetables crops are being adopted by the farmers. Farmers are also taking short stature, drought resistant varieties under changing climate scenarios (Table 3).



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Table 3: Farmer's perceptions and adopted measures regarding growing of horticultural crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Water requirement of crops increased | 71 | 1 |
| Insects pest infestation increased | 69 | 2 |
| Change observed in taste/flavour of fruits | 44 | 3 |
| Early flowering in fruits / plantation crops | 22 | 4 |
| Productivity of tomato increased | 18 | 5 |
| Growing area of tomato increased | 15 | 6 |
| Productivity of banana increased | 14 | 7 |
| Productivity of brinjal increased | 13 | 8 |
| Growing area of banana crops increased | 10 | 9 |
| Growing area of onion increased | 10 | 10 |
| Adaptation measures adopted towards changing climate | | |
| Plant protection measures adopted | 70 | 1 |
| Change in planting dates of vegetables crops | 49 | 2 |
| Changed to short stature, drought resistant varieties | 37 | 3 |
| Introduced new crops | 31 | 4 |
| Early harvest | 27 | 5 |
| Rain water harvesting/Water harvesting structures made | 17 | 6 |
| Night irrigations applied to vegetable crops to mitigate the effect of frost & cold | 16 | 7 |
| Mulching adopted as soil moisture conservation techniques | 15 | 8 |
| Have insurance | 6 | 9 |
| Use of net as hail shelter | 5 | 10 |
| Smokes, heaters are used in the orchard to reduce the effect of cold, frost etc. | 5 | 10 |
| Raise the crops in polyhouse to mitigate the effect of high temperature | 5 | 11 |

Farmer's perceptions and adopted measures regarding animal husbandry

Perception of farmer's regarding rearing of animals, 69% of the respondents agreed with decreased scenario in number of livestock per household in relation to changing climate whereas milk productivity is increased. Goat farming and poultry are getting discarded by the farmers and still farmers are not replacing the cow with buffalo. More than the 50 per cent farmers across the country revealed that prophylactic measures are being taken against disease infestation in animals and they are rearing cross breeds instead of indigenous in case of cattle. Very few percentage of the farmers accepted that they are using the electric fans/coolers



during summer and electric heaters to elevate the shelter temperature during strong cold for nullifying the adverse effect of changing climate on the animals (Table 4).

Table 4: Farmer's perceptions and adopted measures regarding animal husbandry

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Number of livestock per household decreased | 69 | 1 |
| Milk productivity increased | 58 | 2 |
| Numbers of goats per household decreased | 57 | 3 |
| Number of poultry per household decreased | 55 | 4 |
| Changes observed in rearing of animals | 49 | 5 |
| Green fodder availability decreased | 48 | 6 |
| Cow is replaced by buffalo | 26 | 7 |
| Adaptation measures adopted towards changing climate | | |
| Prophylactic measures taken against disease infestation | 57 | 1 |
| Rear cross breeds | 53 | 2 |
| Raise green fodder in off season | 45 | 3 |
| Use of ventilated pukka shelter | 37 | 4 |
| Have insurance | 18 | 5 |
| Use of electric fans/coolers during summer | 7 | 6 |
| Use of electric heaters to elevate the shelter temperature during strong cold | 5 | 7 |

Farmer's perceptions and adopted measures regarding fish farming

Under changing climate scenario it was evidenced by the farmers that water requirement of pond is increased whereas number of pond is decreased. Fish mortality in pond increased due to climate change was witnessed by very little percentage of the farmers (11%). Multiple use of water was come in to picture and about 1/4th of the survey populations are utilizing available water for irrigation/washing of animal's sheds and pond recharge. There is very little percentage of farmers who are using pukka ponds to avoid the seepage loss of water under fish farming (Table 5).



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Table 5: Farmer's perceptions and adopted measures regarding fish farming

| Parameters | Per cent | Rank |
|--|----------|------|
| Farmer's perception | | |
| Water requirement of pond is increased | 26 | 1 |
| Number of ponds decreased/ dried | 22 | 2 |
| Disease infestation increased | 13 | 3 |
| Fish mortality in pond increased | 11 | 4 |
| Adaptation measures adopted towards changing climate | | |
| Multiple use of water as irrigation/washing of animals sheds | 23 | 1 |
| Rear improved fingerlings | 17 | 2 |
| Introduction of new species | 16 | 3 |
| Prophylactic measures taken against disease infestation | 10 | 4 |
| Have insurance | 6 | 5 |
| Use of pukka ponds to avoid the seepage loss of water | 5 | 6 |

Adaptation index

Adaptation index is the measure of the adopted adaptation measures out of recommended adaptation measures towards changing climate by the farmers to harvest better yield of a particular components of the Integrated farming Systems (IFS). Component-wise analysis of adaptation index of the major four components viz, field crops, horticultural crops, animal husbandry and fish farming components

of the Integrated farming systems were calculated. Almost similar adaptation index was recorded in cropping systems as well livestock components of the integrated farming system. However, very low i.e. 8 per cent adaptation index was calculated in case of the horticultural crops. Fish farming is not the components of the integrated farming systems at all the centers, therefore adaptation index on All India basis come as very low.

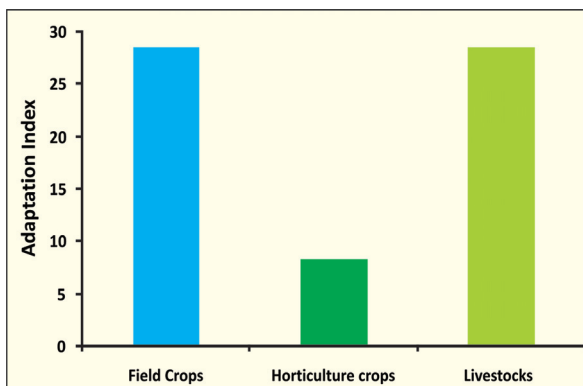


Fig. 2: All India adaptation indexes of various enterprises of the integrated farming system

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Hence, not depicted in the figure showing the adaptation index (Fig. 2).

The results of correlation coefficients (r) between adaptation measures adopted and the various characteristics of the survey population revealed significant correlation ($r=0.20$) between adaptation measures adopted by the farmers with their annual income. Education level of the farmers come to the next of income but it was non-significant with others parameters (Fig.3).

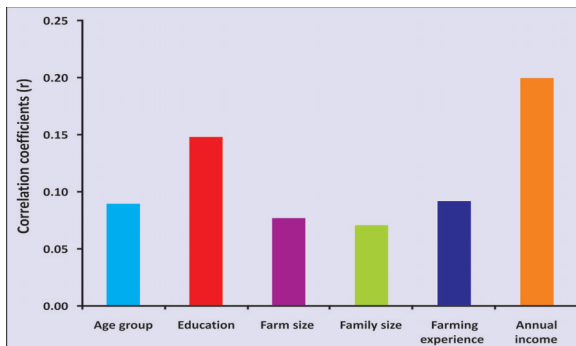


Fig. 3: Correlation coefficients of adaptation measures adopted with various characteristics of the farmers

Conclusion

Out of seventeen sensitive issues related to changing climate, increase in day temperature, late onset of monsoon and decrease in rainfall amount were found first, second and third rank whereas, early onset of monsoon was least supported by the survey population. More than two third farmers revealed that the incidence of pest and diseases increased. Change in planting dates of major crops was found most adopted adaptive measure towards changing climate. The significant correlation coefficients ($r=0.20$) was calculated between adaptation measures adopted with annual income of the farmers. Level of farmers education come to the next in terms of socio-economic factors associated with the adaptive capacity of the farmers towards changing scenario of the climate.



SRIKAKULAM, ANDHRA PRADESH

Md. Latheef P., K.T. Rao, V. Sridevi, A.U. Rao, N. Lakshminarayana
and N.V. Rao

AICFRP-IFS, ARS, Seethampeta, Srikakulam, ANGRAU, A.P.

A study was conducted in the three different villages namely Mahadevalasa, J Gopalapuram and CSR peta in Veeraghottam block which is agriculturally high productive block and also villages of Chinarama, Nadimibillaguda and Naiduguda in Seethampeta block which is considered agriculturally low productive block in High Altitude and Tribal Area of Srikakulam district of AP with the geological coordinates of 18°17.81 N latitude and

83°53.83 E longitude with an elevation of 76.2-110.34 meter. The annual rainfall of the survey area is around 900-1100 mm where maximum rainfall precipitated during the south- west monsoon. About 55% farmers were 21-30 years of farming experience. More than two third farmers are uneducated and cent percent farmers are earning less than ₹ 1.0 lakh from almost less than 1.0 ha and the average family size of 4-8 members.

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|----------------------------|-----------|----------|
| Educational level | None | 62 |
| | Primary | 32 |
| | Secondary | 5 |
| | College | 2 |
| Farm size (ha.) | <1.0 | 88 |
| | 1-2.5 | 12 |
| Farming experience (years) | <10 | 2 |
| | 10-20 | 25 |
| | 21-30 | 55 |
| | >30 | 18 |
| Annual income (₹) | <1.0 | 100 |

Perception of the tribal farmers towards changing climate

Analysis of data pertaining to farmer's perception on changing climate reveals that the farmers opinioned that frequency of drought and day temperature is increasing with the late onset of monsoon, are the main climate change scenario in the district. The other two main climate changes in the district are decrease in the annual rainfall amount with uneven distribution coupled with increased night temperature with reduced water table (Table 2).



Table 2: Farmer's perceptions regarding changing climate

| Parameters | Per cent | Rank |
|---|----------|------|
| Day temperature increased | 100 | 1 |
| Frequency of drought increased | 100 | 1 |
| Late onset of monsoon | 98 | 2 |
| Decrease in rainfall amount | 97 | 3 |
| Night temperature increased | 92 | 4 |
| Water table decreased | 90 | 5 |
| Both day and night temperature increased | 88 | 6 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 87 | 7 |
| Frequency of heat wave increased | 68 | 8 |
| Crop lodging due to high wind velocity increased | 60 | 9 |
| Frequency of hail storm increased | 53 | 10 |
| Terminal heavy rains | 47 | 11 |
| Erratic distribution of rainfall there by, affecting length of growing season | 30 | 12 |
| Frequency of flood increased | 22 | 13 |
| Frequency of cold wave increased | 10 | 14 |
| Frequency of frost increased | 10 | 14 |
| Early onset of monsoon | 5 | 15 |

Farmer's perceptions and adaptation measures adopted in field crops

Cent percent farmers perceive that incidence of pest and diseases enhanced compared to earlier years and productivity of non-traditional oilseed increased. Changes in cropping pattern and area along with the productivity of the rice crop have been witnessed by more than 85 percent of the survey population (Table 3). Regarding the adoption measures to the climate changes in the present context of field crops raising indicates that intercropping and mixed cropping is the priority component in mitigating the change in the view of food security of the marginal and small household is concerned which was opined by the 87 percent of the surveyed population. The habit of growing drought resistant crops with very short duration in order to escape from the adverse climate changes in the tail end of the crop growth. The change in the sowing and planting period based on the seasonal monsoonal rains coupled with the usage of water harvesting structures especially in rain fed and dry land areas is the priority that 58 percent of the sample farmers opinioned and agreed with this adaption measures in most of the field crops.



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Table 3: Farmer's perceptions regarding growing of crops and adaptation measures towards changing climate in field crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Incidence of pest and diseases increased | 100 | 1 |
| Productivity of non-traditional oilseed increased | 97 | 2 |
| Cropping pattern changed | 87 | 3 |
| Growing area of rice increased | 87 | 3 |
| Productivity of rice increased | 85 | 4 |
| Growing area of non-traditional oilseed crops | 83 | 5 |
| Growing area of pulses increased | 73 | 6 |
| Productivity of pulses increased | 73 | 6 |
| Infestation of new weeds/ insect pest increased | 60 | 7 |
| Residue recycling increased | 47 | 8 |
| Availability of irrigation water decreased | 42 | 9 |
| Productivity of ragi increased | 25 | 10 |
| Growing area of ragi increased | 23 | 11 |
| Growing area of sorghum and other millets crops increased | 23 | 11 |
| Productivity of sorghum and other millets increased | 12 | 12 |
| Adaptation measures adopted towards changing climate | | |
| Intercropping/mixed cropping adopted | 87 | 1 |
| Change in planting dates of major crops | 58 | 2 |
| Changed to short, drought resistant varieties | 58 | 2 |
| Rain water harvesting/Water harvesting structures made | 42 | 3 |
| Have insurance | 17 | 4 |
| Mulching adopted as soil moisture conservation techniques | 8 | 5 |
| Land configuration techniques is adopted as soil moisture technique | 8 | 5 |

Farmers' perceptions regarding growing of horticultural crops and adaptation measures adopted towards changing climate

Effects of changing climate and management options are perceived by the most of the farmers on taste and flavour of the fruits. Insects pest infestation increased and water requirement for successful raising of horticultural crops are also increased due to changing climate. As far as horticultural crops are concerned the 97 percent of the farmers opinioned that plant protection is the major adaptation measure to be followed in the hilly commercial Cashew, Turmeric and other mango orchard crops. In order to reap good produce in the horticultural crops the major adaption of the

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change of the planting season of the vegetables crops merged with habit of using early and drought resistant genotypes in the coming days of horticulture. Water harvesting structures especially in rain fed and dry land areas is the priority that 38 percent of the sample farmers opinioned and agreed with this adaption measures in most of the vegetable crops (Table 4).

Table 4: Farmers' perceptions regarding growing of horticultural crops and adaptation measures adopted towards changing climate

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's Perception | | |
| Change observed in taste/flavour of fruits | 97 | 1 |
| Insects pest infestation increased | 90 | 2 |
| Water requirement of crops increased | 90 | 2 |
| Early flowering in fruits / plantation crops | 70 | 3 |
| Growing area of cashew increased | 60 | 4 |
| Productivity of cashew increased | 60 | 4 |
| Growing area of turmeric increased | 50 | 5 |
| Growing area of mango increased | 50 | 5 |
| Growing area of vegetables increased | 50 | 5 |
| Productivity of turmeric increased | 50 | 5 |
| Productivity of mango increased | 50 | 5 |
| Productivity of vegetables increased | 50 | 5 |
| Adaptation measures adopted towards changing climate | | |
| Plant protection measures adopted | 97 | 1 |
| Change in planting dates of vegetables crops | 53 | 2 |
| Changed to short stature, drought resistant varieties | 50 | 3 |
| Rain water harvesting/Water harvesting structures made | 38 | 4 |
| Mulching adopted as soil moisture conservation techniques | 37 | 5 |
| Introduced new crops | 25 | 6 |
| Early harvest | 22 | 7 |



Photo: Adoption measures followed by tribal farmers in hilly areas of A.P.



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Farmers' perceptions and adopted measures regarding animal husbandry

The foremost point from the farmers perceptions about rearing of animals come as availability of green fodder is decreased. Backyard poultry as well as number of livestock per household is decreased under the current climatic situation. Prophylactic measures are being taken against disease infestation and farmers prefer to rear cross breeds over the indigenous breeds. Adoption of insurance policy in case of animal husbandry is still least preferred by the small and marginal farmers (Table 5).

Table 5: Farmers' perceptions regarding rearing of animals and adaptation measures adopted towards changing climate

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Green fodder availability decreased | 93 | 1 |
| Number of poultry per household decreased | 87 | 2 |
| Number of livestock per household decreased | 83 | 3 |
| Changes observed in rearing of animals | 67 | 4 |
| Numbers of goats per household decreased | 67 | 4 |
| Milk productivity increased | 53 | 5 |
| Cow is replaced by buffalo | 48 | 6 |
| Adaptation measures adopted towards changing climate | | |
| Prophylactic measures taken against disease infestation | 87 | 1 |
| Rear cross breeds | 55 | 2 |
| Raise green fodder in off season | 52 | 3 |
| Use of ventilated pacca shelter | 42 | 4 |
| Have insurance | 32 | 5 |

Adaptation index

The highest adaptation index was recorded in case of field crops and in rearing of animals and it was least in case of horticultural crops (Fig. 1).

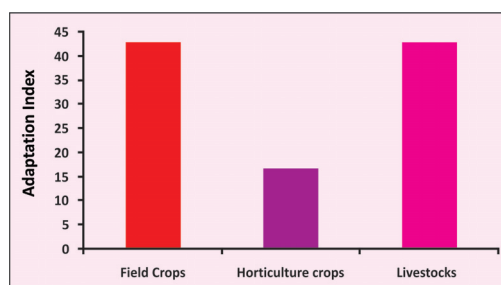


Fig. 1. Adaptation index of the farmers towards changing climate for different components of the farming systems



JORHAT, ASSAM

Ajoy Sankar Borah

Assam Agricultural University

A sample survey of 60 farmers was conducted to study the perception of farmers & adaption towards climate change in six villages under two blocks of Kamrup district of Assam. The district is located between 90.48^o-91.50^oE longitude and 25.46^o-26-49^oN latitude. The district experiences heavy annual rainfall in the range of 1500 mm to 2600 mm. The major agriculture and allied enterprises of the district are rice, rapeseed, vegetables, banana, Pineapple, orange, coconut, arecanut, bamboo, dairy, piggery, poultry and fishery.

General characteristics of the survey population (Table 1) revealed that most of farmers (57 %) had education up to primary school followed by 33 percent upto secondary level. Most of the farmers (73%) had farm size of less than 1 ha followed by 27 percent within the range of 1-2.5 ha. With regard to the farm experience, 40 percent farmers had more than 30 years of farm experience followed by 33 percent with 21 – 30 years of farm experience. All of the farmers had annual income of less than rupees one lakh.

Table 1: Characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | None | 2 |
| | Primary | 57 |
| | Secondary | 33 |
| | College | 8 |
| Farm size (ha.) | <1.0 | 73 |
| | 1-2.5 | 27 |
| Farming experience | 10-20 | 27 |
| | 21-30 | 33 |
| | >30 | 40 |
| Annual income (₹) | <1.0 | 100 |

Perceptions of farmers regarding changing climate

Majority of farmers (80-95%) had opined that there was increase in day temperature, night temperature, both day and night temperature, late onset of monsoon, decrease in rainfall and terminal heavy rains (Table 2). About , 68-75 % farmers opined that there was increase in day frequency of drought, frequency of



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heat wave, decrease in water table, erratic distribution of rainfall their by affecting length of growing season, increase in frequency of flood increased and decrease in water table. Another important perception was that about 43 percent of the farmers believed that indigenous technical knowledge (ITKs) for weather forecasting failing.

Table 2: Farmer's perceptions regarding changing climate

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Day temperature increased | 95 | 1 |
| Both day and night temperature increased | 93 | 2 |
| Night temperature increased | 92 | 3 |
| Late onset of monsoon | 90 | 4 |
| Decrease in rainfall amount | 85 | 5 |
| Terminal heavy rains | 82 | 6 |
| Erratic distribution of rainfall there by, affecting length of growing season | 75 | 7 |
| Frequency of heat wave increased | 73 | 8 |
| Water table decreased | 70 | 9 |
| Frequency of drought increased | 68 | 10 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 43 | 11 |
| Crop lodging due to high wind velocity increased | 25 | 12 |
| Frequency of flood increased | 20 | 13 |
| Frequency of hail storm increased | 5 | 14 |
| Early onset of monsoon | 3 | 15 |
| Frequency of cold wave increased | 2 | 16 |
| Frequency of frost increased | 0 | 17 |

Farmer's perceptions and adopted measures regarding growing of field crops

Perusal of Table 3 revealed that there were changes in growing of major crops namely rice and toria to the extent of 73 and 40 percent respectively. Further, 95 percent of the farmers expressed that there was change in cropping pattern, and 97 per cent farmers believed that there is increased infestation of new weeds/ insect pest. The adaptation measures taken by the farmers was 73 percent with regard to change in planting dates, 50% with regard to use of short and drought resistant varieties and 35% with regards to use of mulching whereas no farmers resort to insurance on their crops. Only 12 per cent of the farmers had adopted mixed and intercropping.



Table 3: Farmer's perceptions and adopted measures regarding growing of crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Infestation of new weeds/ insect pest increased | 97 | 1 |
| Cropping pattern changed | 95 | 2 |
| Incidence of pest and diseases increased | 90 | 3 |
| Residue recycling increased | 75 | 4 |
| Growing area of rice increased | 73 | 5 |
| Productivity of rice increased | 70 | 6 |
| Availability of irrigation water decreased | 45 | 7 |
| Growing area of toria increased | 40 | 8 |
| Productivity of toria increased | 33 | 9 |
| Adaptation measures adopted towards changing climate | | |
| Change in planting dates of major crops | 73 | 1 |
| Changed to short, drought resistant varieties | 50 | 2 |
| Soil moisture conservation techniques adopted as land configuration adopted | 38 | 3 |
| Mulching adopted as soil moisture conservation techniques | 35 | 4 |
| Rain water harvesting/Water harvesting structures made | 30 | 5 |
| Intercropping/mixed cropping adopted | 12 | 6 |

Farmer's perceptions and adopted measures regarding growing of horticultural crops

The data depicted in Table 4 clearly revealed that there were changes in growing of horticultural crops namely arecanut (62%) and turmeric (48%).82% farmers opined that there has been increased pest and disease infestation and about 70% farmers observed that there has been change in taste and flavor of the fruits. The data on adaptation measures adopted by the farmers clearly revealed that 83% of the farmers had taken adaptation measures with regard to plant protection measures, 65% farmers adopted short stature and resistant varieties, while, no farmers resorted to crop insurance.

Farmer's perceptions and adopted measures regarding animal husbandry

Fifty seven per cent of the farmers observed change in rearing of animals. Majority of the farmers (68-77 %) opined that there was decrease in number of livestock's per household and green fodder availability. Only 2-28% farmer's taken



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Table 4: Farmer's perceptions and adopted measures regarding growing of horticultural crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Insects pest infestation increased | 82 | 1 |
| Water requirement of crops increased | 77 | 2 |
| Change observed in taste/flavour of fruits | 70 | 3 |
| Growing area of arecanut | 62 | 4 |
| Growing area of turmeric | 48 | 5 |
| Early flowering in fruits / plantation crops | 48 | 5 |
| Productivity of arecanut | 20 | 6 |
| Productivity of turmeric | 10 | 7 |
| Adaptation measures adopted towards climate change | | |
| Plant protection measures adopted | 83 | 1 |
| Changed to short stature, drought resistant varieties | 65 | 2 |
| Change in planting dates of vegetables crops | 55 | 3 |
| Rain water harvesting/Water harvesting structures made | 50 | 4 |
| Mulching adopted as soil moisture conservation techniques | 47 | 5 |
| Early harvest | 42 | 6 |
| Introduced new crops | 22 | 7 |
| Use of net as hail shelter | 3 | 8 |
| Night irrigations applied to vegetable crops to mitigate the effect of frost & cold | 2 | 9 |

adaptation measures in respect to rearing of cross breeds, raise green fodder in off season, prophylactic against disease infestation etc. On the contrary, no farmers resorted to insurance measures (Table 5).

Table 5: Farmer's perceptions and adopted measures regarding animal husbandry

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Number of livestock per household decreased | 77 | 1 |
| Green fodder availability decreased | 68 | 2 |
| Changes observed in rearing of animals | 57 | 3 |
| Milk productivity increased | 40 | 4 |
| Numbers of goats per household decreased | 38 | 5 |
| Number of poultry per household decreased | 22 | 6 |
| Adaptation measures adopted towards climate change | | |
| Raise green fodder in off season | 28 | 1 |
| Prophylactic measures taken against disease infestation | 27 | 2 |
| Use of ventilated pukka shelter | 20 | 3 |
| Rear cross breeds | 18 | 4 |
| Use of electric heaters to elevate the shelter temperature during strong cold | 15 | 5 |
| Use of electric fans/coolers during summer | 2 | 6 |



Farmer's perceptions and adopted measures regarding fish farming

Most of the farmers observed that water requirement of the ponds have increased (67%). They also opined that disease infestation and fish mortality has increased. It is evident that 45 per cent farmers adopted rearing of improved fingerlings and 35 % farmers introduced new species as part of adaptation measures (Table 6).

Table 6: Farmer's perceptions and adopted measures regarding fish farming

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmers perception | | |
| Water requirement of pond is increased | 67 | 1 |
| Disease infestation increased | 63 | 2 |
| Fish mortality in pond increased | 42 | 3 |
| Number of ponds decreased/ dried | 38 | 4 |
| Adaptation measures adopted towards climate change | | |
| Rear improved fingerlings | 45 | 1 |
| Introduction of new species | 35 | 2 |
| Prophylactic measures taken against disease infestation | 33 | 3 |
| Multiple use of water as irrigation/washing of animals sheds/ animals | 30 | 4 |

Adaptation index of the farmers towards changing climate for different components of the farming systems

The graph (Fig. 1) showed that the adaptation index was 14% with respect to field crops and 25% with respect to horticultural crops, while the adaption index for livestock and fishery is zero.

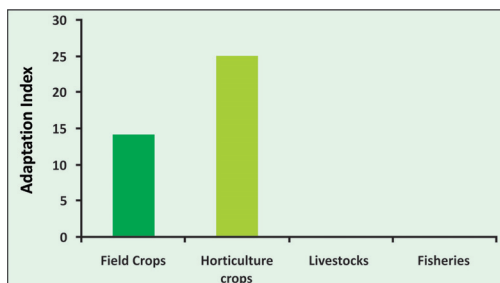


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems



PURNEA, BIHAR

D.K. Mahto

BPSAC, Purnea (Bihar)

The Purnea is located in 25°-13' to 27°-07' N latitude and 86°-59' to 87°-52' E Longitude and 37.5 m above MSL. The soil of the Purnea is sandy loam and the annual rainfall of the region is 1350 mm. The general cropping system of the region is rice- wheat, rice-maize, rice-potato, rice-mustard. The study villages were comes under two blocks i.e. Jalalgarh & Kasba of Purnea.

Perceptions of farmers regarding changing climate

Farmers of Purnea dist. strongly support that the climate is changing and climate parameters like day temperature, night temperature and frequency of drought are increased under current climatic conditions. But no people turned to say that frequency of flood and hail storm have increased (Table 2).

Farmer's perceptions and adopted adaptation measures regarding growing of field crops

Cent per cent farmers witnessed that cropping pattern of the study area is changed, incidence of pest and diseases increased, infestation of new weeds/ insect pest increased and farmers are incorporating crop residue in the fields. As a practice of adaptation measures towards changing climate rain water harvesting/ water harvesting structures are made in the area (Table 3).

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | None | 5 |
| | Primary | 45 |
| | Secondary | 38 |
| | College | 12 |
| Farm size (ha.) | <1.0 | 57 |
| | 1-2.5 | 40 |
| | >2.5 | 3 |
| Farming experience | 10-20 | 37 |
| | 21-30 | 27 |
| | >30 | 37 |
| Annual income (₹) | <1.0 | 100 |

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Table 2: Farmer's perceptions regarding climate changing

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Day temperature increased | 100 | 1 |
| Both day and night temperature increased | 100 | 1 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 100 | 1 |
| Frequency of drought increased | 100 | 1 |
| Decrease in rainfall amount | 98 | 2 |
| Erratic distribution of rainfall there by, affecting length of growing season | 98 | 2 |
| Frequency of heat wave increased | 98 | 2 |
| Late onset of monsoon | 97 | 3 |
| Night temperature increased | 93 | 4 |
| Water table decreased | 82 | 5 |
| Crop lodging due to high wind velocity increased | 75 | 6 |
| Frequency of cold wave increased | 15 | 7 |
| Frequency of frost increased | 3 | 8 |
| Early onset of monsoon | 2 | 9 |
| Terminal heavy rains | 2 | 9 |
| Frequency of flood increased | 0 | 10 |
| Frequency of hail storm increased | 0 | 10 |

Table 3: Farmer's perceptions and adopted measures regarding growing of field crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Cropping pattern changed | 100 | 1 |
| Incidence of pest and diseases increased | 100 | 1 |
| Infestation of new weeds/ insect pest increased | 100 | 1 |
| Residue recycling increased | 100 | 1 |
| Adaptation measures adopted towards climate change | | |
| Rain water harvesting/Water harvesting structures made | 98 | 1 |

Farmer's perceptions and adopted adaptation measures regarding growing of horticultural crops

It was evidenced that cent per cent farmers perceived that there is change in taste/flavor of fruits and insect pest infestation has been increased. Water requirement of horticultural crops is increased under changing climatic conditions.



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Under adaptation measures against ill effect of climate change on the horticultural crops, plant protection measures stands first among others adaptive measures whereas, early harvest of the fruits to avoid the extreme weather effects were least preferred by the farmers of the area (Table 4).

Table 4: Farmer's perceptions and adopted adaptation measures regarding growing of horticultural crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Change observed in taste/flavour of fruits | 100 | 1 |
| Insects pest infestation increased | 100 | 1 |
| Water requirement of crops increased | 100 | 1 |
| Adaptation measures adopted towards climate change | | |
| Plant protection measures adopted | 100 | 1 |
| Rain water harvesting/water harvesting structures made | 95 | 2 |
| Change in planting dates of vegetables crops | 75 | 3 |
| Early harvest | 2 | 4 |

Farmer's perception and adopted adaptation measures regarding rearing of animals

Cent per cent farmers were opined that there are visible changes in rearing of animals and number of livestock and poultry per household is reduced under current scenario of the climate, however milk productivity of the milch animals is increased (Table 5). Among the adaptation measures, only one prophylactic measures are being taken against disease infestation in the animals.

Table 5: Farmer's perceptions and adopted measures regarding animal husbandry

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Changes observed in rearing of animals | 100 | 1 |
| Number of livestock per household decreased | 100 | 1 |
| Milk productivity increased | 100 | 1 |
| Number of poultry per household decreased | 100 | 1 |
| Numbers of goats per household decreased | 98 | 2 |
| Green fodder availability decreased | 2 | 3 |
| Adaptation measures adopted towards climate change | | |
| Prophylactic measures taken against disease infestation | 63 | 1 |
| Rear cross breads | 3 | 2 |



Farmer's perception and adopted adaptation measures regarding fish farming

Cent per cent farmers perceive that the number of ponds decreased/dried, water requirement of pond is increased, fish mortality in pond increased and disease infestation is increased. Below 1/4th population of the farmers accepted that they are using water in principle of the multiple use and they have switched on to the rearing of the improved fingerlings/species of the fish (Table 6).

Table 6: Farmer's perceptions and adopted adaptation measures regarding fish farming

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Number of ponds decreased/ dried | 100 | 1 |
| Water requirement of pond is increased | 100 | 1 |
| Fish mortality in pond increased | 100 | 1 |
| Disease infestation increased | 100 | 1 |
| Adaptation measures adopted towards climate change | | |
| Multiple use of water as irrigation/washing of animals sheds/ animals | 23 | 1 |
| Rear improved fingerlings | 19 | 2 |
| Introduction of new species | 3 | 3 |

Adaptation index of the farmers towards changing climate for different components of the farming systems

The graph (Fig. 1) showed that the adaptation index was 14% with respect to field crops and livestock whereas it was 25% in case of horticultural crops and zero in case of fishery.

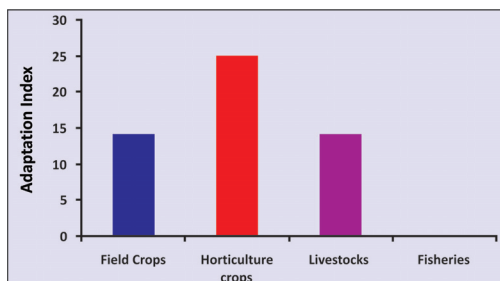


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems



PALAMPUR, HIMACHAL PRADESH

S.K. Sharma

Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur

Selected two blocks were Fatehpur & Dehra in district of Kangra. The area receives annual rainfall of 1902 mm with mean minimum & mean maximum temperatures of 15 & 23°C, respectively. The latitude of the blocks surveyed varies from 31.54-32.08°N and longitude from 75.57 to 76.16°E. Maize-wheat and Rice-wheat are the prominent cropping system & crops-livestock is the prominent farming system in the region. Seventy five per cent surveyed populations were qualified up to secondary whereas only 8% have graduation qualification. Majority of farmers (85%) were marginal possessing farm size of less than 1 ha.

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | None | 8 |
| | Primary | 8 |
| | Secondary | 75 |
| | College | 8 |
| Farm size (ha.) | <1.0 | 85 |
| | 1-2.5 | 15 |
| | >2.5 | 0 |
| Farming experience | <10 | 22 |
| | 10-20 | 13 |
| | 21-30 | 23 |
| | >30 | 42 |
| Annual income (₹) | <1.0 | 70 |
| | 1-2 | 20 |
| | 2-5 | 8 |
| | >5 | 2 |

Annual income of 70% of farmers was less than ₹ 1 lakh (Table 1).

Farmer's perceptions regarding changing climate

As regards perception towards changing climate, 90 % people are of the view that day temperatures are increased whereas 70% consider that both day & night temperatures are increasing. Decrease in amount of rainfall and erratic distribution of rainfall are also of major concern. 50-60 % of population are of the opinion that frequency of cold wave, heat wave & drought are increasing, 23 % of farmers realize that ITK for weather forecast is failing (Table 2).



Table 2: Farmer's perceptions regarding changing climate

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Crop lodging due to high wind velocity increased | 92 | 1 |
| Day temperature increased | 90 | 2 |
| Water table decreased | 77 | 3 |
| Night temperature increased | 73 | 4 |
| Both day and night temperature increased | 70 | 5 |
| Frequency of frost increased | 67 | 6 |
| Late onset of monsoon | 60 | 7 |
| Decrease in rainfall amount | 60 | 7 |
| Frequency of heat wave increased | 60 | 7 |
| Frequency of cold wave increased | 57 | 8 |
| Frequency of drought increased | 53 | 9 |
| Frequency of flood increased | 47 | 10 |
| Early onset of monsoon | 38 | 11 |
| Erratic distribution of rainfall there by, affecting length of growing season | 38 | 11 |
| Terminal heavy rains | 35 | 12 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 23 | 13 |
| Frequency of hail Storm increased | 17 | 14 |

Farmer's perception and adopted adaptation measures for growing of major field crops

Regarding perception towards growing of crops, more than 80% farmers opined that area and productivity of wheat and maize is increased under current climatic condition prevailed in the study area. Insect pest infestation and infestation of new weeds and pest are also emerged under current set up of climatic condition. Among the adaptation measures against climate change to raise the field crops farmers have changed the planting date and switched to the short, drought resistant varieties over traditional varieties (Table 3).

Farmer's perception and adopted adaptation measures for growing of horticultural crops

Regarding horticultural crops 73 % farmers feel that water requirement of crops has increased and 58 % feel that Insects pest infestation increased. Changes



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Table 3: Farmer's perception and adopted adaptation measures for raising the field crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Growing area of wheat increased | 85 | 1 |
| Growing area of maize increased | 83 | 2 |
| Productivity of maize increased | 83 | 2 |
| Productivity of wheat increased | 83 | 2 |
| Incidence of pest and diseases increased | 78 | 3 |
| Infestation of new weeds/ insect pest increased | 62 | 4 |
| Availability of irrigation water decreased | 60 | 5 |
| Productivity of Rice increased | 57 | 6 |
| Cropping pattern changed | 45 | 7 |
| Growing area of rice increased | 38 | 8 |
| Productivity of gobhi-sarson increased | 33 | 9 |
| Growing area of gobhi-sarson increased | 25 | 10 |
| Residue recycling increased | 22 | 11 |
| Adaptation measures adopted towards climate change | | |
| Change in planting dates of major crops | 68 | 1 |
| Changed to short, drought resistant varieties | 65 | 2 |
| Intercropping/mixed cropping adopted | 50 | 3 |
| Mulching adopted as soil moisture conservation techniques | 20 | 4 |
| Rain water harvesting/Water harvesting structures made | 10 | 5 |
| Soil moisture conservation techniques adopted as land configuration adopted | 8 | 6 |

observed in taste/flavours of fruits due to climate change and early fruit setting was supported by 48 and 45 per cent of the population respectively. Among the adaptation measures adopted by the farmers in case of horticultural crops shifting of planting dates of vegetables and plant protections measures stood first and second respectively (Table 4).

Farmer's perception and adopted adaptation measures in animal husbandry

In respect of animal husbandry, about 83% farmers opined that cow is replaced by the farmers under climatic conditions. Farmers also perceive that milk productivity of the milch animals is increased whereas availability of the green fodder is reduced. Farmers are rearing cross breeds and also raising off season green fodder (Table 5).

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Table 4: Farmer's perception and adopted adaptation measures for raising the horticultural crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Water requirement of crops increased | 73 | 1 |
| Insects pest infestation increased | 58 | 2 |
| Change observed in taste/flavour of fruits | 48 | 3 |
| Early flowering in fruits / plantation crops | 45 | 4 |
| Growing area of mango increased | 33 | 5 |
| Productivity of mango increased | 33 | 5 |
| Productivity of orange increased | 3 | 6 |
| Growing area of orange increased | 2 | 7 |
| Adaptation measures adopted towards climate change | | |
| Change in planting dates of vegetables crops | 55 | 1 |
| Plant protection measures adopted | 47 | 2 |
| Early harvest | 40 | 3 |
| Changed to short stature, drought resistant varieties | 32 | 4 |
| Introduced new crops | 20 | 5 |
| Smokes, heaters are used in the orchard to reduce the effect of cold, frost etc | 20 | 5 |
| Use of net as hail shelter | 15 | 6 |
| Rain water harvesting/Water harvesting structures made | 13 | 7 |
| Raise the crops in playhouse to mitigate the effect of high temperature | 12 | 8 |
| Night irrigations applied to mitigate the effect of frost & cold | 10 | 9 |
| Mulching adopted as soil moisture conservation techniques | 7 | 10 |

Table 5 :Farmer's perception and adopted adaptation measures in animal husbandry

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Cow is replaced by buffalo | 83 | 1 |
| Milk productivity increased | 70 | 2 |
| Green fodder availability decreased | 70 | 2 |
| Changes observed in rearing of animals | 60 | 3 |
| Number of livestock per household decreased | 58 | 4 |
| Number of poultry per household decreased | 55 | 5 |
| Numbers of goats per household decreased | 55 | 5 |



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| Parameters | Per cent | Rank |
|---|----------|------|
| Adaptation measures adopted towards climate change | | |
| Rear cross breeds | 65 | 1 |
| Raise green fodder in off season | 52 | 2 |
| Use of ventilated pukka shelter | 33 | 3 |
| Use of electric fans/coolers during summer | 17 | 4 |
| Prophylactic measures taken against disease infestation | 10 | 5 |
| Use of electric heaters to elevate the shelter temperature during strong cold | 7 | 6 |

Adaptation index of the farmers towards changing climate for different components of the farming systems

The graph (Fig. 1) showed that the adaptation index was 29 per cent with respect to field crops and 8 per cent with respect to horticultural crops, while the adaptation index for livestock is 29 per cent.

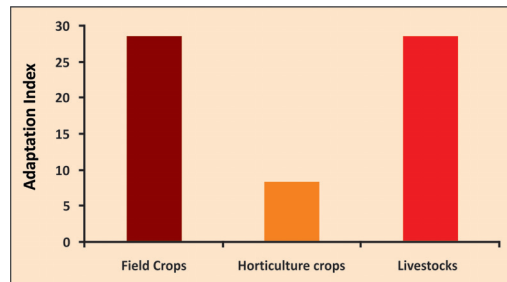


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems



PAKUR, JHARKHAND

W.Aind

Birsa Agricultural University, Pakur, Ranchi (Jharkhand)

Pakur, famous for stone and beedi (Biri) making industry, is one of the important districts of newly created Jharkhand state. The area of the district is 686.21 sq.km extended between 23^o to 40^o & 25^o to 18^o - north latitude and between 86^o-28^o and 87^o-57^o east longitudes. The climate of the major portion of the district has a hot dry summer, a good rainy season and cool winter. However the climate conditions of Pakur is characterized by damp heat. summer begins from the middle of March here and extends up to June. Maximum temperature in May and early June is as high as 46.70 C. December & January are cool months. The district received the average annual rainfall of 1250 mm. Rice-wheat cropping systems are dominant. Draft animal, goat, pig and poultry are kept dominant livestock in the region. The farmers were selected for the survey purpose from five village of Maheshpur and Pakur block of Pakur district (24^o38.07N, 87^o48.62 E, MSL 184.3) of Jharkhand in central and

north eastern plateau zone IV. General characteristics analysis of the surveyed population revealed that more than 3/4th population has secondary level of education. Most of the farmers (82%) has less than one hectare holding size and they earn less than one lakh in a year (Table 1). Ranking of the results was done to know the major finding from the survey.

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | Primary | 3 |
| | Secondary | 72 |
| | College | 25 |
| Farm size (ha.) | <1.0 | 82 |
| | 1-2.5 | 17 |
| | >2.5 | 2 |
| Farming experience | <10 | 12 |
| | 10-20 | 57 |
| | 21-30 | 10 |
| | >30 | 20 |
| Annual income (₹) | <1.0 | 97 |
| | 1-2 | 2 |
| | 2-5 | 2 |



AICRP on IFS: On Farm Research Farmer's Perception on Climate Change

Farmer's perceptions regarding changing climate

The results revealed that decrease in water table and increase in day time temperature was major perception of the farmers (100%) about the changing climate. Decrease in rainfall amount and late onset of the monsoon were given 2nd and 3rd ranking by the farmers. Increased frequency of frost, hail storm and flood were not supported by the farmers and these were given least point (Table 2).

Table 2: Farmer's perceptions regarding changing climate

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Day temperature increased | 100 | 1 |
| Water table decreased | 100 | 1 |
| Decrease in rainfall amount | 97 | 2 |
| Late onset of monsoon | 93 | 3 |
| Frequency of cold wave increased | 70 | 4 |
| Erratic distribution of rainfall there by, affecting length of growing season | 60 | 5 |
| Frequency of drought increased | 60 | 5 |
| Frequency of heat wave increased | 60 | 5 |
| Crop lodging due to high wind velocity increased | 43 | 6 |
| Night temperature increased | 40 | 7 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 40 | 7 |
| Both day and night temperature increased | 27 | 8 |
| Terminal heavy rains | 10 | 9 |
| Early onset of monsoon | 7 | 10 |
| Frequency of flood increased | 0 | 11 |
| Frequency of hail storm increased | 0 | 11 |
| Frequency of frost increased | 0 | 11 |

Farmer's perception and adaptation measures adopted for growing major field crops

Data pertaining to farmer's perceptions regarding growing of crops under changing climate scenario is presented in table 3. Results revealed that shortage of irrigation water and infestation of new weeds/ insect pest are the major constraints in the district. Growing area of major crops like wheat, lentil and gram increased. However productivity of rice and wheat is increased. Farmers are also practicing the concept of crop residue recycling. The farmers of the district are taking only two

**AICRP on IFS: On Farm Research
Farmer's Perception on Climate
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Table 3: Farmer's perceptions and adopted adaptation measures for growing of major field crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Productivity of wheat increased | 100 | 1 |
| Availability of irrigation water decreased | 100 | 1 |
| Infestation of new weeds/ insect pest increased | 100 | 1 |
| Growing area of wheat increased | 93 | 2 |
| Growing area of lentil increased | 93 | 2 |
| Growing area of gram increased | 93 | 2 |
| Productivity of rice increased | 90 | 3 |
| Growing area of rice increased | 82 | 4 |
| Productivity of maize increased | 80 | 5 |
| Productivity of lentil increased | 80 | 5 |
| Residue recycling increased | 20 | 6 |
| Incidence of pest and diseases increased | 15 | 7 |
| Adaptation measures adopted towards climate change | | |
| Change in planting dates of major crops | 100 | 1 |
| Intercropping/mixed cropping adopted | 100 | 1 |

adaptation measure out of seven and they are change in planting dates of major crops and adaptation of intercropping/mixed cropping in case of field crops under changing climate situation.

Farmer's perception and adaptation measures adopted for growing horticultural crops

Water requirement of horticultural crops increased under the changing climate and it was supported by the cent percent of the survey sample. Twenty five percent of the farmers revealed that there is the cultivation of the potato is gaining thrust and its productivity is also increased under changing climate scenario. About 98 percent farmers of the survey population discard that early shift of flowering time in fruits and plantation crops. However none of the adaptation measures out of 12 are being adopted in case of horticultural crops (Table 4).



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Table 4: Farmer's perceptions and adopted adaptation measures regarding growing of horticultural crops under climate change

| Parameters | Per cent | Rank |
|--|----------|------|
| Farmer's perception | | |
| Water requirement of crops increased | 100 | 1 |
| Growing area of potato | 25 | 2 |
| Productivity of potato | 25 | 2 |
| Change observed in taste/flavour of fruits | 20 | 3 |
| Insects pest infestation increased | 20 | 3 |
| Early flowering in fruits / plantation crops | 2 | 6 |

Farmer's perception and adaptation measures adopted in animal husbandry

Results of data collected on perception of farmers about rearing of animals showed that cent percent of the survey population agreed with the fact that number of livestock, poultry and goat per households decreased. However none of them accepted that cow is replaced by buffalo, milk productivity is increased and green fodder availability decreased in the district (table 5). Very few farmers told that they are taking prophylactic measures against disease infestation in case of livestock, poultry, goat etc. Remaining all others measures are untouched by the farmers.

Table 5: Farmer's perceptions and adopted adaptation measures in animal husbandry

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Number of livestock per household decreased | 100 | 1 |
| Number of poultry per household decreased | 100 | 1 |
| Numbers of goats per household decreased | 100 | 1 |
| Changes observed in rearing of animals | 13 | 2 |
| Adaptation measures adopted towards climate change | | |
| Prophylactic measures taken against disease infestation | 3 | 1 |

Farmer's perception and adaptation measures adopted in fish farming

Data related to farmer's perceptions on change in fish rearing under changing climate is presented in table 6 and it was deduced that there is no support towards

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the statement related to increment in the water requirement of the pond, disease infestation and fish mortality. However about 80 percent of the survey population agreed with the fact that number of ponds decreased/ dried in the district. Farmers were asked about six adaptive measures in relation to fish farming towards changing climate and it was noted that cent percent survey population was agreed with multiple use of water as irrigation/washing of animal's sheds/ animals and very few of them are using prophylactic measures against disease infestation (Table 6).

Table 6: Farmer's perceptions and adopted adaptation measures in fish farming

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Number of ponds decreased/ dried | 80 | 1 |
| Adaptation measures adopted towards climate change | | |
| Multiple use of water as irrigation/washing of animals sheds/ animals | 100 | 1 |
| Prophylactic measures taken against disease infestation | 1.67 | 2 |

Adaptation index of the farmers for practicing integrated farming system

The adaptation index for field crops, horticultural crops, livestock and fishery shows that the farmers are adopting adaptation measures only in case of raising field crops and fish farming. There was no any farmers revealed that any adaptation measures are being adopted by the farmers in case of horticultural crops and in rearing of the animals (Fig.1).

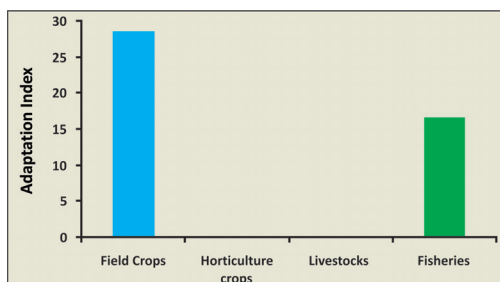


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems



DHARWAD, KARNATAKA

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The average annual rainfall of the region was 300-400 mm. The supplementary irrigation was given with bore well in Gadag block while in Nargund block crop was irrigated by canal water. The predominant cropping system was ground nut (K)-rabi sorghum and maize (K)-chickpea in Gadag and Nargund block, respectively. Dairy (cow /buffalo) was the subsidiary occupation in both the blocks. The latitude, longitude and altitude values for one of the village in Gadag block was 15.22°N, 75.37°E and 688 msl. The respective values for Nargund block was 15.44°E, 75.24°N and 666 msl, respectively.

The survey was conducted to know perception of farmers and adaptation measures towards climate change in the month of September and October, 2014 in the selected on farm research (OFR) farmers (60 farmers) of Kalasapur, Sambapur, Asundi, Dandapur, Surkod and Bhairanahatti villages of Gadag district covering two blocks (Gadag and

Nargund). In order collect the perception of farmers and adaptation measures towards climate change, the farmers were asked to give their option as Yes, No and Can't say. The general characteristics of the survey population (Table 1) revealed that majority of farmers (42 %) did not have education followed by 30 percent education up to primary school. Most of the farmers had farm size of 1-2.5 ha followed by 28

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | None | 42 |
| | Primary | 30 |
| | Secondary | 22 |
| | College | 7 |
| Farm size (ha.) | <1.0 | 28 |
| | 1-2.5 | 55 |
| | >2.5 | 17 |
| Farming experience | <10 | 3 |
| | 10-20 | 28 |
| | 21-30 | 22 |
| | >30 | 47 |
| Annual income (₹) | <1.0 | 100 |

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percent farmers less than one ha. With regard to the farming experience, 50 percent farmers had more than 30 years farm experience followed by 28 percent with 10–20 years of farm experience. Majority of the farmers had annual income of less than one lakh.

Perceptions of farmers regarding changing climate

Majority of farmers (100%) opined that there was increase in day temperature, night temperature, both day and night temperature, frequency of drought, frequency of hail storm, frequency of heat wave, late onset of monsoon, decrease in rainfall amount, terminal heavy rains, and erratic distribution of rainfall (Table 2). On the contrary, survey population rejected the null hypothesis that early onset of monsoon, indigenous technical knowledge (ITKs) for weather forecast failing, frequency of cold wave increased, frequency of frost increased and crop lodging due to high wind velocity increased.

Table 2: Farmer's perceptions regarding changing climate

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Day temperature increased | 100 | 1 |
| Night temperature increased | 100 | 1 |
| Both day and night temperature increased | 100 | 1 |
| Late onset of monsoon | 100 | 1 |
| Decrease in rainfall amount | 100 | 1 |
| Terminal heavy rains | 100 | 1 |
| Erratic distribution of rainfall there by, affecting length of growing season | 100 | 1 |
| Frequency of drought increased | 100 | 1 |
| Frequency of flood increased | 100 | 1 |
| Frequency of hail storm increased | 100 | 1 |
| Frequency of heat wave increased | 100 | 1 |
| Water table decreased | 100 | 1 |
| Early onset of monsoon | 0 | 2 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 0 | 2 |
| Frequency of cold wave increased | 0 | 2 |
| Frequency of frost increased | 0 | 2 |
| Crop lodging due to high wind velocity increased | 0 | 2 |



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Farmer's perceptions and adopted adaptation measures regarding growing of field crops

Perusal of Table 3 revealed that there were changes in growing of major crops (Hybrid maize and BT Cotton) to the extent of 100 percent while, 100 percent farmers opined that productivity of crops (Hybrid maize and BT Cotton) increased. Further, 100 percent of the farmers expressed that there was change in cropping pattern, cropping pattern and increased infestation of new weeds/ insect pest.

Table 3: Farmer's perceptions and adopted adaptation measures regarding growing of field crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Cropping pattern changed | 100 | 1 |
| Incidence of pest and diseases increased | 100 | 1 |
| Growing area of hybrid maize increased | 100 | 1 |
| Growing area of Bt cotton increased | 100 | 1 |
| Productivity of hybrid maize increased | 100 | 1 |
| Productivity of Bt cotton increased | 100 | 1 |
| Availability of irrigation water decreased | 100 | 1 |
| Infestation of new weeds/ insect pest increased | 100 | 1 |
| Growing area of sunflower increased | 50 | 2 |
| Adaptation measures adopted towards climate change | | |
| Change in planting dates of major crops | 100 | 1 |
| Intercropping/mixed cropping adopted | 100 | 1 |
| Have insurance | 42 | 2 |
| Rain water harvesting/Water harvesting structures made | 5 | 3 |

The adaptation measures taken by the farmers was 100 percent with regard to change in planting dates and practicing of intercropping/mixed cropping of major crops where as 42 percent farmers had insurance on their crops (Table 3). Only five percent of the farmers had taken adaptation measures on rain water harvesting/ water harvesting structures.



Farmer's perceptions and adopted adaptation measures regarding growing of horticultural crops

The data depicted in Table 4 clearly revealed that, 100 percent of the farmers opined that there were changes in growing of crops (onion + chilli intercropping), its increased productivity, insect pest infestation and water requirement of crops. The data in Table 4 clearly revealed that 100 percent of the farmers had taken adaptation measures with regard to change in planting dates of vegetables crops, plant protection measures and early harvest. While, only 22 percent farmers adopted rain water harvesting/water harvesting structures.

Table 4: Farmer's perceptions and adopted adaptation measures regarding growing of horticultural crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Growing area of onion+chilli Intercropping | 100 | 1 |
| Productivity of onion+chilli Intercropping increased | 100 | 1 |
| Insects pest infestation increased | 100 | 1 |
| Water requirement of crops increased | 100 | 1 |
| Adaptation measures adopted towards climate change | | |
| Change in planting dates of vegetables crops | 100 | 1 |
| Plant protection measures adopted | 100 | 1 |
| Early harvest | 100 | 1 |
| Rain water harvesting/Water harvesting structures made | 22 | 2 |

Farmer's perceptions and adopted adaptation measures regarding in animal husbandry

Cent percent farmers opined that there was decrease in number of livestock's per household, green fodder availability, number of poultry per household, numbers of goats per household and increased milk productivity (Table 5). Only 27 percent farmers expressed that cow is replaced by buffalo. Cent percent farmers adopted /used ventilated pukka shelter while, 77 percent farmers raised green fodder in off season. With regard to rearing of cross breeds, 42 percent farmers adopted this measure.



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Table 5: Farmer's perceptions and adopted adaptation measures regarding in animal husbandry

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Number of livestock per household decreased | 100 | 1 |
| Milk productivity increased | 100 | 1 |
| Green fodder availability decreased | 100 | 1 |
| Number of poultry per household decreased | 100 | 1 |
| Numbers of goats per household decreased | 100 | 1 |
| Cow is replaced by buffalo | 27 | 2 |
| Adaptation measures towards climate change | | |
| Use of ventilated pukka shelter | 100 | 1 |
| Raise green fodder in off season | 77 | 2 |
| Rear cross breeds | 42 | 3 |

Adaptation index of the farmers towards changing climate for different components of the farming systems

The graph (Fig 1) showed that the adaptation index was 29% with respect to field crops and livestock while; it was 25 percent with respect to horticultural crops.

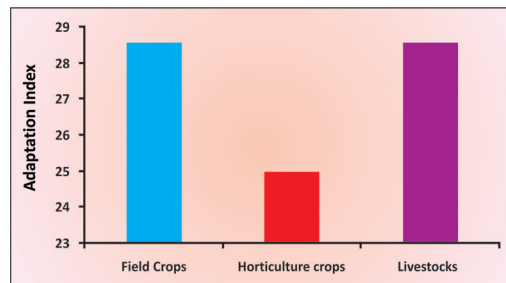


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems



KOLAR, KARNATAKA

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Kolar district is the eastern gateway to Karnataka. The district lies almost in the central part of peninsular India. This district experiences tropical climate throughout the year. The main occupation of people is agriculture. Kolar district lies between North latitude 12° 46' to 13° 58' and East longitude 77° 21' to 78° 35'. Average annual rainfall of the district is 740 mm. 9% of the total area of the district is covered by forest and 66% by cultivable land. 16% of the area is uncultivated. Cereals like maize and finger millet and vegetables like tomato, cabbage, lady's finger and short duration vegetables like coriander and reddish with one or two dairy animal with 2 to 3 sheep are the common farming enterprises. Sixty farmers belonging to small and marginal farmers group from the six villages of the two blocks namely Kollar and Srinivaspura of the district Kollar was interviewed on climate change and adaptation measures aspect. Education levels of the

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | None | 3 |
| | Primary | 18 |
| | Secondary | 47 |
| | College | 32 |
| Farm size (ha.) | <1.0 | 45 |
| | 1-2.5 | 47 |
| | >2.5 | 8 |
| Farming experience | <10 | 17 |
| | 10-20 | 35 |
| | 21-30 | 27 |
| | >30 | 20 |
| Annual income (₹) | <1.0 | 30 |
| | 1-2 | 37 |
| | 2-5 | 33 |

majority was at the secondary level (47%) followed by college level (32%) and in case of primary (18%). Majority of the farmers had farm sizes 1-2.5 ha. (47%) and <1.0 ha. (45%). The average annual income of farm family was ₹ 1.0-2.5 lakhs and no farmer exceeded the income beyond ₹ 5.0 lakh.



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Perceptions regarding climate changing

Majority of farmers have expressed that there is increase in day and night temperatures. They have also expressed there is a late set of rainfall followed by the ITK on weather forecasting has been failing in terms of their predictions. There is a frequent heat wave also due to regular drought situation. Cent percent farmers of revealed that there is decrease in water table due to climate change.

Table 2: Perception of the farmers on climate change

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Water table decreased | 98 | 1 |
| Frequency of drought increased | 93 | 2 |
| Decrease in rainfall amount | 82 | 3 |
| Day temperature increased | 80 | 4 |
| Both day and night temperature increased | 75 | 5 |
| Late onset of monsoon | 65 | 6 |
| Erratic distribution of rainfall there by, affecting length of growing season | 60 | 7 |
| Frequency of heat wave increased | 53 | 8 |
| Early onset of monsoon | 33 | 9 |
| Night temperature increased | 32 | 10 |
| Crop lodging due to high wind velocity increased | 17 | 11 |
| Terminal heavy rains | 13 | 12 |
| Frequency of frost increased | 12 | 13 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 8 | 14 |
| Frequency of hail storm increased | 3 | 15 |
| Frequency of flood increased | 2 | 16 |
| Frequency of cold wave increased | 2 | 16 |

Farmer's perception and adopted adaptation measures for growing field crops

There was a change observed in the productivity of crops and 98% of the farmers referring to incidence to pest and disease damage and change in cropping pattern. Inter cropping and mixed cropping with cultivating and short duration and resistant varieties was the major measures adopted. In order to provide a good crop stand and yield levels. Rain water harvesting and mulching with dust mulch and vegetative mulch could be practiced.

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Table 3: Farmer's perception and adopted adaptation measures for growing field crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Cropping pattern changed | 98 | 1 |
| Incidence of pest and diseases increased | 98 | 1 |
| Availability of irrigation water decreased | 87 | 2 |
| Productivity of fodder maize s increased | 85 | 3 |
| Infestation of new weeds/ insect pest increased | 73 | 4 |
| Productivity of finger millet increased | 70 | 5 |
| Productivity of red gram increased | 50 | 6 |
| Productivity of maize increased | 47 | 7 |
| Growing area of fodder maize increased | 45 | 8 |
| Growing area of finger millet increased | 43 | 9 |
| Productivity of horse gram increased | 40 | 10 |
| Growing area of red gram increased | 33 | 11 |
| Growing area of horse gram increased | 22 | 12 |
| Growing area of maize increased | 22 | 12 |
| Residue recycling increased | 3 | 13 |
| Adaptation measures adopted towards climate change | | |
| Intercropping/mixed cropping adopted | 93 | 1 |
| Change in planting dates of major crops | 77 | 2 |
| Changed to short, drought resistant varieties | 77 | 2 |
| Rain water harvesting/water harvesting structures made | 27 | 3 |
| Mulching adopted as soil moisture conservation techniques | 23 | 4 |
| Soil moisture conservation techniques adopted as land configuration adopted | 18 | 5 |
| Have insurance | 7 | 6 |



Photo: Failure of finger millet crop due to long dry spell



Photo: Only intercrops are surviving, maincrop not germinated



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Photo: Failure of planted mulberry and weed infestation



Photo: Dwindling fodder resources for livestock

Farmer's perception and adopted adaptation measures for horticultural crops

About 82% of the farmers experienced reduction of the productivity of vegetables and fruits in case of climate change. 81% of the farmers witnessed increase in the pest and disease incidents. Changing to short stature, drought resistant varieties with good plant protection measures are top priority for adaptation. Raising high value crops in low cost poly houses is another option. Change in planting dates of vegetables with new introduced crops could also be adapted.

Table 4: Farmer's perception and adopted adaptation measures for horticultural crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Insects pest infestation increased | 82 | 1 |
| Water requirement of crops increased | 75 | 2 |
| Early flowering in fruits / plantation crops | 62 | 3 |
| Productivity of tomato increased | 58 | 4 |
| Productivity of crops (which crops) increased | 43 | 5 |
| Productivity of pole beans increased | 33 | 6 |
| Productivity of marigold increased | 25 | 7 |
| Growing area of tomato increased | 23 | 8 |
| Productivity of carrot increased | 18 | 9 |
| Change observed in taste/flavour of fruits | 18 | 9 |
| Growing area of cabbage increased | 15 | 10 |
| Growing area of carrot increased | 12 | 11 |
| Growing area of pole beans increased | 10 | 12 |
| Growing area of marigold increased | 8 | 13 |

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| Parameters | Per cent | Rank |
|--|----------|------|
| Adaptation measures adopted towards climate change | | |
| Plant protection measures adopted | 87 | 1 |
| Raise the crops in playhouse to mitigate the effect of high temperature | 82 | 2 |
| Introduced new crops | 75 | 3 |
| changed to short stature, drought resistant varieties | 73 | 4 |
| Change in planting dates of vegetables crops | 72 | 5 |
| Early harvest | 62 | 6 |
| Use of net as hail shelter | 38 | 7 |
| Night irrigations applied to the vegetable crops to mitigate the effect of frost, cold | 33 | 8 |
| Rain water harvesting/Water harvesting structures made | 23 | 9 |
| Mulching adopted as soil moisture conservation techniques | 18 | 10 |
| Have insurance | 15 | 11 |
| Smokes, heaters are used in the orchard to reduce the effect of cold & frost etc. | 3 | 12 |



Photo: Fruit borer in brinjal crop



Photo: Drying up of mango plantation



Photo: Tomato wilt



Photo: Diamond black moth damage to cabbage



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Farmer's perception and adopted adaptation measures for animal husbandry

The livestock population has been gradually reduced mainly due shortage of green or dry fodder due to non-availability of irrigation water or scarcity of rainfall. This factor has reduced availability of sufficient biomass especially during lean season. Majority of livestock like milch animals has reduced their milk yield, reduction live weight of sheep and goat and reduced in production in poultry birds. The overall green and dry fodder is gradually reduces due to reduction of productivity of crops.

Making provisions for raising green fodder in off- season and rearing of cross breed of livestock would improve their productivity. Further providing ventilated pukka



Photo: Shortage of green fodder for milch animal



Photo: Purchase of green fodder



Photo: Reduced biomass of green fodder



Photo: Drought affected fodder

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shelter could further improve the productivity of animals. In addition taking up prophylactic measures against disease infection would improve the efficiency of animal productivity. The highest adaptation index (57) was observed in livestock component indicating its measure component indicating its contribution to farm household security followed by horticultural crops (50) and the lower index for field crops (43).

Table 5: Farmer's perceptions regarding rearing of animals

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Green fodder availability decreased | 92 | 1 |
| Changes observed in rearing of animals | 90 | 2 |
| Numbers of goats per household decreased | 90 | 2 |
| Number of livestock per household decreased | 88 | 3 |
| Number of poultry per household decreased | 88 | 3 |
| Milk productivity increased | 85 | 4 |
| Cow is replaced by buffalo | 83 | 5 |
| Adaptation measures adopted towards climate change | | |
| Raise green fodder in off season | 92 | 1 |
| Rear cross breeds | 88 | 2 |
| Use of ventilated pukka shelter | 63 | 3 |
| Have insurance | 58 | 4 |
| Prophylactic measures taken against disease infestation | 37 | 5 |
| Use of electric heaters to elevate the shelter temperature during strong cold | 25 | 6 |
| Use of electric fans/coolers during summer | 5 | 7 |

The adaptation measures taken by farmers are in directly proportionate to age groups i.e. younger people are following adaptation measures higher than elder farmers. Likewise family size; farming experience and annual income have also shown a similar trend. However education and farm size have directly influence the adaptation measures taken up for growing crops and rearing of animals against climate change.

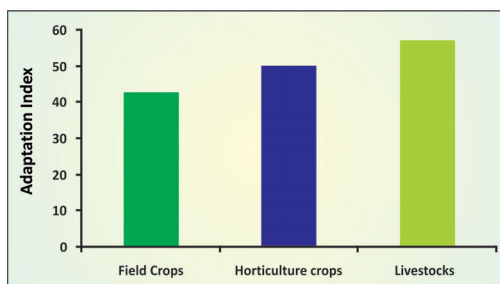


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems



VELLAYANI, KERALA

Thomas Mathew and Jacob D

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Kerala is a state with undulating topography having diversified crops and vegetation. The physiography of Kerala consists of coastal belts, midlands and high ranges experiencing tropical to subtropical climate. Kerala is having a bimodal rainfall received through south west monsoon, northeast monsoon and summer showers with a average annual rainfall of 300 cm, minimum temperature of 23°C and maximum temperature of 32°C respectively. The cropping system consists of coconut and rice based which is the dominating farming system. The cattle population constitutes 15.1 lakhs mainly cow whereas the buffalo and goat population are less. A quick survey was conducted with the farmers coming under Pathanamthitta, Alleppey and Kottayam districts.

About 60 farmers coming under the blocks of Pulikeezhu, Mallappally, Champakulam and Ettumanoor. The villages selected consisted of champakulam, Nemudi, Ramengiri, Kumarakom, Needoor, Aiyamanam, Niranam, Kadpra, Perigara,

Kunnathanam, Mallappally and Anicadu. Based on the survey work carried out with the 60 farmers under On farm research programme, the following information were gathered. Also 72 percent of the farmers have undergone secondary education while 25 % are having graduation. The farmers surveyed come under the category of marginal farmers and it was followed by small farmers constituting 25% (Table 1).

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | Primary | 3 |
| | Secondary | 72 |
| | College | 25 |
| Farm size (ha.) | <1.0 | 55 |
| | 1-2.5 | 45 |
| Farming experience | <10 | 2 |
| | 10-20 | 15 |
| | 21-30 | 15 |
| | >30 | 67 |
| Annual income (₹) | <1.0 | 43 |
| | 1-2 | 27 |
| | 2-5 | 30 |

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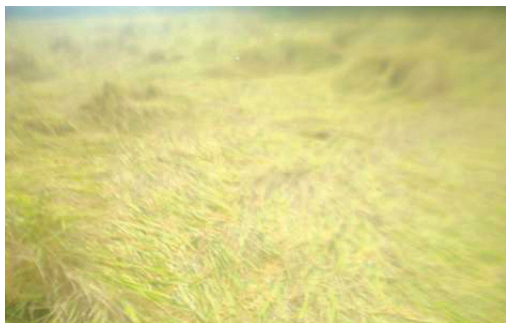


Photo: Crop lodging in paddy due to high wind velocity



Photo: Flood damage in paddy



Photo: Paddy field under submergence

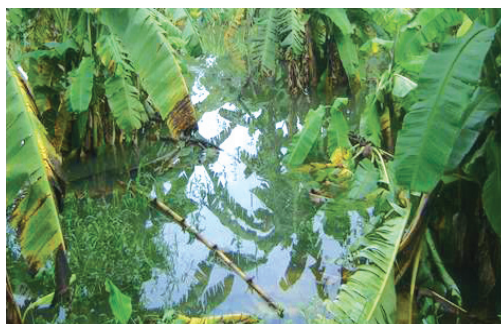


Photo: Flood damage in banana

Farmer's perception regarding changing climate

The data collected on perception regarding changing climate are presented in Table 2. It is informed that all farmers are in the opinion that the day temperature is increasing but majority of the farmers unable to state whether the night temperature is increasing or not or both day and night temperature is increasing. Regarding the onset of monsoon majority of the farmers believe that it is late and all the farmers reported that the amount of rainfall received is decreasing and there are no terminal heavy rains. The distribution of rainfall is erratic and it is affecting the length of growing season. It is also informed by the farmers that the frequency of drought and flood are increasing. But they are not having any idea about hailstorm heat and cold wave. Similarly all the farmers state that crop lodging increased due to high wind velocity and water table started decreasing.



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Table 2: Farmer's perception regarding change in climate

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Day temperature increased | 100 | 1 |
| Decrease in rainfall amount | 100 | 1 |
| Erratic distribution of rainfall there by, affecting length of growing season | 100 | 1 |
| Frequency of drought increased | 100 | 1 |
| Frequency of flood increased | 100 | 1 |
| Crop lodging due to high wind velocity increased | 100 | 1 |
| Water table decreased | 100 | 1 |
| Late onset of monsoon | 73 | 2 |
| Early onset of monsoon | 27 | 3 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 23 | 4 |
| Night temperature increased | 20 | 5 |
| Both day and night temperature increased | 0 | 6 |
| Terminal heavy rains | 0 | 6 |
| Frequency of hail storm increased | 0 | 6 |
| Frequency of heat wave increased | 0 | 6 |
| Frequency of cold wave increased | 0 | 6 |
| Frequency of frost increased | 0 | 6 |

Farmer's perception and adopted adaptation measures for growing field crops

The data on perception on growing of crops is given in Table 3. The data revealed that all the farmers had stated that the cropping pattern has not changed due to climatic change and they are unable to state that whether the pest and disease incidence are building up or not. Eighty per cent of the farmers surveyed reported that the crop growth of coconut and rice has not changed. Similarly majority (80%) are in the opinion that the productivity of coconut had not been increased. But all have agreed that the productivity of rice got increased. Also the availability of irrigation water is not decreasing and none of the farmers are unable to say whether there is buildup of weed, pest and diseases. All the farmers surveyed also states that the residue recycling is increased. All the farmers had revealed that the crops have been insured and the planting dates are not changed. Intercropping and mixed cropping are followed. None of the farmers are involved in rain water harvesting and short drought resistant varieties are being used. Mulching and soil moisture conservation techniques are followed.

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Table 3: Farmer's perceptions regarding growing of field crops

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Productivity of rice increased | 100 | 1 |
| Residue recycling increased | 100 | 1 |
| Productivity of coconut increased | 30 | 2 |
| Growing area of coconut increased | 20 | 3 |
| Growing area of rice increased | 20 | 3 |
| Adaptation measures adopted towards climate change | | |
| Have insurance | 100 | 1 |
| Change in planting dates of major crops | 100 | 1 |
| Intercropping/mixed cropping adopted | 100 | 1 |
| Mulching adopted as soil moisture conservation techniques | 100 | 1 |
| Soil moisture conservation techniques adopted as land configuration adopted | 100 | 1 |
| Changed to short, drought resistant varieties | 2 | 2 |



Photo: Adaption measures adopted towards changing climate



AICRP on IFS: On Farm Research Farmer's Perception on Climate Change

Farmer's perception and adopted adaptation measures for growing of horticultural crops

The data had shown that all the 60 farmers are having the opinion that no changes were observed with the growth of banana and vegetables and at the same time, the productivity of banana and vegetables got increased, while with the early flowering of fruit and plantation crops, majority of the farmers were unable to give proper answer. But all have agreed to the point that insect pest infestation and water requirement of vegetables were showing an increasing trend. All have opined that insurance is provided for horticultural crops. Date of planting is changed in case of vegetables. Rain water harvesting structures are not being constructed. Short duration drought resistant varieties are not cultivated. Plant protection measures are followed by all the farmers. Early harvest is not taking place. All the farmers are of the opinion that use of rain shelters such as raising the crop in poly house to mitigate the climate are not being adopted. Also all the farmers interviewed revealed that night irrigation, smoke heaters are not being followed but mulching is adopted as a mitigating technique.

Table 4: Farmer's perceptions regarding growing of horticultural crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Productivity of banana increased | 100 | 1 |
| Productivity of vegetable crop increased | 100 | 1 |
| Insects pest infestation increased | 100 | 1 |
| Water requirement of crops increased | 100 | 1 |
| Adaptation measures adopted towards climate change | | |
| Have insurance | 100 | 1 |
| Change in planting dates of vegetables crops | 100 | 1 |
| Plant protection measures adopted | 100 | 1 |
| Mulching adopted as soil moisture conservation techniques | 100 | 1 |

Farmer's perception and adopted adaptation measures for growing of animal husbandry

The data collected on farmers perception of rearing livestock is depicted in Table 5. It is observed that all the farmers report that no changes were observed

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with the rearing of animals and having the opinion that number of livestock per household got decreased. The cow is not being replaced by buffalos. This is the view of the 75% of the farmers surveyed. But all have opined that the milk production got increased and 75 percent of farmers believe that green fodder availability is not decreased. But all are having the same view that number of poultry per household and number of goats per household got decreased. The data also revealed that all the farmers are insuring the animals and cross breeds are being reared. Green fodder is received during off season. Ventilated pukka shelter is provided for domestic animals. Electric heaters to elevate shelter temperature are not followed. Electric fan /coolers are being used during summer.

Table 5: Farmer's perceptions and adopted adaptation measures regarding rearing of animals

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Number of livestock per household decreased | 100 | 1 |
| Milk productivity increased | 100 | 1 |
| Number of poultry per household decreased | 100 | 1 |
| Numbers of goats per household decreased | 100 | 1 |
| Adaptation measures towards climate change | | |
| Have insurance | 100 | 1 |
| Rear cross breeds | 100 | 1 |
| Raise green fodder in off season | 100 | 1 |
| Use of ventilated pukka shelter | 100 | 1 |
| Use of electric fans/coolers during summer | 100 | 1 |
| Prophylactic measures taken against disease infestation | 100 | 1 |

Farmer's perception and adopted adaptation measures in fish farming

Most of the farmers (72%) are unable to say whether the number of ponds is decreasing or not. But all are supporting the view that the water requirement of the pond is increasing. With regard to mortality and disease infestation 75% of the farmers are unable to give definite answers. All are having the opinion that insurance is taken, improved fingerlings are reared, and multiple uses of water bodies are not used. All the farmers take prophylactic measures against disease incidence, new species are introduced, and pukka ponds are made to avoid seepage.



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Table 6: Farmer's perceptions and adopted adaptation measures regarding rearing of animals

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Water requirement of pond is increased | 100 | 1 |
| Adaptation measures towards climate change | | |
| Have insurance | 100 | 1 |
| Rear improved fingerlings | 100 | 1 |
| Multiple use of water as irrigation/washing of animals sheds/ animals | 100 | 1 |
| Prophylactic measures taken against disease infestation | 100 | 1 |
| Introduction of new species | 100 | 1 |
| Use of pukka ponds to avoid the seepage loss of water | 100 | 1 |

It is found that the adapted index towards changing climate with regard to growing of field crops was at the tune of 71% while the horticultural crops had registered only 33% which again indicates that the adaptation measures followed to mitigate the adverse effect of climatic parameters were comparatively less. In the case of livestock as well as fisheries the adaptive index was above 80% (Fig.1).

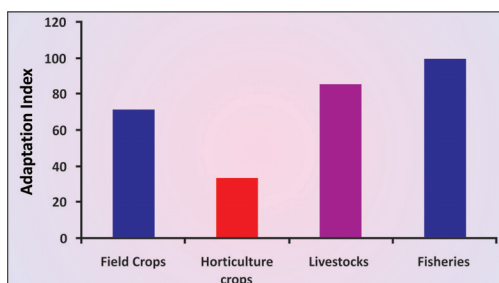


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems

Conclusion

It can be concluded that the farmers interviewed for the study are fully aware of the climatic change like rise in day temperature increase in the intensity of rainfall, late arrival of rainfall and depletion water table as well as soil moisture. However it is not affecting the productivity of crop like rice, vegetables and banana, since the farmer is taking adequate agronomic practices consisting of mulching, crop residue management, moisture conservation measures and increasing the water use efficiency through micro irrigation systems and following land configuration for better drainage and overcoming the ill effects of monsoonal inundation caused by flooded situation.



AKOLA, MAHARASHTRA

Varsha Tapre

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(Maharashtra)*

The data is collected from 60 households of OFR farmers in Nandgaon Khandeshwar and Morshi block of Amravati district. Village Ajani, Dhawalsari and Takli Block of Nandgaon Khandeshwar and Asona, Dhamangaon and Wagholi of Morshi. Amravati district belongs more than 80% of rainfed farming situation. Most predominant cropping system of the district is cotton - fallow, and soybean – chickpea. Crop + Live stock is also major farming system of the district.

The data pertaining to general characteristics of the survey population is presented in table 1 showed that most of the sample group (72%) are educated up to secondary level of education. However none of the sample was illiterate. The more than half of the sample size holds less than 1.0 ha of land whereas none of the sample holds more than 2.5 ha of land. More than 68 percent of the farmers interviewed were having more than 30 years of farming experience. However, only 2 per cent of the farmers were having less than 10

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | Primary | 3 |
| | Secondary | 72 |
| | College | 25 |
| Farm size (ha.) | <1.0 | 55 |
| | 1-2.5 | 45 |
| | >2.5 | 0 |
| Farming experience | <10 | 7 |
| | 10-20 | 17 |
| | 21-30 | 38 |
| | >30 | 38 |
| Annual income (₹) | <1.0 | 98 |
| | 1-2 | 2 |

years of farming experience. More than the 98 percent of the interviewed farmers were coming in the range of less than ₹ 1.0 lakhs annual income from the farm whereas none of the farmers was earning more than ₹ 2.0 lakhs from the farm.



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Farmer's perceptions regarding climate change

The perception of farmers on weather parameters indicates late onset of monsoon 98 % farmers have perceived late onset of monsoon as a major factor related to climate change followed by 88% of the farmers feeling that the terminal heavy rain event has increased which affects their yield. More than 82 % farmers also perceived that the weather parameters like erratic distribution of rainfall thereby, affecting length of growing season, Frequency of flood increased, Water table decreased, Day temperature increased which ranks 2 to 6 ranking. Remaining weather parameters are not perceived by the farmers.

Table 2: Farmer's perceptions regarding climate change

| Farmer's perception | Per cent | Rank |
|--|----------|------|
| Late onset of monsoon | 98 | 1 |
| Terminal heavy rains | 88 | 2 |
| Erratic distribution of rainfall thereby, affecting length of growing season | 87 | 3 |
| Frequency of flood increased | 85 | 4 |
| Water table decreased | 83 | 5 |
| Day temperature increased | 82 | 6 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 60 | 7 |
| Decrease in rainfall amount | 57 | 8 |
| Frequency of Heat wave increased | 42 | 9 |
| Night temperature increased | 40 | 10 |
| Both day and night temperature increased | 40 | 10 |
| Crop lodging due to high wind velocity increased | 33 | 11 |
| Frequency of cold wave increased | 28 | 12 |
| Early onset of monsoon | 18 | 13 |
| Frequency of frost increased | 18 | 13 |
| Frequency of drought increased | 15 | 14 |
| Frequency of hail storm increased | 7 | 15 |

Farmer's perception and adopted adaptation measures regarding growing of major field crops

Results about farmers' perceptions regarding growing of crops due to changing climatic condition of the study area revealed that cropping pattern changed, incidence of pest and disease increase and residue recycling increased is observed by more than 92 % farmers these factors ranks first among all the factors. On the farmer's

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field are getting momentums whereas new weeds and insect pest infestation are also increasing (Table 3). Forty per cent and above farmers of the sample area told about increase in the productivity of major crops like cotton and soybean yield of the district. Out of seven adaptation measures towards climate change, shifting of planting dates of major crops, adoption of intercropping and growing of short, drought resistant crop cultivars are adopted by the 100 % of the farmers. Eighty seven percent of farmers adopted rain water harvesting.

Table 3: Farmer's perceptions and adopted adaptation measures towards climate change for growing of field crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Cropping pattern changed | 100 | 1 |
| Incidence of pest and diseases increased | 100 | 1 |
| Infestation of new weeds/ insect pest increased | 100 | 1 |
| Residue recycling increased | 100 | 1 |
| Productivity of soybean increased | 92 | 2 |
| Growing area of soybean increased | 73 | 3 |
| Availability of irrigation water decreased | 73 | 3 |
| Growing area of cotton increased | 72 | 4 |
| Productivity of cotton increased | 58 | 5 |
| Adaptation measures adopted towards climate change | | |
| Change in planting dates of major crops | 100 | 1 |
| Intercropping/mixed cropping adopted | 100 | 1 |
| Changed to short, drought resistant varieties | 100 | 1 |
| Rain water harvesting/water harvesting structures made | 87 | 2 |
| Soil moisture conservation techniques adopted as land configuration adopted | 18 | 3 |
| Mulching adopted as soil moisture conservation techniques | 5 | 4 |

Farmer's perceptions and adopted adaptation measures regarding growing of horticultural crops

Result pertaining to farmer's perception regarding growing of horticultural crops is presented in table 4. Change observed in taste/flavour of fruits and increasing water requirement of crops under changing climate situation came out first followed by other parameters. Early flowering in fruits crops is not very common, only 7%



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farmers are in favour of early flowering in fruit crops. In case of raising of horticultural crops, about half of the adaptation measures towards changing climate are being adopted by the framers of Amravati district. Cent-percent farmers are adopting plant protection measures and about 92% farmers have switched towards short stature, drought resistant varieties.

Table 4: Farmer's perceptions and adopted adaptation measures regarding growing of horticultural crops

| Farmer's perception | Per cent | Rank |
|--|----------|------|
| Change observed in taste/flavour of fruits | 100 | 1 |
| Water requirement of crops increased | 100 | 1 |
| Insects pest infestation increased | 95 | 2 |
| Growing area of citrus increased | 93 | 3 |
| Productivity of vegetable increased | 88 | 4 |
| Productivity of citrus increased | 85 | 5 |
| Growing area of vegetable increased | 83 | 6 |
| Early flowering in fruits / plantation crops | 7 | 7 |
| Adaptation measures adopted towards climate change | | |
| Plant protection measures adopted | 100 | 1 |
| Changed to short stature, drought resistant varieties | 92 | 2 |
| Introduced new crops | 77 | 3 |
| Change in planting dates of vegetables crops | 70 | 4 |
| Rain water harvesting/Water harvesting structures made | 53 | 5 |
| Night irrigations applied to the vegetable crops to mitigate the effect of frost, cold | 43 | 6 |
| Have insurance | 5 | 7 |



Photo: Use of soil moisture conservation methods



Photo: Multitier cropping system

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Result from data related to rearing of animals showed that 100% farmers noted that milk productivity increased which ranks first, while 90% and above farmers revealed that number of livestock, poultry and goats per household decreased. Eighty seven percent farmers were responded to changes observed in rearing of the animals, cow is replaced by buffalo was noted by 80% of the farmers where as green fodder availability was decreased denoted by 62% of the farmers (Table 5).

Table 5: Farmer's perceptions and adopted adaptation measures regarding animal husbandry

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Milk productivity increased | 100 | 1 |
| Number of livestock per household decreased | 93 | 2 |
| Numbers of goats per household decreased | 90 | 3 |
| Changes observed in rearing of animals | 87 | 4 |
| Number of poultry per household decreased | 87 | 4 |
| Cow is replaced by buffalo | 80 | 5 |
| Green fodder availability decreased | 62 | 6 |
| Adaptation measures adopted towards climate change | | |
| Rear cross breeds | 67 | 1 |
| Raise green fodder in off season | 38 | 2 |
| Prophylactic measures taken against disease infestation | 28 | 3 |





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Photo: Intercropping adopted towards changing climate

Adaptation index is the measure of the adopted adaptation measures out of recommended adaptation measures towards changing climate by the farmers to harvest better yield of a particular components of the Integrated farming Systems (IFS). Component-wise analysis of adaptation index of the major four components viz, field crops, horticultural crops, and livestock rearing of the Integrated farming systems

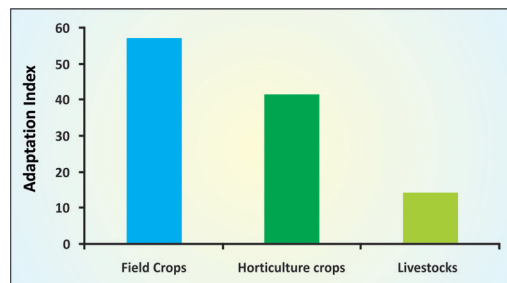


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems

showed that growing of field crops first among other components where more than 55 percent adaptation measures are being adopted by the farmers. In case of horticultural crops more than 46 percent adaptation measures towards changing climate are being adopted by the farmers to grow horticultural crops. However least adaptation index was recorded in case of rearing of livestock.



DAPOLI, MAHARASHTRA

S.B. Bhagat

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Palghar climate is characterized by very warm and humid round the year due to coastal effects of the Arabian Sea. The average maximum temperature of 33°C and minimum temperature of 17°C prevails during winter season from December to February and summer seasons from March to June have an average maximum temperature of 33°C. The district lies at 19.1054 N latitude, 72.57 E longitude with 20 m altitude and having annual rainfall 2400 mm. The region is having rice-fallow, rice-rice and rice-vegetables as the major cropping patterns and dairy as the main livestock component. A field survey on farmer's perception on climate change at 60 households in Palghar & Vikramgad blocks of Thane district was conducted. The farmers' perception on the climate change was assessed using yes or no type questions and the results were analyzed. Out of total population 73% had primary education, 10% secondary education, 3% college level and 13% non educated. 87%

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | None | 13 |
| | Primary | 73 |
| | Secondary | 10 |
| | College | 3 |
| Farm size (ha.) | <1.0 | 87 |
| | 1-2.5 | 13 |
| Farming experience | <10 | 7 |
| | 10-20 | 40 |
| | 21-30 | 22 |
| | >30 | 32 |
| Annual income (₹) | <1.0 | 88 |
| | 1-2 | 12 |

households were having less than 1.0 ha landholding while, 13% households had 1-2.5 ha landholding. Forty two per cent farmers were having farming experience 10-20 years, 32% population having >30yrs and that of 20% population was having 21-30 years of farming experience. Annual income of 82% households was <₹ 1.0 lakh per annum while that of 18% households having ₹ 1-2 lakh per annum.



AICRP on IFS: On Farm Research Farmer's Perception on Climate Change

Farmer's perceptions regarding changing climate

100% of population is of opinion that day temperatures are increased and onset of monsoon is late while 97% population opines that both day and night temperatures are increased and there is decrease in rainfall amount. Out of total population, 93% population is saying that there is failure of ITKs for weather forecasting while 88% population is of opinion that night temperatures are increased and 87% population experienced crop lodging due to high wind velocity. None of the population experienced either early onset of monsoon or increased frequency of cold wave.

Table 2: Farmer's perceptions regarding changing climate

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Day temperature increased | 100 | 1 |
| Late onset of monsoon | 100 | 1 |
| Both day and night temperature increased | 97 | 2 |
| Decrease in rainfall amount | 97 | 2 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 93 | 3 |
| Night temperature increased | 88 | 4 |
| Crop lodging due to high wind velocity increased | 87 | 5 |
| Frequency of heat wave increased | 73 | 6 |
| Terminal heavy rains | 55 | 7 |
| Frequency of drought increased | 48 | 8 |
| Water table decreased | 17 | 9 |
| Frequency of frost increased | 15 | 10 |
| Frequency of flood increased | 12 | 11 |
| Erratic distribution of rainfall there by, affecting length of growing season | 5 | 12 |
| Frequency of hail storm increased | 2 | 13 |
| Early onset of monsoon | 0 | 14 |
| Frequency of cold wave increased | 0 | 14 |

Farmer's perceptions and adopted adaptation measures regarding growing of crops

In case of farmers' perception regarding growing of crops, 100% population observed increased incidence of pest and diseases while 97% population experienced similar things in case of infestation of new weeds/insect pests. 82% population observed increased residue recycling. Decreased availability of irrigation

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water and increased productivity of rice crop was experienced by 53% and 17% population respectively. 20% population opines that cropping pattern is changed. Due to changed climate, 68% population changed to short, drought resistant varieties of crops while 18% population changed the planting dates of major crops. None of the households either had insurance, rainwater harvesting structures, soil moisture conservation techniques, mulching or intercropping/mixed cropping practice (Table 3).

Table 3: Farmer's perceptions and adopted measures regarding growing of crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Incidence of pest and diseases increased | 100 | 1 |
| infestation of new weeds/ insect pest increased | 97 | 2 |
| Residue recycling increased | 82 | 3 |
| Availability of irrigation water decreased | 53 | 4 |
| Cropping pattern changed | 20 | 5 |
| Growing area of rice increased | 17 | 6 |
| Growing area of vegetable increased | 17 | 6 |
| Growing area of floriculture increased | 17 | 6 |
| Growing area of fruits increased | 17 | 6 |
| Adaptation measures adopted towards climate change | | |
| Changed to short, drought resistant varieties | 68 | 1 |
| Change in planting dates of major crops | 18 | 2 |

Farmer's Perceptions and adopted measures regarding growing of horticultural crops

Increased infestation of insect pests and changes in taste/flavour of fruits were observed by 93% and 67% population respectively. 23% population is of opinion that water requirements of horticultural crops have been increased while 17% population agrees to increased area and productivity of sapota and mango. Plant protection measures were adopted by 77% population to cope up with the increased problem of pests and diseases. 28% population changed to short stature, drought resistant varieties of horticultural crops. 20% population introduced new crop varieties and had early harvest. Mulching was adopted as soil moisture conservation techniques by 13% households. Only 10% population applied night irrigation to



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Table 4: Farmer's perceptions regarding growing of horticultural crops

| Parameters | Per cent | Rank |
|--|----------|------|
| Farmer's perception | | |
| Insects pest infestation increased | 93 | 1 |
| Change observed in taste/flavour of fruits | 67 | 2 |
| Water requirement of crops increased | 23 | 3 |
| Growing area of sapota increased | 17 | 4 |
| Growing area of mango increased | 17 | 4 |
| Productivity of sapota increased | 17 | 4 |
| Productivity of mango increased | 17 | 4 |
| Adaptation measures adopted towards climate change | | |
| Plant protection measures adopted | 77 | 1 |
| changed to short stature, drought resistant varieties | 28 | 2 |
| Early harvest | 20 | 3 |
| Introduced new crops | 20 | 3 |
| Mulching adopted as soil moisture conservation techniques | 13 | 4 |
| Night irrigations applied to the crops (Potato, tomato etc.) to mitigate the effect of frost, cold | 10 | 5 |
| Smokes, heaters are used in the orchard to reduce the effect of cold, frost etc. | 10 | 5 |
| Change in planting dates of vegetables crops | 7 | 6 |

mitigate the effect of frost, cold and smokes, heaters were used in the orchard to reduce the effect of cold, frost etc (Table 4).

Farmer's perceptions and adopted adaptation measures regarding animal husbandry

Decreased number of poultry, livestock and goats per household has been reported by 77, 62 and 38 percent population respectively. 52% population experienced increased milk productivity while 37% population observed changes in rearing of animals. Only 18% population expressed their views that green fodder availability being decreased and cow is being replaced by buffalo. In case of rearing of animals, 65% of households preferred to have ventilated pukka shelter for livestock while fifty two per cent population took prophylactic measures against disease infestation. 37% of households preferred to rear cross breeds and 32% of them raised green fodder in off season. None of the households either had insurance of



Table 5: Farmer's perceptions and adopted adaptation measures regarding animal husbandry

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Number of poultry per household decreased | 77 | 1 |
| Number of livestock per household decreased | 62 | 2 |
| Milk productivity increased | 52 | 3 |
| Numbers of goats per household decreased | 38 | 4 |
| Changes observed in rearing of animals | 37 | 5 |
| Cow is replaced by buffalo | 18 | 6 |
| Green fodder availability decreased | 18 | 6 |
| Adaptation measures adopted towards climate change | | |
| Use of ventilated pukka shelter | 65 | 1 |
| Prophylactic measures taken against disease infestation | 52 | 2 |
| Rear cross breeds | 37 | 3 |
| Raise green fodder in off season | 32 | 4 |

animals or electric heaters to elevate the shelter temperature during strong cold or electric fans/coolers during summer (Table 5).

Adaptation measures towards changing climate for different components of the farming systems

The highest adaptation index (29%) was recorded in case of livestock component and it was followed by field crops (14%) and horticulture crops (8%).

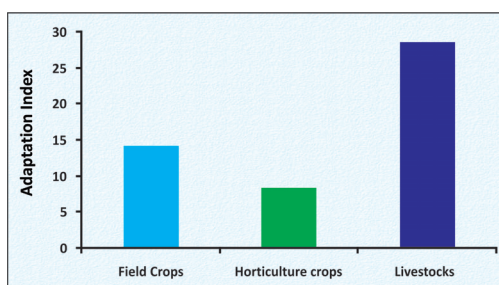


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems



RAHURI, MAHARASHTRA

M.M. Desai, Y.C. Sale, R.B. Gangurde and N.S. Kudal

Mahatma Phule Krishi Vidyapeeth, Rahuri

The Farming system for Pune is crop +dairy + horticulture and cropping system are soybean-onion, Pearl millet-wheat, rice-wheat. The annual rainfall Pune is 744 mm. GPS location of Pune is 16°30' to 20°3' N latitude, 73°47' to 74°4' E longitude and 577.74 m altitude. Total 60 households of OFR, farmer in Haveli & Maval block of Pune district were selected for quick survey. Education level of 55% farmers was from secondary level followed by college level 28%. Seventy five percent farmers were having less than 1.0 hectare land and 25 % framer has 1 to 2.50 hectare land.

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | Primary | 17 |
| | Secondary | 55 |
| | College | 28 |
| Farm size (ha.) | <1.0 | 75 |
| | 1-2.5 | 25 |
| Farming experience | <10 | 60 |
| | 10-20 | 13 |
| | 21-30 | 15 |
| | >30 | 12 |
| Annual income (₹) | <1.0 | 72 |
| | 1-2 | 25 |
| | 2-5 | 3 |

The farmer having experience of 10-20 years has highest percentage of 60% followed by more than 21-30 and 30 years' experience with 15%. The 72% farmer has less than ₹ 1.0 lakh annual income.

Farmer's perception on climate change

Cent percent farmer said that there is increase in day temperature, cold waves, flood, late onset of monsoon, terminal heavy rains, erratic distribution, and increase in frequency of hail storm. The 50% farmer said that ITKs for weather forecast failing, frequency of flood increased, crop lodging due to high wind velocity increased, water table is decreased. Thirty three per cent farmer sad that frequency of frost is increased followed by 17% said that frequency of cold wave is increased.

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Table 2: Farmer's perceptions regarding changing climate

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Day temperature increased | 100 | 1 |
| Late onset of monsoon | 100 | 1 |
| Terminal heavy rains | 100 | 1 |
| Erratic distribution of rainfall there by, affecting length of growing season | 100 | 1 |
| Frequency of heat wave increased | 100 | 1 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 50 | 2 |
| Frequency of drought increased | 50 | 2 |
| Frequency of flood increased | 50 | 2 |
| Crop lodging due to high wind velocity increased | 50 | 2 |
| Water table decreased | 50 | 2 |
| Frequency of frost increased | 33 | 3 |
| Frequency of cold wave increased | 17 | 4 |
| Night temperature increased | 0 | 5 |
| Both day and night temperature increased | 0 | 5 |
| Early onset of monsoon | 0 | 5 |
| Decrease in rainfall amount | 0 | 5 |
| Frequency of hail storm increased | 0 | 5 |

Farmer's perception and adopted adaptation measures for growing major field crops

Incidence of pest and diseases are increased in case of major field crops and it was supported by 100% farmers. More than 3/4 survey population revealed that infestation of new weeds/ insect pest increased. However 50% farmers told that the practice of residue recycling in farming systems is practiced. Soil moisture conservation techniques under changing climate 83% farmer said that they adopted. 68 % respondent said that they changed in planting dates of crops ,57% said they adopted Intercropping/mixed cropping .and changed to short stature, drought resistant varieties 47% farmer said they Have insurance. Twenty seven per cent farmer used rain water harvesting/Water harvesting structures while 10% farmer adopted mulching as soil moisture conservation techniques.



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Table 3: Farmer's perception and adopted adaptation measures for growing major field crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Incidence of pest and diseases increased | 100 | 1 |
| Infestation of new weeds/ insect pest increased | 83 | 2 |
| Productivity of soybean increased | 67 | 3 |
| Productivity of rice increased | 67 | 3 |
| Cropping pattern changed | 50 | 4 |
| Growing area of soybean increased | 50 | 4 |
| Growing area of rice increased | 50 | 4 |
| Residue recycling increased | 50 | 4 |
| Adaptation measures adopted towards climate change | | |
| Soil moisture conservation techniques adopted as land configuration adopted | 83 | 1 |
| Change in planting dates of major crops | 68 | 2 |
| Intercropping/mixed cropping adopted | 57 | 3 |
| Changed to short, drought resistant varieties | 57 | 3 |
| Have insurance | 47 | 4 |
| Rain water harvesting/Water harvesting structures made | 27 | 5 |
| Mulching adopted as soil moisture conservation techniques | 10 | 6 |

Farmer's perceptions and adopted adaptation measures regarding growing of horticultural crops

Eight three percent farmers said that incidence of pest and diseases are increased in case of field crops under climate change scenario. Increased water requirement of crops was supported by 67% respondent and 50% farmer observed change in growing of crops, & taste/flavors of fruits. About 1/3 respondent said that there is early flowering in fruits. To reduce the ill effect of the climate change, change in planting dates of horticulture crops was witnessed by 100 respondent, 67 % adopted plant protection measures and 33% used of net as hail shelter. 17% respondent has insurance, 83% used short stature variety, rain water harvesting/ water harvesting, 17% raising the crops in polyhouse to mitigate the effect of high temperature, 17% introduced new crops, 17% used to night irrigations applied to the crops, smokes, 12% used heaters in the orchard to reduce the effect of cold, frost etc. and 15% farmer used mulching as soil moisture conservation techniques.



Table 4: Farmer's perceptions and adopted adaptation measures regarding growing of horticultural crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Insects pest infestation increased | 83 | 1 |
| Water requirement of crops increased | 67 | 2 |
| Productivity of banana increased | 50 | 3 |
| Change observed in taste/flavour of fruits | 50 | 3 |
| Growing area of banana increased | 33 | 4 |
| Early flowering in fruits / plantation crops | 33 | 4 |
| Growing area of vegetable increased | 15 | 5 |
| Adaptation measures adopted towards climate change | | |
| Change in planting dates of vegetables crops | 100 | 1 |
| changed to short stature, drought resistant varieties | 83 | 2 |
| Plant protection measures adopted | 67 | 3 |
| Use of net as hail shelter | 33 | 4 |
| Have insurance | 17 | 5 |
| Raise the crops in poly house to mitigate the effect of high temperature | 17 | 5 |
| Introduced new crops | 17 | 5 |
| Night irrigations applied to the vegetable crops to mitigate the effect of frost & cold | 17 | 5 |
| Mulching adopted as soil moisture conservation techniques | 15 | 6 |
| Smokes, heaters are used in the orchard to reduce the effect of cold, frost etc. | 12 | 7 |

Farmer's perceptions and adopted adaptation measures regarding animal husbandry

More than 2/3rd respondent said that number of poultry and goat per household decreased while 52% respondent said that cow is replaced by buffalo. More than half of the survey population said that milk productivity is increased and 28% respondent said that green fodder availability is decreased. It is clear from the table 5 that 67 % respondent said that number of poultry and goat per household decreased. Eighty three percent farmers said that they have insurance of livestock, 82% has cross breeds, 43% raise green fodder in off season and 27% farmers said that they are using pukka shelter.



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Table 5: Farmer's perceptions and adopted adaptation measures regarding animal husbandry

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Number of poultry per household decreased | 67 | 1 |
| Numbers of goats per household decreased | 67 | 1 |
| Milk productivity increased | 53 | 2 |
| Cow is replaced by buffalo | 52 | 3 |
| Number of livestock per household decreased | 50 | 4 |
| Green fodder availability decreased | 28 | 5 |
| Changes observed in rearing of animals | 2 | 6 |
| Adaptation measures adopted towards climate change | | |
| Have insurance | 83 | 1 |
| Rear cross breeds | 82 | 2 |
| Raise green fodder in off season | 43 | 3 |
| Use of ventilated pukka shelter | 27 | 4 |

Adaptation index of the farmers towards changing climate for different components of the farming systems

Highest adaptation index was recorded in case of field crop i.e. 57% whereas 25% and 29% were observed in livestock and horticultural crops, respectively (Fig. 1).

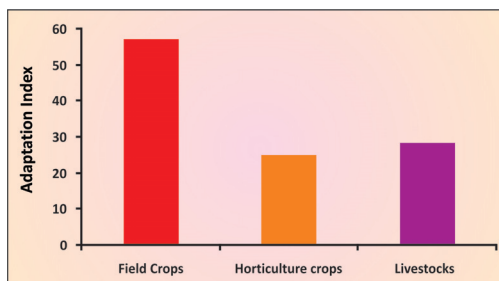


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems

Conclusion

It is concluded that the small and medium farmers were highly vulnerable to climate change and to a larger extent the small and medium farmers adopted coping mechanisms for climate change compared. the study indicate and suggest for addressing at the earliest to avoid short term effect such as yield and income loss and long-term effects such as leaving agricultural profession by the farmers.



ANGUL, ODISHA

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Among all the human activities, agriculture is possibly the most dependent on the weather and climate. Weather and climate is a natural resource and is considered as a basic input in agricultural planning. Climate influences the distribution of crops over different regions, while weather influences crop production and productivity. All the agricultural activities are affected directly or indirectly by weather and climate. The cropping pattern depends on the climate of the place. However, change in climate during the last few decades has caused much concern for the farmers and the agricultural policy makers as well.

Keeping these views in mind, a study was carried out in Angul district of Odisha to have an overall idea about the perception of farmers and adaptation measures towards climate change. Six villages of the district (Koshala, Handiguda, and Machhakuta villages in Chhendipada block, and Jamunali, Gulasar and Madhupur villages in Kishorenagar block) were taken as sample villages.

The normal annual rainfall of the district is 1402 mm with 69 rainy days. The normal annual mean maximum and minimum temperatures of the region are 33°C and 22°C, respectively. Major components of farming systems of the region include field crops like rice, maize, groundnut, sesame, green gram, black gram and pigeon pea, vegetables like cow pea, brinjal, lady's finger, tomato, onion, cabbage, cauliflower, garden pea and cucurbits, fruit crops like mango, cashew nut and banana, dairy, poultry and fishery. Rice-groundnut is the most prevalent cropping system.



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The general characteristics of sample population like education, farm size, farming experience and annual income are presented in Table 1. Fifty and thirty three percent of the sample population had primary and secondary education, respectively. However, none was illiterate. Sixty percent of the respondents were marginal farmers and rests were small farmers. Fifty two percent of the sample had more the 30 years of farming experience. The annual gross income of 70% respondents was less than one lakh and rest 30% had within one to two lakhs.

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | Primary | 50 |
| | Secondary | 33 |
| | College | 17 |
| Farm size (ha.) | <1.0 | 60 |
| | 1-2.5 | 40 |
| Farming experience | <10 | 5 |
| | 10-20 | 27 |
| | 21-30 | 17 |
| | >30 | 52 |
| Annual income (₹) | <1.0 | 70 |
| | 1-2 | 30 |

Farmers' perceptions regarding changing climate

All the respondents agreed that both the day and night temperatures were increased over the years (Table 2). Similarly, all opined that the onset of monsoon was delayed and amount of rainfall decreased with erratic distribution of rainfall, thereby affecting length of growing season. Ninety two percent farmers agreed that there were terminal heavy rains. Sixty eight percent respondents experienced the failure of indigenous technical knowledge for weather forecasting. All the farmers agreed that drought conditions and heat wave increased and ground water table decreased over the years. However, none agreed that frequency of flood, hail storm, cold wave and frost increased. Eighty five percent of the respondents agreed that crop lodging due to wind velocity increased.

Farmers' perceptions and adaptation measures adopted regarding field crops

Farmers' perceptions regarding growing of major field crops and adaptation measure adopted by the farmers are presented in Table 3. All the respondents agreed that cropping pattern changed, incidence of pest and diseases increased, growing area of major crops like rice and groundnut and increase in their productivity,

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Table 2: Farmer's perceptions regarding changing climate

| Parameters | Per cent | Rank |
|---|----------|------|
| Day temperature increased | 100 | 1 |
| Night temperature increased | 100 | 1 |
| Both day and night temperature increased | 100 | 1 |
| Late onset of monsoon | 100 | 1 |
| Decrease in rainfall amount | 100 | 1 |
| Erratic distribution of rainfall there by, affecting length of growing season | 100 | 1 |
| Frequency of drought increased | 100 | 1 |
| Frequency of heat wave increased | 100 | 1 |
| Water table decreased | 100 | 1 |
| Terminal heavy rains | 92 | 2 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 68 | 3 |
| Crop lodging due to high wind velocity increased | 15 | 4 |
| Early onset of monsoon | 0 | 5 |
| Frequency of flood increased | 0 | 5 |
| Frequency of hail storm increased | 0 | 5 |
| Frequency of cold wave increased | 0 | 5 |
| Frequency of frost increased | 0 | 5 |

Table 3: Farmer's perceptions and adaptation measures adopted regarding field crops under changing climate

| Parameters | Per cent | Rank |
|--|----------|------|
| Farmer's perceptions | | |
| Cropping pattern changed | 100 | 1 |
| Incidence of pest and diseases increased | 100 | 1 |
| Growing area of rice increased | 100 | 1 |
| Growing area of groundnut increased | 100 | 1 |
| Growing area of maize increased | 100 | 1 |
| Growing area of green gram/ black gram increased | 100 | 1 |
| Growing area of sesame increased | 100 | 1 |
| Productivity of rice increased | 100 | 1 |
| Availability of irrigation water decreased | 100 | 1 |
| Infestation of new weeds/ insect pest increased | 100 | 1 |
| Residue recycling increased | 100 | 1 |
| Productivity of maize increased | 97 | 2 |
| Productivity of groundnut increased | 8 | 3 |
| Productivity of green gram/ black gram increased | 5 | 4 |
| Productivity of sesame increased | 3 | 5 |



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| Parameters | Per cent | Rank |
|---|----------|------|
| Adaptation measures adopted towards changing climate | | |
| Change in planting dates of major crops | 100 | 1 |
| Intercropping/mixed cropping adopted | 100 | 1 |
| Have insurance | 80 | 2 |
| Changed to short, drought resistant varieties | 80 | 2 |
| Rain water harvesting/water harvesting structures made | 20 | 3 |
| Mulching adopted as soil moisture conservation techniques | 20 | 3 |

availability of irrigation water decreased, infestation of new weeds/ insect pest increased and residue recycling increased. Change in planting dates of major crops and adoption of intercropping or mixed cropping ranked first with 100 percent of the sample following the practices as an adaptation measure towards the changing climate to raise field crops. Insurance against crop failure and changed to short, drought resistant varieties ranked second (60%) as adaptation measures of climate change. Adaptation measures like construction of rain water harvesting/water harvesting structures and practicing of mulching as soil moisture conservation techniques ranked third (40%). However, none of the farmers adopted construction of rain water harvesting/water harvesting structures and soil moisture conservation techniques as land configuration (Table 3).

Farmer's perceptions and adopted measures regarding growing of horticultural crops

All the farmers ascertained that growing area of vegetable and fruit crops like brinjal, tomato, lady's finger, banana and cashew nut in the region and productivity of these crops except cashew nut increased over the years. Sixty five percent farmers agreed to the fact that productivity of cashew nut increased. All the respondents confirmed that change observed in taste/flavour of fruits, insect pest infestations increased and water requirement of crops increased. However, all the farmers disagreed that early flowering in fruits/ plantation crops was observed.

All the respondents took the adaptation measures like early harvest, changing in planting dates of vegetable crops, changing to short stature and drought resistant varieties, introduction of new crops and effective plant protection towards changing

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climate to raise horticultural crops. On the other hand, they were not practicing the adaptation measures like insurance of the horticultural crops against crop failure, rain water harvesting/water harvesting structures, use of net as hail shelter, raise the crops in poly-house to mitigate the effect of high temperature, night irrigations applied to the crops (potato, tomato etc.) to mitigate the effect of frost, cold, use of smokes, heaters in the orchard to reduce the effect of cold, frost etc. and mulching as soil moisture conservation techniques (Table 4).

Table 4: Farmer's perceptions and adopted measures regarding growing of horticultural crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Growing area of brinjal increased | 100 | 1 |
| Growing area of tomato increased | 100 | 1 |
| Growing area of lady's finger increased | 100 | 1 |
| Growing area of banana increased | 100 | 1 |
| Growing area of cashewnut increased | 100 | 1 |
| Productivity of brinjal increased | 100 | 1 |
| Productivity of tomato increased | 100 | 1 |
| Productivity of lady's finger increased | 100 | 1 |
| Productivity of banana increased | 100 | 1 |
| Change observed in taste/flavour of fruits | 100 | 1 |
| Insects pest infestation increased | 100 | 1 |
| Water requirement of crops increased | 100 | 1 |
| Productivity of cashewnut increased | 65 | 2 |
| Adaptation measures adopted towards changing climate | | |
| Plant protection measures adopted | 100 | 1 |
| Early harvest | 100 | 1 |
| Change in planting dates of vegetables crops | 80 | 2 |
| changed to short stature, drought resistant varieties | 80 | 2 |
| Introduced new crops | 80 | 2 |
| Rain water harvesting/water harvesting structures made | 20 | 3 |
| Use of net as hail shelter | 20 | 3 |
| Night irrigations applied to vegetable crops to mitigate the effect of frost and cold | 20 | 3 |

Farmer's perceptions and adopted measures regarding animal husbandry

All the respondents agreed to the statements that changes observed in rearing of animals, number of livestock per household decreased, milk productivity increased





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and numbers of goats per household decreased. On the other hand, none of the farmers agreed that cow was replaced by buffalo and number of poultry per household decreased. Only 35% of the respondents agreed that green fodder availability decreased. All the respondents opined that they switched over to cross breeds, and take prophylactic measures against disease infestation of animals. But no one insured their animals. Also none of the respondents raised green fodder in off season. They never used ventilated pukka shelter for their livestock, nor did they use electric heaters to elevate the shelter temperature during strong cold or electric fans/coolers during summer (Table 5).

Table 5: Farmer's perceptions and adopted measures regarding animal husbandry

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Changes observed in rearing of animals | 100 | 1 |
| Number of livestock per household decreased | 100 | 1 |
| Milk productivity increased | 100 | 1 |
| Numbers of goats per household decreased | 100 | 1 |
| Green fodder availability decreased | 35 | 2 |
| Adaptation measures adopted towards changing climate | | |
| Rear cross breeds | 80 | 1 |
| Prophylactic measures taken against disease infestation | 80 | 1 |
| Raise green fodder in off season | 20 | 2 |

Farmer's perceptions and adopted measures regarding fish farming

All the farmers confirmed that water requirement of pond was increased over the years; however, none of them agreed that fish mortality in pond increased. 52% of the respondents opined that number of ponds decreased or dried. Only seven percent of the respondents told that disease infestation in fish increased. The respondents never insured their fish farming nor did they take prophylactic measures against disease infestation of the fishes. All the farmers used improved fingerlings and also introduced new species to their fish culture. All of them told that they used pond water for irrigation of crops, washing of animals and animal sheds, besides fish farming (Table 6).



Table 6: Farmer's perceptions and adopted measures regarding fish farming

| Parameters | Per cent | Rank |
|---|----------|------|
| Perception on climate change | | |
| Water requirement of pond is increased | 100 | 1 |
| Number of ponds decreased/ dried | 52 | 2 |
| Disease infestation increased | 7 | 3 |
| Adaptation measures adopted towards changing climate | | |
| Multiple use of water as irrigation/washing of animals sheds/ animals | 100 | 1 |
| Rear improved fingerlings | 80 | 2 |
| Introduction of new species | 80 | 2 |
| Have insurance | 20 | 3 |
| Prophylactic measures taken against disease infestation | 20 | 3 |
| Use of pacca ponds to avoid the seepage loss of water | 20 | 3 |

Adaptation index

It was observed that farmers were adopting more adaptive measures towards changing climate in raising the field crops and fisheries, followed by horticultural crops and animal husbandry (Fig. 1).

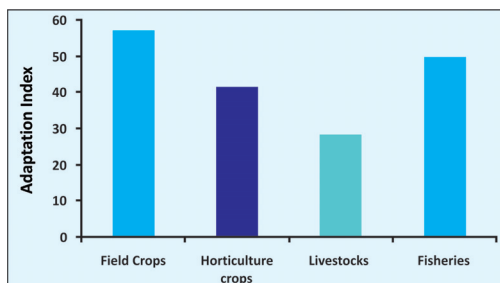


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems



BHUBANESWAR, ODISHA

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Climate induced variability, over the years, has become a threat to farm based livelihood systems in the costal part of Odisha. This refers to the susceptibility of the farmers and farm dependent communities to recurrent droughts, erratic rainfall, soil moisture stress, flood, flash floods, water logging etc. resulting in crop failures thereby severely impacting the lives of agricultural communities, mostly marginal and small farmers and agricultural labourers. With the context of climate change, a study was undertaken in Kendrapara, a coastal district of Odisha lying between 20°34' North latitude and 86°33' East longitudes. Sixty farmers from Darbal, Kanarpur and Chatrasasan village of Derabish block and Jarishai, Gualigaon and Mukundpur village of Rajkanika block were interviewed. The mean annual rainfall of the zone is 1439 mm with dominant cropping systems of rice-fallow and rice-greengram/blackgram. Cows and goats are the main livestock component of the farming community.



Photo: Farmers are surveyed on their perception and adaptation measure to climate change

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A questionnaire was developed for taking up a survey for analysing the perception regarding climate change and their effect on general agriculture, livestock and fishery components and their adaptation measures for managing climate change. After data collection correlation and ranking method were adopted for analysing the perception adaptation behaviour of the sample.

The general characteristics like age group, educational level, farm size, family size, farming experience and annual income of the survey population are presented in Table 1. Results revealed that farmers were with primary (43%) and secondary (40%) level of education. Seventy two percentages of the respondents were with less than 1.0 ha land holdings, and 52% of the respondents are with more than 30 years of farming experience. Income of 98% of the sample was below ₹ 1.0 lakh.

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | None | 5 |
| | Primary | 43 |
| | Secondary | 40 |
| | College | 12 |
| Farm size (ha.) | <1.0 | 72 |
| | 1-2.5 | 28 |
| Farming experience | <10 | 2 |
| | 10-20 | 12 |
| | 21-30 | 35 |
| | >30 | 52 |
| Annual income (₹) | <1.0 | 98 |
| | 1-2 | 2 |

Farmer's perceptions regarding changing climate

The perception of the respondents regarding climate change is presented in Table 2. The data reveals that 100% (rank 1) of the respondents agreed to increased day temperature and 92% (rank 3) to increased night temperature, increase in both day and night temperature as well as late onset of monsoon respectively. Erratic distribution of rainfall and increase in frequency of occurrence of flood in the district was supported by 93% farmers. Most of the respondents did not agree with the increase in cold wave (rank 12) and frost (rank 14), but agreed to increase in frequency of heat wave (88% with rank 4). High wind velocity resulting in crop lodging was supported by 83% (rank 5) followed by response to decrease in water table (68% with rank 6). Sixty percent (rank 8) of the farmers agreed with failure of Indigenous Technical Knowledge (ITKs) for forecasting weather (Table 2).



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Table 2: Farmer's perceptions regarding changing climate

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Day temperature increased | 100 | 1 |
| Erratic distribution of rainfall there by, affecting length of growing season | 93 | 2 |
| Frequency of flood increased | 93 | 2 |
| Night temperature increased | 92 | 3 |
| Both day and night temperature increased | 92 | 3 |
| Late onset of monsoon | 92 | 3 |
| Frequency of heat wave increased | 88 | 4 |
| Crop lodging due to high wind velocity increased | 83 | 5 |
| Water table decreased | 68 | 6 |
| Decrease in rainfall amount | 65 | 7 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 60 | 8 |
| Frequency of drought increased | 58 | 9 |
| Terminal heavy rains | 40 | 10 |
| Early onset of monsoon | 5 | 11 |
| Frequency of cold wave increased | 3 | 12 |
| Frequency of hail storm increased | 2 | 13 |
| Frequency of frost increased | 0 | 14 |

Farmer's perception and adopted measures regarding growing major field crops

Regarding the perception of farmers in growing of different crops under changing climate scenario, data presented in Table 3, it is observed that all the respondents agreed to increased incidence of pest and diseases and productivity of rice is increased in changing climate (rank 1). Ninety three percent and 88% of the group has observed changes in growing in green gram, black gram and rice crop respectively. Similar response was observed for increase in productivity of crops, where 77% and 60% of the respondents agreed to increased productivity of green gram and rice, respectively. Least percentage of respondents agreed to decrease in availability of irrigation water (Table 3).



Photo: Mulching adopted as soil moisture conservation techniques



Table 3: Farmer's perception and adopted measures regarding growing major field crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Incidence of pest and diseases increased | 100 | 1 |
| Productivity of crops Rice increased | 100 | 1 |
| Growing area of green gram increased | 93 | 2 |
| Growing area of black gram increased | 93 | 2 |
| Growing area of rice increased | 88 | 3 |
| Availability of irrigation water decreased | 80 | 4 |
| Growing area of Jute increased | 77 | 5 |
| Infestation of new weeds/ insect pest increased | 72 | 6 |
| Growing area of groundnut increased | 60 | 7 |
| Cropping pattern changed | 58 | 8 |
| Residue recycling increased | 58 | 8 |
| Productivity of jute increased | 45 | 9 |
| Productivity of crops green gram increased | 22 | 10 |
| Productivity of crops groundnut increased | 22 | 10 |
| Productivity of crops black gram increased | 3 | 11 |
| Adaptation measures adopted towards climate change | | |
| Change in planting dates of major crops | 100 | 1 |
| Changed to short, drought resistant varieties | 75 | 2 |
| Intercropping/mixed cropping adopted | 48 | 3 |
| Soil moisture conservation techniques adopted as land configuration adopted | 27 | 4 |
| Rain water harvesting/Water harvesting structures made | 13 | 5 |
| Have insurance | 7 | 6 |
| Mulching adopted as soil moisture conservation techniques | 2 | 7 |

Analysis on adaptation measures towards raising field crops depicts that 100% of respondents have changed their planting dates of major crops, 75% have changed to short, drought resistant varieties and 48% have adopted intercropping /mixed cropping. limited number of the farmers (7%) knows about insurance.

Farmer's perceptions and adopted measures regarding growing of horticultural crops

Table 4 below depicts the perception of the respondents regarding growing of horticultural crops. All most all the respondents have experienced the changes in



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growing tomato (98%) and increase in tomato productivity (100%). In case of brinjal, 98% of the respondents agreed to Growing area of crops and 73% to increase in productivity. Increase in pest infestation and increase in water requirement of crops have been responded by 97% and 90% respectively. Eighty three percent of the respondents have observed change in taste and flavour of fruits due to climate change and management practices. It is observed that all the respondents have changed the planting dates, 72% have changed to short stature, drought resistant varieties, 73% have adopted special measures for plant protection and 72% have introduced new crops. Smokes are used in the orchard to reduce the effect of cold

Table 4: Farmer's perceptions and adopted measures regarding growing of horticultural crops

| Parameters | Per cent | Rank |
|--|----------|------|
| Farmer's perception | | |
| Productivity of crops Tomato increased | 100 | 1 |
| Growing area of tomato increased | 98 | 2 |
| Insects pest infestation increased | 97 | 3 |
| Growing area of brinjal increased | 92 | 4 |
| Water requirement of crops increased | 90 | 5 |
| Growing area of banana increased | 83 | 6 |
| Change observed in taste/flavour of fruits | 83 | 6 |
| Productivity of brinjal increased | 73 | 7 |
| Growing area of potato increased | 68 | 8 |
| Productivity of potato increased | 67 | 9 |
| Growing area of chilli increased | 60 | 10 |
| Early flowering in fruits / plantation crops | 55 | 11 |
| Productivity of chilli increased | 50 | 12 |
| Productivity of banana increased | 43 | 13 |
| Adaptation measures adopted towards climate change | | |
| Change in planting dates of vegetables crops | 92 | 1 |
| changed to short stature, drought resistant varieties | 77 | 2 |
| Early harvest | 77 | 2 |
| Plant protection measures adopted | 73 | 3 |
| Introduced new crops | 72 | 4 |
| Smokes, heaters are used in the orchard to reduce the effect of cold, frost etc | 45 | 5 |
| Mulching adopted as soil moisture conservation techniques | 43 | 6 |
| Night irrigations applied to the vegetable crops to mitigate the effect of frost, cold | 25 | 7 |
| Rain water harvesting/Water harvesting structures made | 17 | 8 |
| Raise the crops in polyhouse to mitigate the effect of high temperature | 3 | 9 |

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by 45% and mulching adopted as soil moisture conservation techniques by 43% of the farmers of the response group. None of the farmers used net as a hail shelter (Table 4).

Farmer's perceptions and adopted measures regarding animal husbandry

Perception of farmer's regarding rearing of animals, 95% of the respondents agreed to changes in rearing of animals. Decrease in number of livestock per household are responded by 52%, whereas decrease in number of goats and poultry were observed by 80% and 53% by the farmers respectively. Increase in milk productivity has been positively responded by 85% of the farmers (Table 5). Animal rearing adaptation measures shows that 75% of the farmer's have reared cross breeds and 73% take prophylactic measures taken against disease infestation (Table 9). Nearby 28% of the respondents use of electric heaters to elevate the shelter temperature during strong cold and 12% use of electric fans/coolers during summer. Only 22% of them have insurance of horticultural crops.

Table 5: Farmer's perceptions and adopted measures regarding animal husbandry

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Changes observed in rearing of animals | 95 | 1 |
| Milk productivity increased | 85 | 2 |
| Numbers of goats per household decreased | 80 | 3 |
| Number of poultry per household decreased | 53 | 4 |
| Number of livestock per household decreased | 52 | 5 |
| Green fodder availability decreased | 27 | 6 |
| Adaptation measures adopted towards climate change | | |
| Rear cross breeds | 75 | 1 |
| Prophylactic measures taken against disease infestation | 73 | 2 |
| Have insurance | 37 | 3 |
| Use of ventilated pukka shelter | 33 | 4 |
| Use of electric heaters to elevate the shelter temperature during strong cold | 28 | 5 |
| Use of electric fans/coolers during summer | 12 | 6 |
| Raise green fodder in off season | 5 | 7 |



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Farmer's perceptions and adopted measures regarding fish farming

Perception regarding rearing fish reveals that 83% and 75% of the respondents agreed to increase in water requirement of ponds and increase in fish mortality, respectively. Seventy three percent of the sample responded positively to decrease /dried of number of ponds (Table 6). Results reveal the adaptation measures by the farmers in rearing fish under climate change scenario. "Multiple use of pond water as irrigation/washing of animal's sheds/ animals" is supported by 73% of the respondents (rank 1). Rearing of improved fingerlings and introduction of new species are practiced by 65% and 57% of the sample. Prophylactic measures are being taken against disease infestation by 37% of the respondents (rank 4).None of the respondents either have insurance or Use of pukka ponds to avoid the seepage loss of water.

Table 6: Farmer's perceptions and adopted measures regarding fish farming

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Water requirement of pond is increased | 83 | 1 |
| Fish mortality in pond increased | 75 | 2 |
| Number of ponds decreased/ dried | 73 | 3 |
| Disease infestation increased | 67 | 4 |
| Adaptation measures adopted towards climate change | | |
| Multiple use of water as irrigation/washing of animals sheds/ animals | 73 | 1 |
| Rear improved fingerlings | 65 | 2 |
| Introduction of new species | 57 | 3 |
| Prophylactic measures taken against disease infestation | 37 | 4 |

The adaptation index for field crops, horticultural crops, live stock and fishery shows that the farmers have a very high adaptation index (50%) in fish rearing, followed by adaptation measures for horticultural crops (42%). Adaptation index of both field crops and livestock were found to be 29% (Fig. 1).

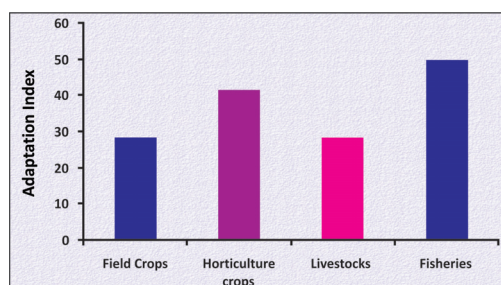


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems



UDAIPUR, RAJASTHAN

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Climate change is an essential phenomenon posing severe threat towards the present agriculture. Vagaries of climate change are increasing and adversely affecting the agriculture and allied activities. These changes are vulnerable to the sustainability, livelihood and income of poor farmers. Udaipur district of Rajasthan (24°35"N, 73°42"E and AMSL 598m) is characterised by mild climate throughout the year. The maximum temperatures range between 35°C to 42°C on most of the days during summer season. Although the highest maximum temperature during April to June months has yet been recorded 44.4°C, 46.4°C and 46.2°C respectively. Heat wave also prevails for a few days in the summer season, when day's temperature rose to 4–6°C above normal. In winter minimum temperatures remain around 5–10 °C or so when chilly wind (northerly) blow from Himalayan region. The annual rainfall of the district is 630.0 mm. In general crop –livestock farming is adopted in the region. Maize-wheat is the dominant cropping system of the district. For assessing the perception of the farmers on climate change and their adaptation

strategies towards it, 60 farmers from 6 villages namely Namla, Roba, Bujhfala, Bovas, Chandu ji ka Guda and Padarda under two blocks i.e. Salumber and Sarada of Udaipur district were surveyed. For calculating the climate change correlation coefficients of perception measures were adopted with various characteristics of the farmers.

Study clearly indicates that in the studied district that the education level of the farmers is very poor and 55% of the farmers are illiterate and only 33.3

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | None | 55 |
| | Primary | 33 |
| | Secondary | 10 |
| | College | 2 |
| Farm size (ha.) | <1.0 | 85 |
| | 1-2.5 | 15 |
| Farming experience | <10 | 8 |
| | 10-20 | 33 |
| | 21-30 | 22 |
| | >30 | 37 |
| Annual income (₹) | <1.0 | 100 |



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% farmers are educated up to primary. Most of farmers (85%) are having below one ha. of land. About 38.3 % farmers are more than 30 years age group having farming experience. All the farmers are having less than one lack rupee income round the year.

Farmer's perceptions regarding changing climate

Among the 17 parameters related to climate change were asked from the small and marginal farmers of the district and it was came out that 6 parameters viz, day temperature, night temperature and both day and night temperature, frequency of hail storm, frequency of heat wave increased however water table is decreased ranked 1st. Most of the farmers of the opinion that there is late onset of monsoon (95%) and erratic distribution of rainfall there by, affecting length of growing season (98%). It was also noticed by 90% of the farmers that there is decrease in the amount of rainfall due to climate change. There is erratic distribution of rainfall there by affecting length of growing season. There is failure of ITK technologies for weather forecasting. Frequency of flood is also increased and water table is decreased.

Table 2: Farmer's perceptions regarding changing climate

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Day temperature increased | 100 | 1 |
| Night temperature increased | 100 | 1 |
| Both day and night temperature increased | 100 | 1 |
| Frequency of hail storm increased | 100 | 1 |
| Frequency of heat wave increased | 100 | 1 |
| Water table decreased | 100 | 1 |
| Erratic distribution of rainfall there by, affecting length of growing season | 98 | 2 |
| Late onset of monsoon | 95 | 3 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 95 | 3 |
| Frequency of cold wave increased | 95 | 3 |
| Decrease in rainfall amount | 90 | 4 |
| Frequency of flood increased | 78 | 5 |
| Frequency of frost increased | 58 | 6 |
| Frequency of drought increased | 20 | 7 |
| Crop lodging due to high wind velocity increased | 20 | 7 |
| Early onset of monsoon | 0 | 8 |
| Terminal heavy rains | 0 | 8 |



Table 3: Farmer's perceptions and adopted measure regarding growing of major field crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Cropping pattern changed | 100 | 1 |
| Growing area of maize increased | 100 | 1 |
| Growing area of wheat increased | 100 | 1 |
| Productivity of maize increased | 100 | 1 |
| Productivity of wheat increased | 100 | 1 |
| Infestation of new weeds/ insect pest increased | 98 | 2 |
| Incidence of pest and diseases increased | 93 | 3 |
| Availability of irrigation water decreased | 93 | 3 |
| Adaptation measures adopted towards climate change | | |
| Changed to short, drought resistant varieties | 92 | 1 |
| Change in planting dates of major crops | 90 | 2 |
| Intercropping/mixed cropping adopted | 30 | 3 |

Farmer's perceptions and adopted measure regarding growing of major field crops

Cent percent farmers are of the opinion that the cropping pattern changed. Growing area and productivity of the maize and wheat are getting impetus whereas; infestation of new weeds/ insect pest is also increased. Availability of irrigation water decreased but there is no farmers turn to say that residue recycling practice is increased on the farmers field. The highly adapted measures in response of climate change adopted by the farmers to grow the field crops is came out as change in traditional verities to short and drought resistant varieties. Most of the farmers (90%) are also changed the normal dates of planting of major crops to reduce the ill effect of the climate change. Some farmers have also adopted intercropping/mixed cropping to maintain the productivity. No farmers turn to say that they are having crop insurance against weather vagaries and adopting mulching and land configuration techniques as soil moisture conservation techniques (table 6).



Farmer's perceptions and adopted measures regarding growing of horticultural crops

The perception study reveal that there is increased in the productivity of both the vegetables and there is early flowering in the horticultural crops and water requirement of horticultural crops is increased. Results of adopted measures clearly indicate that 98% of the farmers have changed in the planting dates of vegetables crops, 87% changed to short stature, drought resistant varieties, 93% farmers adopted plant protection measures, 88% farmers go for early harvest of the crops 55% introduced new crops and 93% farmers started night irrigations to the crops (tomato, brinjal etc.) to mitigate the effect of frost, cold to cut down the negative impact of climate change on the productivity of the crops.

Table 4: Farmer's perceptions and adopted measures regarding growing of horticultural crops

| Parameters | Per cent | Rank |
|--|-----------------|-------------|
| Farmer's perception | | |
| Productivity of tomato increased | 100 | 1 |
| Productivity of brinjal increased | 100 | 1 |
| Early flowering in fruits / plantation crops | 97 | 2 |
| Water requirement of crops increased | 42 | 3 |
| Insects pest infestation increased | 20 | 4 |
| Change observed in taste/flavour of fruits | 12 | 5 |
| Adaptation measures adopted towards climate change | | |
| Change in planting dates of vegetables crops | 98 | 1 |
| Plant protection measures adopted | 93 | 2 |
| Night irrigations applied to the vegetable crops to mitigate the effect of frost, cold | 93 | 2 |
| Early harvest | 88 | 3 |
| Changed to short stature, drought resistant varieties | 87 | 4 |
| Introduced new crops | 55 | 5 |

Farmer's perceptions and adopted measures regarding animal husbandry

Most of the farmers (85%) noticed changes in rearing of animals where it was came out that number of livestock per household decreased and milk productivity



increased. Availability of green fodder is decreased and it was witnessed by 80% of surveyed population (table 5). Cent percent farmers are raising green fodder in off season whereas, 93% farmers are rearing cross breeds in place of desi breeds. Most of the farmers (92%) farmers are taking prophylactic measures against disease infestation in the livestock (table 8). Other adaptation measures shown in the table are not in practiced against the climate change.

Table 5: Farmer's perceptions and adopted measures regarding animal husbandry

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Changes observed in rearing of animals | 85 | 1 |
| Green fodder availability decreased | 80 | 2 |
| Milk productivity increased | 77 | 3 |
| Number of livestock per household decreased | 38 | 4 |
| Number of poultry per household decreased | 20 | 5 |
| Numbers of goats per household decreased | 18 | 6 |
| Cow is replaced by buffalo | 13 | 7 |
| Adaptation measures adopted towards climate change | | |
| Raise green fodder in off season | 100 | 1 |
| Rear cross breeds | 93 | 2 |
| Prophylactic measures taken against disease infestation | 92 | 3 |

Adaptation index of the farmers towards changing climate for different components of the farming systems

The highest adaptation index (50%) was recorded in case of growing of horticultural crops of by the farmers towards changing climate. Most of the adaptation measures (43%) are also being adapted by the farmers in rearing of the animals. But in case of field crops farmers are still either unaware or not able to adopt the measures which may reduce the productivity due to climate change.

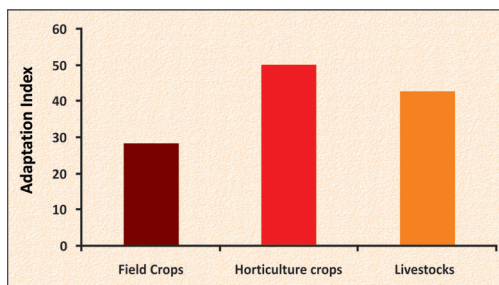


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems



CHETTINAD, TAMIL NADU

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As water is the most important factor for crop production and maintaining of animals. Inadequacy and uncertainty of rainfall coupled with drought and higher soil moisture depletion often cause partial or complete failure of the crops which leads to period of scarcity of food particularly for small and marginal farmers. Thus the life of both human being and animal components of such small and marginal farmers becomes difficult and highly insecure. Therefore, all the available technologies should be inculcated and imparted among the farming community for their livelihood security besides increasing the productivity of crops and animal components under changing climatic conditions. To know the farmers perception and adaptation towards mitigating climate change under changing climatic condition, a characterization survey was conducted in two mandatory districts viz., Sivagangai and Pudukottai district of Tamil Nadu. From each district, three revenue villages (Ammayenthal, Chandranpatty and Kuruvadipatty in

Sivagangai district and Aranginpatty, Melur and Thirumayam in Pudukottai district) have been selected and from each revenue village, ten farmers were identified. Similarly, a total of 60 farmers were surveyed on climate change aspects. The average annual rainfall of the region is 940 mm. The major cropping system followed in this region is rice-rice-ice/blackgram/groundnut/vegetables. Regarding the livestock components, the major breed reared by the farmers is cross bred jercy. Using

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | Primary | 43 |
| | Secondary | 40 |
| | College | 17 |
| Farm size (ha.) | <1.0 | 38 |
| | 1-2.5 | 62 |
| Farming experience | 10-20 | 18 |
| | 21-30 | 40 |
| | >30 | 42 |
| Annual income (₹) | <1.0 | 85 |
| | 1-2 | 13 |
| | 2-5 | 2 |

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the simple correlation analysis, the characterization data was correlated between socio- economic parameters and farmer perception and adaptation towards climate change. With respect to educational level, majority were under the category of primary followed by secondary level. 10 percent of the farmers have completed their degree. Regarding farm size, majority (62 percent) were small followed by marginal (38 percent) category. The average farming experience of the farmers showed that 42 percent farmers having more than 30 years of experience while, 40 percent farmers are having farm experience of 21-30 years. Regarding the annual income of the farmers, majority i.e. 85 percent of the famers have earned rupees less than one lakh and 13 percent farmers fall under the category of ₹ 2-5 lakh. Only 2 percent have earned more than ₹ 5 lakh per annum. The details of the general characteristics of the survey population are given in table 1.

Farmer's perception regarding climate change

The details of the farmers perceptions regarding changing climate in Sivagangai and Pudukottai District are elaborated in table 2. The results showed that both increase in day and night temperature coupled with poor rainfall with uneven

Table 2. Farmer's perceptions regarding changing climate in Sivagangai and Pudukottai District.

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Decrease in rainfall amount | 100 | 1 |
| Erratic distribution of rainfall there by, affecting length of growing season | 100 | 1 |
| Water table decreased | 100 | 1 |
| Both day and night temperature increased | 92 | 2 |
| Frequency of drought increased | 90 | 3 |
| Day temperature increased | 87 | 4 |
| Late onset of monsoon | 83 | 5 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 83 | 5 |
| Night temperature increased | 73 | 6 |
| Frequency of heat wave increased | 42 | 7 |
| Early onset of monsoon | 8 | 8 |
| Frequency of cold wave increased | 2 | 9 |
| Terminal heavy rains | 0 | 10 |
| Frequency of flood increased | 0 | 10 |
| Frequency of hail storm increased | 0 | 10 |
| Frequency of frost increased | 0 | 10 |
| Crop lodging due to high wind velocity increased | 0 | 10 |



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distribution along with higher frequency of drought which resulted in lowering in the water table (open well, bore well and reservoirs. Consequently, the crop productivity and milk yield is affected drastically. The failure of indigenous technical knowledge on sowing time resulted in poor crop establishment and crop coincided with early and terminal drought. Majority of the farmers have perceived that there was increase in day and night temperature, decrease in rainfall and its distribution, occurrence of drought, decrease in water table and failure of ITK particularly for weather forecasting.

Farmer's perceptions and adopted measures regarding growing of field crops

The farmer's perceptions pertinent to change in cropping pattern, weeds, pest, and disease outbreak, lowering in crop and animal productivity and residue recycling are discussed in table 3. The results showed that only 20 percent farmers have

Table 3: Farmers perceptions and adopted measures regarding growing of field crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Availability of irrigation water decreased | 100 | 1 |
| Incidence of pest and diseases increased | 35 | 2 |
| Productivity of crops ragi increased | 35 | 2 |
| Productivity of brinjal increased | 30 | 3 |
| Infestation of new weeds/ insect pest increased | 30 | 3 |
| Productivity of groundnut increased | 23 | 4 |
| Cropping pattern changed | 20 | 5 |
| Growing area of rice increased | 20 | 5 |
| Growing area of black gram increased | 20 | 5 |
| Growing area of groundnut increased | 20 | 5 |
| Growing area of ragi increased | 18 | 6 |
| Residue recycling increased | 17 | 7 |
| Productivity of rice increased | 15 | 8 |
| Productivity of black gram increased | 12 | 9 |
| Adaptation measures adopted towards climate change | | |
| Changed to short, drought resistant varieties | 75 | 1 |
| Change in planting dates of major crops | 73 | 2 |
| Intercropping/mixed cropping adopted | 62 | 3 |
| Have insurance | 38 | 4 |
| Mulching adopted as soil moisture conservation techniques | 20 | 5 |
| Rain water harvesting/Water harvesting structures made | 18 | 6 |
| Soil moisture conservation techniques adopted as land configuration adopted | 12 | 7 |

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observe that there is change in cropping pattern, reduce in crop productivity while 35 percent of the farmers have expressed that there is increase in pests and disease incidence. Eighteen percent of the farmers have indicated that there is increase in the productivity of groundnut crop during rabi season.

Regarding adaptation measures to counteract climate change, out of 60 farmers 44 farmers (73 percent) have adapted change in the date of sowing of rice particularly to escape from the early and terminal drought which resulted in minimizing the crop damage due to severe drought and soil moisture depletion. While during summer season, 75 percent of the farmers have utilized short duration and drought resistant (ephemerals) sesame (SVPR1), blackgram (VBN 5), green gram (VBN2).



Photo: Adaptation measures adopted towards changing climate



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38 percent of the farmers have insured their crops and 62 percent of the farmers have implemented intercropping with redgram (VBN 3), cowpea (CO 5) as these crops which will act as crop insurance against crop failure when drought occurs and farmers have also grown mixed crop in groundnut and blackgram with onion, raddish and greens.

Farmer's perceptions and adopted measures regarding growing of horticultural crops

The results pertinent to the farmers perception on horticultural crops revealed that reduction in the productivity owing to the non availability of water during monsoon as well as summer season, 17 percent of the farmers prefers to go for short duration annual crops instead of maintaining the orchard which is not remunerative and population is drastically reduced due to mortality of aged coconut trees. 38 percent of the farmers opined that there is increase in the pest and disease outbreaks and infestation was higher than the normal year. Eventually, the water requirement of coconut and mango is increased under higher soil temperature with low intensity of rainfall. The details of the farmers perception are furnished in table 4. Regarding farmer's adaptation pertinent to horticultural crops, 87 percent farmers have implemented plant protection measures against the major pests and diseases followed by introducing short and drought resistant varieties (55 percent) and 42 percent farmers introduce new crops such as turmeric, yam in their region and

Table 4: Farmer's perceptions and adopted measures regarding growing of horticultural crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Water requirement of crops increased | 100 | 1 |
| Insects pest infestation increased | 38 | 2 |
| Early flowering in fruits / plantation crops | 18 | 3 |
| Growing area of coconut | 17 | 4 |
| Change observed in taste/flavour of fruits | 17 | 4 |
| Productivity of crops increased Mango | 10 | 5 |
| Adaptation measures adopted towards climate change | | |
| Plant protection measures adopted | 87 | 1 |
| changed to short stature, drought resistant varieties | 55 | 2 |
| Introduced new crops | 42 | 3 |

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with these management practices the productivity is increased with minimum cost and the details of the adaptation measures towards changing climate on horticultural crops by the farmers are as furnished in the table 4.

Farmer's perceptions and adopted measures regarding animal husbandry

The results of the farmers perception on animal components are given in table 5 and it showed that all the farmers have indicated that there is great demand for green fodder particularly during the lean period owing to non-availability of the green fodder (poor forage yield owing to severe drought and failure of monsoon), had significantly affected the milk yield and conception rate of the animals. Subsequently, 62 percent of the farmers have sold their stocks due to non-availability of water and green as well as dry fodder. Regarding stock load of poultry, 50 percent of the farmers have reduced their stock load due to heavy outbreak of diseases during summer season. The majority of the farmers (93 percent) are rearing crossbred dairy cows particularly jercy cow in well-constructed shed with proper cross ventilation facilities. The major constraints for low milk yield and poor animal growth are non-availability of green fodder particularly during lean period and poor health care. To ensure year round supply of green fodder and improve the animal health, 72 percent of the farmers have raised CNH CO 4 grass and supplemented with location specific mineral mixture. 83 percent of the farmers have taken up prophylactic vaccination

Table 5: Farmer's perceptions and adopted measures regarding animal husbandry

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Green fodder availability decreased | 100 | 1 |
| Number of livestock per household decreased | 62 | 2 |
| Number of poultry per household decreased | 50 | 3 |
| Adaptation measures adopted towards climate change | | |
| Rear cross breeds | 93 | 1 |
| Use of ventilated pukka shelter | 92 | 2 |
| Prophylactic measures taken against disease infestation | 83 | 3 |
| Raise green fodder in off season | 72 | 4 |
| Have insurance | 68 | 5 |



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measures particularly for FMD in dairy cows and RDVK vaccine for poultry. Due to these interventions, the additional milk yield of 1.0 liter per day per animals was realized besides improving the conception rate, lactation period and a narrow down the inter calving period. The details of the adaptation measures to rear animals are furnished in table 5.

With respect to adaptation index, the results revealed that the highest value of 71 was observed under livestock components due to its contribution towards the livelihood security followed by crop which recorded 43. The lowest value of adaptation index was noticed with horticultural component. The details of the adaptation index were furnished in figure 1.

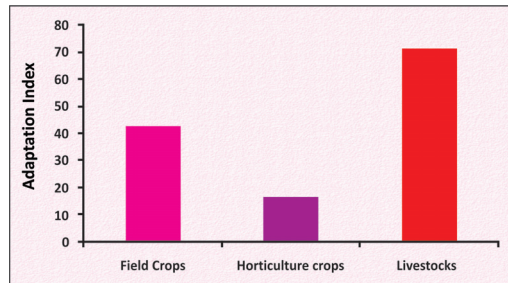


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems



KRISHNAGIRI, TAMIL NADU

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Fast pace of global warming due to accelerated industrialization, infrastructure development and urbanization leads to climate change that result in a vicious interference in the farming. Extreme conditions of flood and drought, delayed monsoon and early cessation; high intensity rainfall and lesser rainy days; shift in pests and weeds and so on will influence the livelihood and decision making processes of the farming community. This precarious situation will play spoilsport in the especially in the lives of poor marginal and small farmers of the country who constitute more than 86%. Scientific evidences and simulation models on the effects of climate change also confirm the bleak future of farming across the globe by posing a big danger to the food basket. In this line, an analysis among farmers were planned and carried out about the perception and adaptation measures for the phenomena. North Western zone of Tamil Nadu comprises of Salem, Namakkal, Dharmapuri and Krishnagiri districts. A total of 60 sample farmers were drawn from Kaveripattinam block (Krishnagiri) and Karimangalam block (Dharmapuri) for the analysis. Both the blocks receive a normal rainfall of 880mm in about 44 rainy days. Since, Kaveripattinam has Krishnagiri Reservoir Project, the predominant cropping is rice- rice and Karimangalam rice- groundnut/ pulses- rice/ pulses- groundnut. Both the blocks are having sustainable animal husbandry, mainly cows. With a pretested questionnaire, the primary data were collected and analysed for correlation coefficients and presented hereunder.

Characteristic features of the samples

More than 72% of the samples have completed their secondary education or graduates. Marginal farmers were 60% and small 40% thereby representing the



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majority and 63% of the samples had a farming experience of more than 21 years. This favoured the analysis to assess the effect over longer periods. The annual income of 80% samples was below ₹ 1.0 lakh only. No sample has more than ₹ 2.0 lakh income.

Farmer's perceptions on climate change

A total of 17 parameters on temperature, rainfall, forecasting, monsoon behavior, hail storms, heat waves and cold waves were considered for the study. All the sample farmers' were of the perception that decrease in rainfall amount, erratic distribution and decrease in water table were order of the day. Late onset was perceived by 93% of the samples, day temperature increase by 92%,

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | None | 13 |
| | Primary | 33 |
| | Secondary | 37 |
| | College | 17 |
| Farm size (ha.) | <1.0 | 60 |
| | 1-2.5 | 40 |
| Farming experience | <10 | 12 |
| | 10-20 | 25 |
| | 21-30 | 30 |
| | >30 | 33 |
| Annual income (₹) | <1.0 | 80 |
| | 1-2 | 20 |

Table 2: Farmer's perceptions regarding changing climate

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Decrease in rainfall amount | 100 | 1 |
| Erratic distribution of rainfall there by, affecting length of growing season | 100 | 1 |
| Water table decreased | 100 | 1 |
| Late onset of monsoon | 93 | 2 |
| Day temperature increased | 92 | 3 |
| Night temperature increased | 85 | 4 |
| Both day and night temperature increased | 78 | 5 |
| Frequency of drought increased | 62 | 6 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 48 | 7 |
| Crop lodging due to high wind velocity increased | 7 | 8 |
| Early onset of monsoon | 0 | 9 |
| Terminal heavy rains | 0 | 9 |
| Frequency of flood increased | 0 | 9 |
| Frequency of hail storm increased | 0 | 9 |
| Frequency of heat wave increased | 0 | 9 |
| Frequency of cold wave increased | 0 | 9 |
| Frequency of frost increased | 0 | 9 |

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night temperature increase by 85% and both day and night temperature increase by 78% samples. Increased frequency of drought was told by 37 samples constituting 62%. Forecasting failure by ITK was to the tune of 48%. Only 7% of the samples felt crop lodging due to high wind velocity. All the samples negative early onset of monsoon, terminal heavy rains, frequency of flood, hail storm, heat wave, cold wave and frost.

Farmer's perception and adopted measures for growing of field crops

All the 100% samples opined an increased incidence of pests and diseases and also incidence of new weeds and pests. 80% samples perceived a decrease in the availability of irrigation water for the crops. Changed cropping pattern and change in major crops (cereals and pulses) were perceived by 50% of the sample farmers and majority was from Karimangalam block of Dharmapuri district. The perception of 100% of the samples was that there was no increase in the productivity of crops and residue recycling. Farmers numbering 44 constituting 73% perceived a change in planting dates of major crops. The change was to short duration and drought resistant crops as told by 25% samples. Only 7% farmers adapted intercropping/ mixed cropping. None of the farmers resorted to insurance, rain water harvesting, mulching or soil moisture conservation techniques.

Table 3: Farmer's perception and adopted measures for growing of field crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Incidence of pest and diseases increased | 100 | 1 |
| infestation of new weeds/ insect pest increased | 100 | 1 |
| Availability of irrigation water decreased | 80 | 2 |
| Cropping pattern changed | 50 | 3 |
| Adaptation measures adopted towards climate change | | |
| Change in planting dates of major crops | 73 | 1 |
| Changed to short, drought resistant varieties | 25 | 2 |
| Intercropping/mixed cropping adopted | 7 | 3 |



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Farmer's perception and adopted measures for growing of horticultural crops

All the sample farmers' perception was that increased pest infestation in horticultural crops. Water requirement has also increased for 82% samples. Vegetables and flowers were the change of horticulture crops for 67% farmers comprising 40 samples. None of the samples perceived early flowering and changes in taste and flavor of fruits. Of the total sample farmers, 75% introduced new horticultural crops and 50% samples adopted plant protection techniques. Change in planting dates was perceived by 37% of the samples. None of the samples had insurance, rain water harvesting to mulching and so on.

Table 4: Farmer's perception and adopted measures for growing of horticultural crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Insects pest infestation increased | 100 | 1 |
| Water requirement of crops increased | 82 | 2 |
| Adaptation measures adopted towards climate change | | |
| Introduced new crops | 75 | 1 |
| Plant protection measures adopted | 50 | 2 |
| Change in planting dates of vegetables crops | 37 | 3 |

Farmer's perception and adopted measures regarding animal husbandry

All the sample farmers perceived that number of livestock have come down and at the same time milk productivity got increased. 53% of the farmers felt the changing behavior in rearing of animals. Number of poultry and goats reared per household deceased as per the perception of 37 and 35% samples respectively. 17% of the farmers perception was that decrease in green fodder availability and 13% saw a change in buffalos to cows. All 100% sample farmers reared crossbred animals with offseason cultivation of green fodder. They also had resorted to prophylactic disease management practices. 75% sample farmers had pukka shelter for animals. No farmer had insurance, heaters, and coolers for the animals.



Table 5: Farmer's perception and adopted measures regarding animal husbandry

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Number of livestock per household decreased | 100 | 1 |
| Milk productivity increased | 100 | 1 |
| Changes observed in rearing of animals | 53 | 2 |
| Number of poultry per household decreased | 37 | 3 |
| Numbers of goats per household decreased | 35 | 4 |
| Green fodder availability decreased | 17 | 5 |
| Cow is replaced by buffalo | 13 | 6 |
| Adaptation measures adopted towards climate change | | |
| Rear cross breeds | 100 | 1 |
| Raise green fodder in off season | 100 | 1 |
| Prophylactic measures taken against disease infestation | 100 | 1 |
| Use of ventilated pukka shelter | 75 | 2 |

Farmer's perception and adopted measures regarding fish rearing

Sample farmers of 95% comprising 57 farmers perceived a decrease in the number of ponds and also dried. 88% also felt the increased water requirement for the parched ponds.

Table 6: Farmer's perceptions and adopted measures regarding fish farming

| Farmers perception | Per cent | Rank |
|--|----------|------|
| Number of ponds decreased/ dried | 95 | 1 |
| Water requirement of pond is increased | 88 | 2 |

Adaptation index of the farmers towards changing climate for different components of the farming systems

The computed adaptation index showed a larger sample size of 57% changed their practices for livestock rearing. This was followed by field crops with 14% and horticulture 8% only.

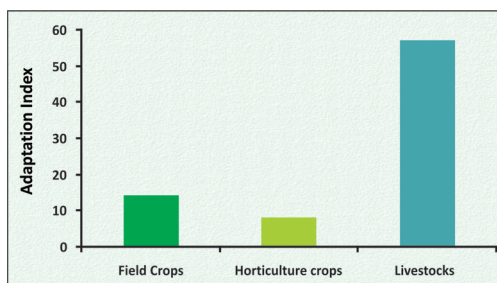


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems



WARANGAL, TELANGANA

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The geographical coordinates of Warangal district are 17°19' to 18°36' N latitude and 78° 49' to 80°43' E longitude with an altitude of 1036 meter. The normal annual rainfall of the district is 1059 mm with 63 normal rainy days. The major crops are rice, cotton, maize, greengram, redgram and groundnut. Mango is the major fruit crop of the district followed by orange and banana. Chillies and turmeric are major vegetable and spice crops respectively. The sample survey was conducted in six villages of Vanamaala kanparthi, Tekulagudem, Dharmapuram, Rajavaram, chinnapendyala and Kadarigudem of Hanamkonda, Dharmasagar, Station ghanpur and wardhannapeta mandals of Warangal district of Telangana state.

General characteristics of the survey population

Twenty two numbers of farmers (37%) studied upto secondary school followed by 18 number were illiterate (30%), 14 farmers (23%) were educated up to primary school and only six farmers (10%) reached up to college level. There were 41 farmers (68%) having the land holding size between ₹ 1-2.5 ha falls under small farmer category followed by 16 farmers' falls under marginal size group (27%) are having the land less than one ha and only three medium range farmers are having more than 2.5 ha. Sixty seven per cent of the farmers are having more

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | None | 30 |
| | Primary | 23 |
| | Secondary | 37 |
| | College | 10 |
| Farm size (ha.) | <1.0 | 27 |
| | 1-2.5 | 68 |
| | >2.5 | 5 |
| Farming experience | <10 | 0 |
| | 10-20 | 32 |
| | 21-30 | 18 |
| | >30 | 33 |
| Annual income (₹) | <1.0 | 0 |
| | 1-2 | 48 |
| | 2-5 | 50 |
| | >5 | 2 |

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than 20 years of farm experience followed by 37% farmers having 10-20 years of experience farming. 50% of the farmers are earning 2-5 lakhs per annum followed by 1-2 lakh annual income were earned by 48% of the farmer (Table 1).

Farmer's perception regarding climate change

Ninety five percent of the farmers participated in survey opined that, day temperatures are increased and 90% of farmers revealed that decreased in water table. Most of the farmers (85%) responded positively for the decrease of rainfall amount however, 83% farmers out rightly said that ITKS were failed to forecast the weather. The same percentage of farmers also revealed that drought frequency was increased. The phenomenon of heat waves is very common and about 78% farmers agreed that the frequency of heat waves is increased. Night temperature is increased as per the 73% of the farmers of the survey sample however, 60% of the farmers admitted that both day and night temperatures are increased. The effect of erratic distribution of rainfall on the length of the growing season was advocated by the 52% of farmers. Only few percentage of farmers expressed that, early onset of monsoon (18%), crop lodging due to wind velocity (40%), cold wave frequency increased (20%) and terminal heavy rains (15%) (Table 2). In changing climate situations farmers have to adjust the dates of sowing of major crops (75%) and to grow short, drought resistant varieties under adverse conditions (52%) (Table 6). To get sustain income and minimize the risk, farmers have to grow inter/mixed cropping (47%). Farmers have to construct rain water harvesting structures to save the crop from during critical stages of crop periods by giving life saving irrigations and to resort moisture conservation practices to beat the drought situations.



Photo: Introduction of non-traditional crops, cold tolerant rice varieties and Intercropping of maize + french bean



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Table 2: Farmer's perceptions regarding changing climate

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Day temperature increased | 95 | 1 |
| Water table decreased | 73 | 7 |
| Decrease in rainfall amount | 60 | 8 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 18 | 13 |
| Frequency of drought increased | 75 | 6 |
| Frequency of heat wave increased | 85 | 3 |
| Late onset of monsoon | 15 | 14 |
| Night temperature increased | 52 | 9 |
| Both day and night temperature increased | 83 | 4 |
| Erratic distribution of rainfall there by, affecting length of growing season | 83 | 4 |
| Crop lodging due to high wind velocity increased | 0 | 16 |
| Frequency of hail Storm increased | 22 | 11 |
| Frequency of cold wave increased | 78 | 5 |
| Early onset of monsoon | 20 | 12 |
| Terminal heavy rains | 3 | 15 |
| Frequency of frost increased | 40 | 10 |
| Frequency of flood increased | 90 | 2 |

Farmer's perception and adopted measures regarding cultivation of field crops

Due to change in climate, pest and disease attack was increased (100%) cropping pattern was changed (82%) followed by infestation of new weeds/insect pest attack was increased (Table 3). 22% of the farmer opined that residue recycling increased. Cotton area is increased as 50% farmers responded positively followed by rice area (48%). 67% farmers voiced that maize yields are increased.

Table 3: Farmer's perception and adopted measures regarding cultivation of field crops

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Incidence of pest and diseases increased | 100 | 1 |
| Availability of irrigation water decreased | 92 | 2 |
| Cropping pattern changed | 82 | 3 |
| Infestation of new weeds/ insect pest increased | 70 | 4 |
| Productivity of maize increased | 67 | 5 |
| Growing area of maize increased | 62 | 6 |
| Productivity of rice increased | 57 | 7 |

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| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Growing area of cotton increased | 50 | 8 |
| Growing area of rice increased | 48 | 9 |
| Productivity of cotton increased | 38 | 10 |
| Growing area of vegetable increased | 32 | 11 |
| Residue recycling increased | 22 | 12 |
| Productivity of vegetables increased | 12 | 13 |
| Adaptation measures towards climate change | | |
| Change in planting dates of major crops | 75 | 1 |
| Changed to short, drought resistant varieties | 52 | 2 |
| Intercropping/mixed cropping adopted | 47 | 3 |
| Have insurance | 20 | 4 |
| Rain water harvesting/Water harvesting structures made | 5 | 5 |
| Mulching adopted as soil moisture conservation techniques | 3 | 6 |
| Soil moisture conservation techniques adopted as land configuration adopted | 3 | 6 |

Farmer's perception and adopted measures regarding cultivation of horticultural crops

There was change in area and productivity of vegetable crops and horticulture crops and changes observed in taste and flavor of fruit crops due to more pests and disease incidence (72%) and most of the farmers were spraying pesticides to control the pests and diseases (Table 4). They come to early flowering in fruit and plantation crops as there is deficit in soil moisture and more water requirement (82% opined positively) finally it effects on the yield of horticultural crops.

Due to change in climate, pests and disease attack is more. 95% of the farmers are resorting to spray the pesticides to control the pests and diseases (Table 7). Planting dates of vegetables are adjusted to cope with favorable conditions of climate (50%). Farmers are adopting to grow short stature, drought resistant varieties and introducing new crops under changing climatic conditions. Other measure is early harvest to avoid adverse climatic situation and to insure the crop for getting compensation of loss from extreme weather situations. Other few techniques like use of net as hail shelter raise of crops in poly houses to mitigate the effect of high temperature. In cool crops like potato and tomato irrigations should be given during nights to mitigate the effect of frost and cold and also to use smokes and heaters



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Table 4: Farmer's perception and adopted measures regarding cultivation of Horticultural crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Water requirement of crops increased | 82 | 1 |
| Growing area of leafy vegetables increased | 10 | 10 |
| Early flowering in fruits / plantation crops | 10 | 10 |
| Insects pest infestation increased | 72 | 2 |
| Productivity of tomato increased | 62 | 3 |
| Growing area of tomato increased | 50 | 4 |
| Productivity of chilies increased | 50 | 4 |
| Growing area of chilies increased | 45 | 5 |
| Change observed in taste/flavour of fruits | 45 | 5 |
| Growing area of lady's finger increased | 25 | 6 |
| Productivity of lady's finger increased | 22 | 7 |
| Productivity of lady's finger increased | 18 | 8 |
| Productivity of cucumber increased | 18 | 8 |
| Growing area of cucumber/water melon increased | 17 | 9 |
| Adaptation measures towards climate change | | |
| Plant protection measures adopted | 95 | 1 |
| Change in planting dates of vegetables crops | 50 | 2 |
| changed to short stature, drought resistant varieties | 40 | 3 |
| Introduced new crops | 25 | 4 |
| Early harvest | 20 | 5 |
| Have insurance | 12 | 6 |



Photo: Drip irrigation in tomato and turmeric+ maize- water melon crop sequence

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are used to reduce the effect of cold and frost etc. Mulching can be adopted to conserve the soil moisture during dry spells.

Farmer's perception and adopted measures regarding animal husbandry

Number of live stocks, poultry, and goat population was decreased due to decrease of green fodder availability (Table 5). 92% of farmers admitted that less availability of green fodder throughout the year. Only few farmers responded positively for increase of milk yield as the cow population is decreasing and cow is replaced by buffalo consequently milk yields are decreased.

Diseases infestation is more in adverse weather conditions (Table 8). Farmers have to take prophylactic measures against disease infestation (87%). Moreover, round the year green fodder should be cultivated to increase the milk yield (47%). Rear the cross breeds for more milk yield (8%) Electric fans/coolers and heaters are to be used to protect the livestock during hot summer and cool winters respectively. Insurance is the best option from adverse weather situations.

Table 5: Farmer's perception and adopted measures regarding animal husbandry

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Green fodder availability decreased | 92 | 1 |
| Number of poultry per household decreased | 80 | 2 |
| Numbers of goats per household decreased | 75 | 3 |
| Number of livestock per household decreased | 73 | 4 |
| Cow is replaced by buffalo | 52 | 5 |
| Changes observed in rearing of animals | 48 | 6 |
| Milk productivity increased | 30 | 7 |
| Adaptation measures adopted towards climate change | | |
| Prophylactic measures taken against disease infestation | 87 | 1 |
| Raise green fodder in off season | 47 | 2 |
| Use of ventilated pukka shelter | 32 | 3 |
| Use of electric heaters to elevate the shelter temperature during strong cold | 22 | 4 |
| Rear cross breeds | 8 | 5 |
| Have insurance | 7 | 6 |
| Use of electric fans/coolers during summer | 7 | 6 |



AICRP on IFS: On Farm Research Farmer's Perception on Climate Change

Adaptation Index

Among different components of farming systems, highest adaptation index was recorded in case of field crops (29%) followed by livestock (14%) and Horticultural crops (8%) (Fig.1).

Conclusion

The farmers from AICRP IFS Warangal voiced that, increase in temperature and decrease in rainfall amount i.e. frequent drought situations leads to decrease in availability of irrigation water are major climate deciding factors for change in cropping pattern of field crops, more and pest and disease incidence in field crops due to abnormal weather. It affects not only field crops as well as horticultural crops. Due to adversity in weather, disease and pest incidence increased, taste and flavor was changed and crops completes the life cycle early due to deficit in soil moisture. In livestock, due to less green fodder availability milk

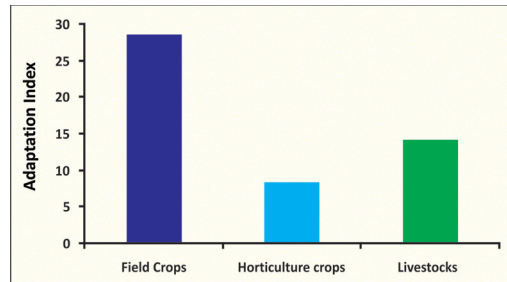


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems



Photo: Green fodder cultivation throughout the year

yield is decreased. To overcome the adverse weather situations, farmers have to adjust the dates of sowing, select the short, drought resistant varieties, adopt inter/mixed cropping. Construction of Rain water harvesting structures, mulching should be adopted as moisture conservation technique, plant protections measures are to be adopted, introduction of new crops both in field and horticultural crops. Raise the green fodder throughout the year and prophylactic measures are adopted against diseases infestation in animals.



AMROHA, UTTAR PRADESH

**L.R. Meena, M.P. Singh, Suresh Malik, Vinod Kumar, A.K. Prusty,
R.S. Yadav, Sanjeev Kumar and A.L. Meena**

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Change in climate is posing a great threat towards making the agriculture and livestock sectors more vulnerable and unprofitable. The variability in weather parameters like rainfall pattern, air temperature, relative humidity, wind speed and bright hours of sunshine are increasing day by day conditions. Change in these climatic parameters cause adverse effects on sustainability, livelihood improvement, environment etc. leading to reduced income of the resource poor farmers across the globe and especially developing countries including India. Small and marginal farmers are more prone to climate change risks owing to poor resource base. Majority of farmers in the country are belonging to small and marginal categories (86%). Though, scientists across the globe have generated and collected sufficient information about the climate change, impacts and adaptations in the agriculture. On the other hand, farmers have their own perception about the

climate change, impacts and adaptation to their own socio-economic and edaphic conditions. To ascertain the perception of the farmers about the climate change, a study was conducted in Amroha district, Uttar Pradesh. The climate of the study area is hot humid (dry) and comes under northern plain zone (NPZ) of Uttar Pradesh. The average annual rainfall (RF) of the district is 942 mm with 90 rainy days. For the present study, 60 farmers of six villages i.e. Varsabad, Khalipur, Dhoriya, Daulatpur, Gulampur and Gangwar were selected under covering two blocks i.e. Gajraula and Gangaswary of the district (Latitude: 28°52' 7"N, Longitude: 78°28' 8"E and Altitude: 211 meter). The respondents were selected for on farm research (OFR) running under Indian Institute of Farming Systems Research (IIFSR), Modipuram centre (Uttar Pradesh). Therefore, a survey was conducted to understand the farmer's perceptions and adaptations of mitigation strategies about climatic change.



AICRP on IFS: On Farm Research Farmer's Perception on Climate Change

Results of general characteristics of surveyed farmers revealed that about 40% farmers are having farming experience more than 30 year and 70% farmers are earning annual income less than 1 lac (Table 1).

Farmer's perceptions regarding changing climate

The farmers were asked about changes in various weather parameters like increased day and night temperatures, early and late onset of monsoon, decrease in rainfall, terminal heavy and erratic rainfall distribution, increase drought, flood, cold wave, increase lodging of crops due to high wind velocity and decreased water table.

All the farmers perceived positively about occurrence of above changes. Sixty per cent of the farmers were of the view that ITK (Indigenous Technical Knowledge) for weather forecasting has been failing and they completely denied regarding increasing frequency of flood and hailstorm and early onset of monsoon (Table 2).

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|---------------------------|-----------|----------|
| Educational level | None | 12 |
| | Primary | 27 |
| | Secondary | 52 |
| | College | 9 |
| Farm size (ha.) | <1.0 | 50 |
| | 1-2.5 | 50 |
| | >2.5 | 0 |
| Farming experience (year) | <10 | 5 |
| | 10-20 | 30 |
| | 21-30 | 25 |
| | >30 | 40 |
| Annual income (₹) | <1.0 | 70 |
| | 1-2 | 25 |
| | 5 | 5 |

Table 2: Farmer's perceptions regarding climate change

| Farmer's perception | Per cent | Rank |
|--|----------|------|
| Day temperature increased | 82 | 6 |
| Night temperature increased | 40 | 10 |
| Both day and night temperature increased | 40 | 10 |
| Early onset of monsoon | 18 | 13 |
| Late onset of monsoon | 98 | 1 |
| Decrease in rainfall amount | 57 | 8 |
| Terminal heavy rains | 88 | 2 |
| Erratic distribution of rainfall thereby, affecting length of growing season | 87 | 3 |
| Indigenous Technological Knowledge (ITKs) for weather forecasting failing | 60 | 7 |
| Frequency of drought increased | 85 | 4 |
| Frequency of flood decreased | 85 | 4 |
| Frequency of hail storm increased | 7 | 14 |
| Frequency of heat wave increased | 42 | 9 |
| Frequency of cold wave increased | 28 | 12 |
| Frequency of frost increased | 18 | 13 |
| Crop lodging due to high wind velocity increased | 33 | 11 |
| Water table decreased | 83 | 5 |



Farmer's perceptions and adopted measures regarding growing of field crops under change climate scenario

The survey carried out indicates that all farmers perceived that changes are taking place in cropping pattern (100%) and increased incidence of pest and diseases (100%). Most of the farmers perceived that growing area of wheat (73%) and rice (72%) is increasing in place of sugarcane. Thirty seven percent farmers opined about decreasing availability of irrigation water. The recycling of crops residues is decreased as per received by 92% farmers. Survey data on adaptation revealed that majority of the farmers are not adopting suggested adaptation strategies, however, 43% of the farmers are following inter/mixed cropping systems, whereas, 18% farmers are adopting rain water harvesting strategies. Further, other measures are poorly adopted by farmers in Amroha district of Uttar Pradesh (Table 3).



Photo: Sugarcane crop severely hit by drought

Table 3: Farmer's perceptions and adopted measures regarding growing of field crops under climate change scenario

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Cropping pattern changed | 100 | 1 |
| Incidence of pest and diseases increased | 100 | 1 |
| Growing of Rice increased | 72 | 4 |
| Growing of wheat increased | 73 | 3 |
| Productivity of sugarcane increased | 40 | 7 |
| Productivity of maize increased | 42 | 6 |
| Availability of irrigation water decreased | 37 | 8 |
| Infestation of new weeds/ insect pest increased | 58 | 5 |
| Residue recycling decreased | 92 | 2 |
| Adaptation measures adopted towards climate change | | |
| Rain water harvesting/Water harvesting structures made | 18 | 2 |
| Intercropping/mixed cropping adopted | 43 | 1 |



AICRP on IFS: On Farm Research Farmer's Perception on Climate Change

Farmer's perceptions and adopted measures regarding growing of horticultural crops

According to perceptions on climatic changes, the majority of the farmers opined that early flowering in fruit/plantation crops is occurring (93%). Similarly, they also perceived that changes in taste and flavour of the fruits and vegetables are occurring (80%). There is a growing feeling among the farmers (53%) that water requirement in fruit and vegetable crops are increased due to change in climate. There is increase in insects and pests infestation as perceived by more than two third of the survey population. In case of horticultural crops, majority of the farmers (84%) are adopting plant protection measures and application of night irrigations for mitigating the impacts of frost and cold (Table 4). Whereas, measures like changes in planting dates, rain water harvesting, raising the crop in poly-house, mulching and use of net as hail shelter are rarely adopted.

Table 4: Farmer's perceptions and adopted measures regarding growing of horticultural crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Insects pest infestation increased | 97 | 1 |
| Water requirement of horticultural crops increased | 53 | 4 |
| Early flowering in fruits / plantation crops | 93 | 2 |
| Change observed in taste/flavour of fruits | 80 | 3 |
| Adaptation measures towards climate change | | |
| Plant protection measures adopted | 84 | 1 |
| Night irrigations applied to vegetable crops to mitigate the effect of frost and cold | 73 | 2 |
| Smokes, heaters are used in the orchard to reduce the effect of cold, frost etc. | 43 | 3 |
| Change in planting dates of vegetables crops | 73 | 2 |
| Mulching adopted as soil moisture conservation techniques | 8 | 5 |
| Use of net as hail shelter | 20 | 4 |

Farmer's perceptions and adopted measures regarding animal husbandry

Survey data indicated that changes are taking place in rearing of livestock; number of livestock per household is decreasing but milk production per animal is increasing and cow is being replaced by buffalo. On the contrary, the number of poultry and goats and green fodder availability are decreasing (Table 5). In livestock, 80% farmers are adopting prophylactic measures against disease control,

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Table 5: Farmers' perceptions and adopted measures regarding animal husbandry

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Changes observed in rearing of animals | 100 | 1 |
| Number of livestock per household decreased | 100 | 1 |
| Cow is replaced by buffalo | 67 | 4 |
| Number of poultry per household decreased | 75 | 2 |
| Numbers of goats per household decreased | 52 | 5 |
| Green fodder availability decreased | 40 | 6 |
| Milk productivity increased | 70 | 3 |
| Adaptation measures towards climate change | | |
| Prophylactic measures adapted against disease infestation | 80 | 1 |
| Growing green fodder in off season | 57 | 3 |
| Use of ventilated pucca shelter house | 47 | 4 |
| Rear cross breed cow | 68 | 2 |
| Use of electric heaters to elevate the shelter temperature during strong cold | 6 | 5 |
| Use of electric fans/coolers during summer | 5 | 6 |



Photo: Use of ventilated pucca shelter house to milch buffalo

Adaptation index

The Fig. 1 shows that on the basis of farmer's perception, adaptation measures due to climate change are applied more in field crops in comparison to horticultural crops and livestock.

whereas, growing of green fodder in off season, use of ventilated pucca shelter house, use of electric fans/coolers during summer, use of electric heaters to increase the shelter house temperature during strong cold and rearing of crossbred animals were poorly adopted.

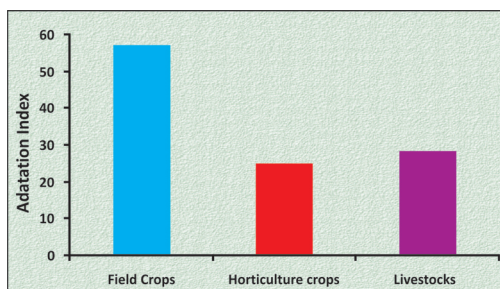


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems



KANPUR, UTTAR PRADESH

Naushad Khan

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Climate change is posing severe threat towards making the agriculture more vulnerable and unprofitable. Variability in weather parameters are increasing day by day which adversely affects agriculture and its allied activities. These changes are vulnerable to the sustainability, improved livelihood and enhanced income of resource poor farmers. In the present context, the majority of the farmers are belonging to small and marginal categories where decreasing land is a major constraint withholding the productivity of crops and no further scope exists for horizontal land expansion. The climate of the study

area is semi-arid comes under central plain zone of Uttar Pradesh. The normal rain fall 801.5 mm precipitated during 67 rainy days.

In view of these climatic changes 60 farmers of 6 Villages namely Bharat Singh Ka Purwa, Sarva, Ambarpur,

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | None | 3 |
| | Primary | 22 |
| | Secondary | 57 |
| | College | 18 |
| Farm size (ha.) | <1.0 | 58 |
| | 1-2.5 | 42 |
| | >2.5 | 0 |
| Farming experience | <10 | 5 |
| | 10-20 | 22 |
| | 21-30 | 40 |
| | >30 | 33 |
| Annual income (₹) | <1.0 | 87 |
| | 1-2 | 13 |
| | 2-5 | 0 |
| | >5 | 0 |



Photo: Farmer interviewed on perception and adaptation towards climate change

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Jaitpur, Sahtawanpurwa, Aurangabad under two block i.e. Akbarpur and Maitha of district Kanpur Dehat (Lat: N26°30'508", Long: E079°52'610" Alt: 127m) U.P, selected for On-farm research running under C.S. Azad University of Agriculture & Technology, Kanpur, were interviewed to understand their perceptions and adaptations of mitigation strategies about climatic change.

Results of general characteristics of surveyed farmers revealed that about 40% surveyed farmers are having farming experience of 21-30 year and 87% farmers annual income was < ₹ 1 lakh.

Farmer's perceptions regarding changing climate

The farmers were asked about changes in various weather parameters like increased day and night temperature, early and late onset of monsoon, decrease in rainfall, terminal heavy and erratic rainfall distribution, increase drought, flood, cold wave, increase lodging of crops due to high wind velocity and decreased water level. All farmers perceived positively about occurrence of above changes. 100% of the farmers were in view that ITK for weather forecasting has been failing and they

Table 2: Farmer's perceptions regarding climate change

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Day temperature increased | 100 | 1 |
| Night temperature increased | 100 | 1 |
| Both day and night temperature increased | 100 | 1 |
| Late onset of monsoon | 100 | 1 |
| Decrease in rainfall amount | 100 | 1 |
| Terminal heavy rains | 100 | 1 |
| Erratic distribution of rainfall there by, affecting length of growing season | 100 | 1 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 100 | 1 |
| Frequency of drought increased | 100 | 1 |
| Frequency of heat wave increased | 100 | 1 |
| Frequency of cold wave increased | 100 | 1 |
| Frequency of frost increased | 100 | 1 |
| Crop lodging due to high wind velocity increased | 100 | 1 |
| Water table decreased | 100 | 1 |
| Early onset of monsoon | 0 | 2 |
| Frequency of flood increased | 0 | 2 |
| Frequency of Hail Storm increased | 0 | 2 |



AICRP on IFS: On Farm Research Farmer's Perception on Climate Change

completely denied regarding increasing frequency of flood and hailstorm and early onset of monsoon (Table 2).

Farmer's perceptions and adopted measures regarding growing of field crops under climate change scenario

The survey carried out is indicative that all farmers perceived that no changes are taking place in cropping pattern, whereas, on the other hand, 98% farmers agreed on increase of incidence of pest and diseases. Most of the farmers (82%) and (78%) farmers perceived about growing area of rice and wheat increased, respectively. Sixty eight percent farmers opined about decreasing about availability of irrigation water. Survey on adaptation revealed that majority of farmers are not adopting suggested adaptation strategies, however, 33% of the farmers are following inter/mixed cropping, whereas, 40% farmers adopting rain water harvesting. Other measures are poorly adopted (Table 3).



Photo: Mulching of rice straw used as soil moisture conservation techniques

Table 3: Farmer's perceptions and adopted measures regarding growing of field crops under climate change scenario

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Incidence of pest and diseases increased | 98 | 1 |
| Growing area of rice increased | 82 | 2 |
| Growing area of wheat increased | 78 | 3 |
| Availability of irrigation water decreased | 68 | 4 |
| Infestation of new weeds/ insect pest increased | 67 | 5 |
| Adaptation measures adopted towards climate change | | |
| Rain water harvesting/Water harvesting structures made | 40 | 1 |
| Intercropping/mixed cropping adopted | 33 | 2 |



Farmer's perceptions and adopted measures regarding growing of horticultural crops

According to perceptions on climatic changes, the majority of the farmers opined that no early flowering in fruit/plantation is occurring, no changes in taste and flavour of the fruits. There is a growing feeling among the farmers that water requirement are enhancing due to changing climate. There is increase in insect/pest infestation are perceived by more than two third of the survey population.

Table 4: Farmer's perceptions and adopted measures regarding growing of horticultural crops

| Parameters | Per cent | Rank |
|---|-----------------|-------------|
| Farmer's perception | | |
| Insects pest infestation increased | 67 | 1 |
| Water requirement of crops increased | 53 | 2 |
| Growing area of banana | 23 | 3 |
| Adaptation measures towards climate change | | |
| Plant protection measures adopted | 90 | 1 |
| Night irrigations applied to vegetable crops to mitigate the effect of frost and cold | 43 | 2 |
| Smokes, heaters are used in the orchard to reduce the effect of cold, frost etc. | 13 | 3 |
| Change in planting dates of vegetables crops | 10 | 4 |
| Mulching adopted as soil moisture conservation techniques | 8 | 5 |
| Use of net as hail shelter | 3 | 6 |

In case of horticultural crops, majority of the farmers adopting plant protection measures and application of night irrigations for mitigating the effect of frost and cold. Whereas, measures like changes in planting dates, rain water harvesting, raising the crop in poly-house, mulching and use of net hail shelter are rarely adopted (Table 4).

Farmer's perceptions and adopted measures regarding animal husbandry

Survey indicated that changes taking place in rearing of livestock; number of livestock per household is decreasing, milk production by and large is increasing and buffalo is replacing cow. On the contrary, the number of poultry and goats and green fodder availability are decreasing (Table 5).



AICRP on IFS: On Farm Research Farmer's Perception on Climate Change

Table 5: Farmers' perceptions and adopted measures regarding animal husbandry

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Changes observed in rearing of animals | 100 | 1 |
| Number of livestock per household decreased | 100 | 1 |
| Cow is replaced by buffalo | 77 | 2 |
| Number of poultry per household decreased | 75 | 3 |
| Numbers of goats per household decreased | 62 | 4 |
| Green fodder availability decreased | 60 | 5 |
| Milk productivity increased | 40 | 6 |
| Adaptation measures towards climate change | | |
| Prophylactic measures taken against disease infestation | 100 | 1 |
| Raise green fodder in off season | 17 | 2 |
| Use of ventilated pukka shelter | 17 | 2 |
| Rear cross breeds | 8 | 3 |
| Use of electric heaters to elevate the shelter temperature during strong cold | 8 | 3 |
| Use of electric fans/coolers during summer | 7 | 4 |

In livestock 100% farmers are adopting prophylactic measures against disease, whereas, raising green fodder in off season, Use of ventilated pukka shelter, use of electric fans/coolers during summer, use of electric heaters to elevate the shelter temperature during strong cold and rearing of crossbred animals were poorly adopted (Table 5).

Adaptation index

The fig.1 shows that on the basis of farmer's perception, adaptation measures due to climate change are applied more in livestock in comparison to field crop and horticulture crops.

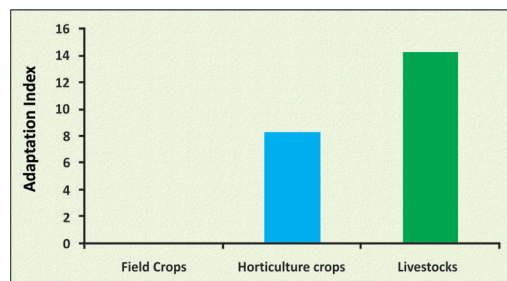


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems



NAINITAL, UTTARAKHAND

Dinesh Kumar Singh

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Jeolikot lies between Latitude 29.40° E to 30.30° N Longitude and 1219 meter above mean sea level in the district Nainital. The climate of the Jeolikot can be characterized as mild summers and generally last between the months of March to June. The temperature ranges between a comfortable 12°C-20°C in these months. Jeolikot experiences moderate rainfalls in the months of July till September. The rainfall here averages 1711 mm. The winters are extremely cool here with the temperature diving down to 5°C - 10°C during October to February. Field crops + livestock + horticulture are the pre-dominant farming system in the villages selected for the study. While rice-wheat-maize and tomato-onion are the pre-dominant cropping systems of this region.

The present study was carried out to know the perception and adaptation measures towards climate change through field survey of the small and marginal farmers of the from the six village of the two blocks namely

Kotabagh (Latitude 29.40° N and 79.13° E Longitude and Altitude 2152 m) and Bhimtal (Latitude 29°0' and 20'40" N; Longitude 79°0' and 36'16"E and mean elevation of all the lakes is 1310 meters) of district Nainital, Uttarakhand. From each block thirty farmers were selected from three different villages. The villages and farmers were selected randomly.

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | None | 0 |
| | Primary | 62 |
| | Secondary | 33 |
| | College | 5 |
| Farm size (ha.) | <1.0 | 92 |
| | 1-2.5 | 8 |
| | >2.5 | 0 |
| Farming experience | <10 | 12 |
| | 10-20 | 28 |
| | 21-30 | 28 |
| | >30 | 30 |
| Annual income (₹) | <1.0 | 52 |
| | 1-2 | 42 |
| | 2-5 | 7 |
| | >5 | 0 |



AICRP on IFS: On Farm Research Farmer's Perception on Climate Change

Perceptions regarding changing climate

More than eighty percent farmers perceive that day temperature has increased over the years, while 70 % perceive erratic distribution of rainfall there by, affecting length of growing season. Sixty seven per cent farmers reported decrease in rainfall amount over the time (Table 2).

Table 2: Farmer's perceptions regarding climate change

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Day temperature increased | 82 | 1 |
| Erratic distribution of rainfall there by, affecting length of growing season | 70 | 2 |
| Decrease in rainfall amount | 67 | 3 |
| Early onset of monsoon | 53 | 4 |
| Night temperature increased | 52 | 5 |
| Both day and night temperature increased | 50 | 6 |
| Terminal heavy rains | 50 | 6 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 50 | 6 |
| Frequency of heat wave increased | 50 | 6 |
| Frequency of cold wave increased | 50 | 6 |
| Frequency of frost increased | 50 | 6 |
| Crop lodging due to high wind velocity increased | 50 | 6 |
| Late onset of monsoon | 47 | 7 |
| Frequency of drought increased | 30 | 8 |
| Water table decreased | 30 | 8 |
| Frequency of flood increased | 0 | 9 |
| Frequency of hail Storm increased | 0 | 9 |

Farmer's perceptions and adopted measures regarding growing of field crops

From the table 3, it is clear that cent percent farmers perceived that incidence of pest and diseases and infestation of new weeds/ insect pest increased due to the climate change. More than three fourth surveyed populations revealed that there is decrease in the availability of irrigation water over the time. Seventy percent of the farmers surveyed reported that they have adopted Intercropping/mixed cropping over the time to sustain the production against climate change, while 63 % farmers reported that they have changed to short, drought resistant varieties over the time (Table 3).



Table 3: Farmer's perceptions and adopted measures regarding growing of field crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Incidence of pest and diseases increased | 100 | 1 |
| Infestation of new weeds/ insect pest increased | 100 | 1 |
| Availability of irrigation water decreased | 80 | 2 |
| Cropping pattern changed | 50 | 3 |
| Growing area of soybean increased | 50 | 3 |
| Growing area of urd increased | 50 | 3 |
| Adaptation measures towards climate change | | |
| Intercropping/mixed cropping adopted | 70 | 1 |
| Changed to short, drought resistant varieties | 63 | 2 |
| Mulching adopted as soil moisture conservation techniques | 35 | 3 |
| Change in planting dates of major crops | 33 | 4 |
| Rain water harvesting/water harvesting structures made | 13 | 5 |

Farmer's perceptions and adopted measures regarding growing of horticultural crop

Due to climate change about cent percent farmers revealed that water requirement of horticultural crops and increased insects pest infestation have increased. A sizable population under survey turn to put on the record that change in taste/flavour of fruits is obvious and it is due to climate change. About 50 percent farmers also revealed that there is increase in the productivity of the mango and the area is increased under jack fruit, tomato and onion (table 4). Eighty percent farmers reported that they have adopted plant protection measures over the time, while 60 % farmers use to provide night irrigations to the crops (potato, tomato etc.) to mitigate the effect of frost & cold (Table 4).

Farmer's perceptions and adopted measures regarding animal husbandry

All the farmers surveyed reported increased milk productivity along with the decreased green fodder availability. Eighty per cent farmers reported that the rearing of animals has changed over the years and the number of livestock per household has decreased over the years. About 45 % farmers switched to rear the cross



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Table 4: Farmer's perceptions and adopted measures regarding growing of horticultural crops

| Parameters | Per cent | Rank |
|--|----------|------|
| Farmer's perception | | |
| Insects pest infestation increased | 100 | 1 |
| Water requirement of crops increased | 100 | 1 |
| Change observed in taste/flavour of fruits | 80 | 2 |
| Growing area of jack fruit increased | 50 | 3 |
| Growing area of tomato increased | 50 | 3 |
| Growing area of onion increased | 50 | 3 |
| Productivity of mango increased | 50 | 3 |
| Productivity of goose berry increased | 47 | 4 |
| Productivity of banana increased | 28 | 5 |
| Early flowering in fruits / plantation crops | 17 | 6 |
| Adaptation measures towards climate change | | |
| Plant protection measures adopted | 80 | 1 |
| Night irrigations applied to vegetable crops to mitigate the effect of frost, cold | 60 | 2 |
| Introduced new crops | 33 | 3 |
| changed to short stature, drought resistant varieties | 23 | 4 |
| Change in planting dates of vegetables crops | 20 | 5 |
| Rain water harvesting/Water harvesting structures made | 15 | 6 |
| Smokes, heaters are used in the orchard to reduce the effect of cold, frost etc. | 13 | 7 |
| Mulching adopted as soil moisture conservation techniques | 3 | 8 |

Table 5: Farmer's perceptions and adopted measures regarding animal husbandry

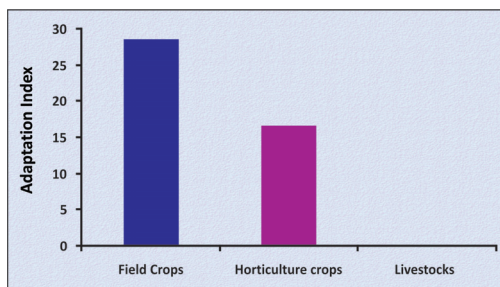
| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Milk productivity increased | 100 | 1 |
| Green fodder availability decreased | 100 | 1 |
| Changes observed in rearing of animals | 80 | 2 |
| Number of livestock per household decreased | 80 | 2 |
| Cow is replaced by buffalo | 50 | 3 |
| Number of poultry per household decreased | 50 | 3 |
| Numbers of goats per household decreased | 50 | 3 |
| Adaptation measures adopted towards climate change | | |
| Rear cross breeds | 45 | 1 |
| Prophylactic measures taken against disease infestation | 37 | 2 |
| Raise green fodder in off season | 27 | 3 |
| Use of ventilated pukka shelter | 17 | 4 |
| Have insurance | 10 | 5 |

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breeds instead of indigenous and more than 1/3rd farmers are using prophylactic measures taken against disease infestation (Table 5).

Adaptation index of the farmers surveyed towards changing climate for the field crops was more than 25 while it was about 15 for the horticulture crops. No adaptation index or zero indexes was observed for the livestock and fisheries (Fig. 1).



Conclusion

On the basis of this survey on perception of farmers & adaptation measures towards climate change it can be concluded that most of the farmers perceive that climate has changed over the time as 82 farmers reported that day temperature has increased, 100 % of them reported increased incidence of pest and diseases in field and horticulture crops over the time and increased milk productivity over the years. Adaptation measures towards changing climate are also being taken up by the farmers seriously like 70 % of them reported that they have adopted the intercropping / mixed cropping, 80 % of them have adopted the plant protection measures in horticultural crops. However, adaptation index of the farmers towards changing climate was more in field crops (28) than the horticulture crops (17) and livestock.

Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems



NADIA, WEST BENGAL

M. Ray

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The Geographical area of South 24 Parganas is 953.37 thousand ha. out of which 380.46 thousand ha. is cultivable area. The major category of soil of the district is loamy and cropping intensity 143%. Rice is the major crop of the area and it is grown throughout the year on gross area of 392.5 thousand ha. These farmers' fields lie between 21°50.068'N to 22°06.975' N latitude and 88°11.858' E to 88°19.653' E longitude with an average altitude of 8.18 m above mean sea level in coastal saline flood plain of

West Bengal. The area experiences a normal rainfall of 1761 mm and having with rice-fallow and rice-green gram cropping systems. Predominant farming system of this area is Crop + Dairy + Fishery. The data analysis was done in simple excel sheet using mean along with correlation of different factors.

Table 1: General characteristics of the survey population

| Characteristics | Category | Per cent |
|--------------------|-----------|----------|
| Educational level | None | 0 |
| | Primary | 3 |
| | Secondary | 73 |
| | College | 23 |
| Farm size (ha.) | <1.0 | 97 |
| | 1-2.5 | 3 |
| | >2.5 | 0 |
| Farming experience | <10 | 20 |
| | 10-20 | 22 |
| | 21-30 | 18 |
| | >30 | 40 |
| Annual income (₹) | <1.0 | 42 |
| | 1-2 | 37 |
| | 2-5 | 22 |
| | >5 | 0 |



Photo: Survey work regarding farmers' perception for climate change

AICRP on IFS: On Farm Research Farmer's Perception on Climate Change



A purposive sampling was done among sixty On-Farm Farmers' of Kakdwip OFR farmers located in two blocks (Mandirbazar and Kakdwip) of South 24 Parganas. In both the blocks farmers are evenly spread over three villages having ten households in each village.

Most of the farmers belong to the age group of 30-50 years (44%). Regarding education level 73% farmers are of secondary, whereas 23% belongs to college level. Marginal farmers accounts to 97% of whole population. Family size was categorized among below 4, 4-8 and above 8, which contributed 30%, 60% and 10% of respectively to the total population. Forty percent of the farmers having experiences of more than 30 years followed 22% farmers having 10-20 years of experience. Regarding family income 42% of the farmers have below 1 lac per annum, whereas 37% farmers have below 1-2 lac per annum income (Table 1).

Perception regarding changing climate

Data pertaining to farmer's perception reading climate change is presented in table 1. Results revealed that cent percent farmers are of the opinion that day

Table 2: Farmer's perceptions regarding changing climate

| Farmer's perception | Per cent | Rank |
|---|----------|------|
| Day temperature increased | 100 | 1 |
| Night temperature increased | 100 | 1 |
| Both day and night temperature increased | 100 | 1 |
| Late onset of monsoon | 100 | 1 |
| Decrease in rainfall amount | 85 | 2 |
| Frequency of Heat wave increased | 85 | 2 |
| Terminal heavy rains | 82 | 3 |
| Erratic distribution of rainfall there by, affecting length of growing season | 73 | 4 |
| Water table decreased | 73 | 4 |
| Indigenous Technical Knowledge (ITKs) for weather forecast failing | 43 | 5 |
| Crop lodging due to high wind velocity increased | 25 | 6 |
| Frequency of drought increased | 5 | 7 |
| Frequency of hail storm increased | 5 | 7 |
| Early onset of monsoon | 0 | 8 |
| Frequency of flood increased | 0 | 8 |
| Frequency of cold wave increased | 0 | 8 |
| Frequency of frost increased | 0 | 8 |



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temperature, night temperature, both day and night temperature is increasing and onset of monsoon is delayed. Whereas 85% of the farmers are of the opinion that rainfall is decreasing and frequency of heat wave increased. Eighty two percent farmers informed about the terminal heavy rains and 73% told that the erratic rainfall hampers the crop growing period. Significant numbers of farmers are also of opinion that ITK's for weather forecast failing (43%), frequency of heat wave increased (85%) and water table decreased (73%) (Table 2).

Farmer's perceptions and adopted measures regarding growing of field crops

All most all of the farmers perceived that cropping pattern has been changed (100%) and incidence of disease pest has been increased (98%). 87% of the farmers are of opinion that there was a change for the major crops like rice and green gram, while just 87% perceived that the yield of rice was increased and 87% reported about the increase of green gram production. Regarding availability of irrigation water decrease 85% farmers are of positive opinion. Infestation of new weeds/ insect pest increased for 85% farmer, whereas 78% farmers reported about the increase in residue recycling (Table 3). None of the farmers adopted insurance to secure his crop. However they have adopted various measures like change of planting date (73%), intercropping/mixed cropping (28%), rain water harvesting (43%), short/draught resistant varieties (78%), mulching (40%) and moisture conservation techniques (55%).



Photo: Vermicomposting for residue recycling



Photo: Micro-irrigation with narrow plastic pipe to conserve irrigation water resource



Table 3: Farmer's perceptions and adopted measures regarding growing of field crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Cropping pattern changed | 100 | 1 |
| Incidence of pest and diseases increased | 98 | 2 |
| infestation of new weeds/ insect pest increased | 98 | 2 |
| Growing area of rice increased | 87 | 3 |
| Growing area of green gram increased | 87 | 3 |
| Productivity of rice increased | 85 | 4 |
| Residue recycling increased | 82 | 5 |
| Productivity of green gram increased | 78 | 6 |
| Growing area of sunflower increased | 57 | 7 |
| Productivity of sunflower increased | 55 | 8 |
| Availability of irrigation water decreased | 35 | 9 |
| Adaptation measures towards climate change | | |
| Changed to short, drought resistant varieties | 78 | 1 |
| Change in planting dates of major crops | 73 | 2 |
| Soil moisture conservation techniques adopted as land configuration adopted | 55 | 3 |
| Rain water harvesting/Water harvesting structures made | 43 | 4 |
| Mulching adopted as soil moisture conservation techniques | 40 | 5 |
| Intercropping/mixed cropping adopted | 28 | 6 |

Farmer's perceptions and adopted measures regarding growing of horticultural crops

In case of horticultural crops, Insects pest infestation increased came out as very important and cent percent of the surveyed population agreed with this fact about the effect of climate change on the farming constraints coming out. Change observed in taste/flavour of fruits witnessed by 97% of the farmers whereas, 87% farmers revealed that lady's finger and onion crops area has been increased and about 77% farmers told that the productivity of these two vegetables is also increased. Regarding early flowering/fruit setting and water requirement increased under changing climate scenario (Table 4).

Similar to the field crops none of the farmers adopted crop insurance for the horticultural crops. But they adopted some measures like change of planting date of some vegetable crops (65%), rain water harvesting (50%), short drought resistant



AICRP on IFS: On Farm Research Farmer's Perception on Climate Change

Table 4: Farmer's Perceptions regarding growing of horticultural crops

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Insects pest infestation increased | 100 | 1 |
| Change observed in taste/flavour of fruits | 97 | 2 |
| Growing area of lady's finger increased | 87 | 3 |
| Growing area of onion increased | 87 | 3 |
| Productivity of lady's finger increased | 77 | 4 |
| Productivity of onion increased | 77 | 4 |
| Water requirement of crops increased | 77 | 4 |
| Early flowering in fruits / plantation crops | 52 | 5 |
| Adaptation measures adopted towards climate change | | |
| Plant protection measures adopted | 92 | 1 |
| Introduced new crops | 87 | 2 |
| Change in planting dates of vegetables crops | 65 | 3 |
| changed to short stature, drought resistant varieties | 65 | 3 |
| Rain water harvesting/Water harvesting structures made | 50 | 4 |
| Mulching adopted as soil moisture conservation techniques | 47 | 5 |
| Early harvest | 42 | 6 |

varieties (65%), plant protection measures (92%), early harvest (42%), introduced new crops (87%) and mulching (47%).

Farmer's perceptions and adopted measures regarding animal husbandry

The table 5 depicts that 53% farmer perceived the change in animal rearing, while 77% observed the decrease in livestock number per house hold. No farmer told that cow has been replaced with buffalo. Regarding milk productivity increase, decrease in green fodder availability, decrease in poultry bird per



Photo: Prophylactic measures taken against disease infestation in livestock



Table 5: Farmer's perceptions and adopted measures regarding animal husbandry

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmers perception | | |
| Number of livestock per household decreased | 77 | 1 |
| Green fodder availability decreased | 68 | 2 |
| Milk productivity increased | 57 | 3 |
| Changes observed in rearing of animals | 53 | 4 |
| Numbers of goats per household decreased | 40 | 5 |
| Number of poultry per household decreased | 22 | 6 |
| Adaptation measures towards climate change | | |
| Prophylactic measures taken against disease infestation | 85 | 1 |
| Raise green fodder in off season | 47 | 2 |
| Rear cross breeds | 27 | 3 |
| Use of ventilated pukka shelter | 20 | 4 |
| Use of electric heaters to elevate the shelter temperature during strong cold | 15 | 5 |

house hold and decrease in goat per house hold 57%, 68%, 22% and 44% has given positive response.

As like as crop no farmer insured their animals. Only 27% farmers are rearing crossbred cows but 47% farmers grow off season fodder. In respect of use of ventilated pukka shelter (20%), use of electric heater (15%) and cooler (2%) farmers did not show much interest. In contrast 85% farmers use prophylactic measures against disease infestation (Table 5).

Farmer's perceptions and adopted measures regarding fish farming

Only 38% farmers are of the opinion that ponds has been dried out or decreased in number. Due to multipurpose use of water 67% perceived that water requirement of the pond has been increased. Forty five percent farmers perceived that fish mortality has been increased, whereas 67% farmers have perceived that there is increase in the disease infestation (Table 6). In case of fish rearing significant number of farmers showed their innovativeness regarding rear improved fingerlings (90%), multi-use of water (98%) and introduction of new species. Surprisingly only 33% of farmers adopted prophylactic measures against disease infestation. None of the farmer adopted pukka ponds to avoid seepage loss of water (Table 6).



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Table 6: Farmer's perceptions and adopted measures regarding fish farming

| Parameters | Per cent | Rank |
|---|----------|------|
| Farmer's perception | | |
| Water requirement of pond is increased | 67 | 1 |
| Disease infestation increased | 67 | 1 |
| Fish mortality in pond increased | 45 | 2 |
| Number of ponds decreased/ dried | 38 | 3 |
| Adaptation measures adopted towards climate change | | |
| Multiple use of water as irrigation/washing of animals sheds/ animals | 98 | 1 |
| Introduction of new species | 94 | 2 |
| Rear improved fingerlings | 90 | 3 |
| Prophylactic measures taken against disease infestation | 34 | 4 |

Among different components highest adaptation index was recorded in fishery (50), followed by field crops (43), horticulture crops (33) and livestock (14) (Fig.1).

Conclusion

Most of the farmers perceived that the climatic parameters like day temperature, night temperature and both night and day temperature are increasing. Whereas rainfall events like decrease in total rainfall, terminal heavy rain, erratic rainfall etc. are increasing day by day. Incidence of heat wave and ITK's failure are very frequent. Due to changing climate disease pest incidence in crop, livestock and fishery are increasing day by day, which posing problem for farming.

But at the same time farmers are taking some adaptation like changing planting date, mulching, taking new crops, water conservation measures and water harvesting etc. Adaptation index showed the maximum value for fishery.

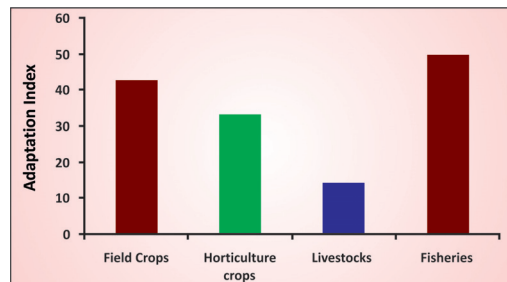
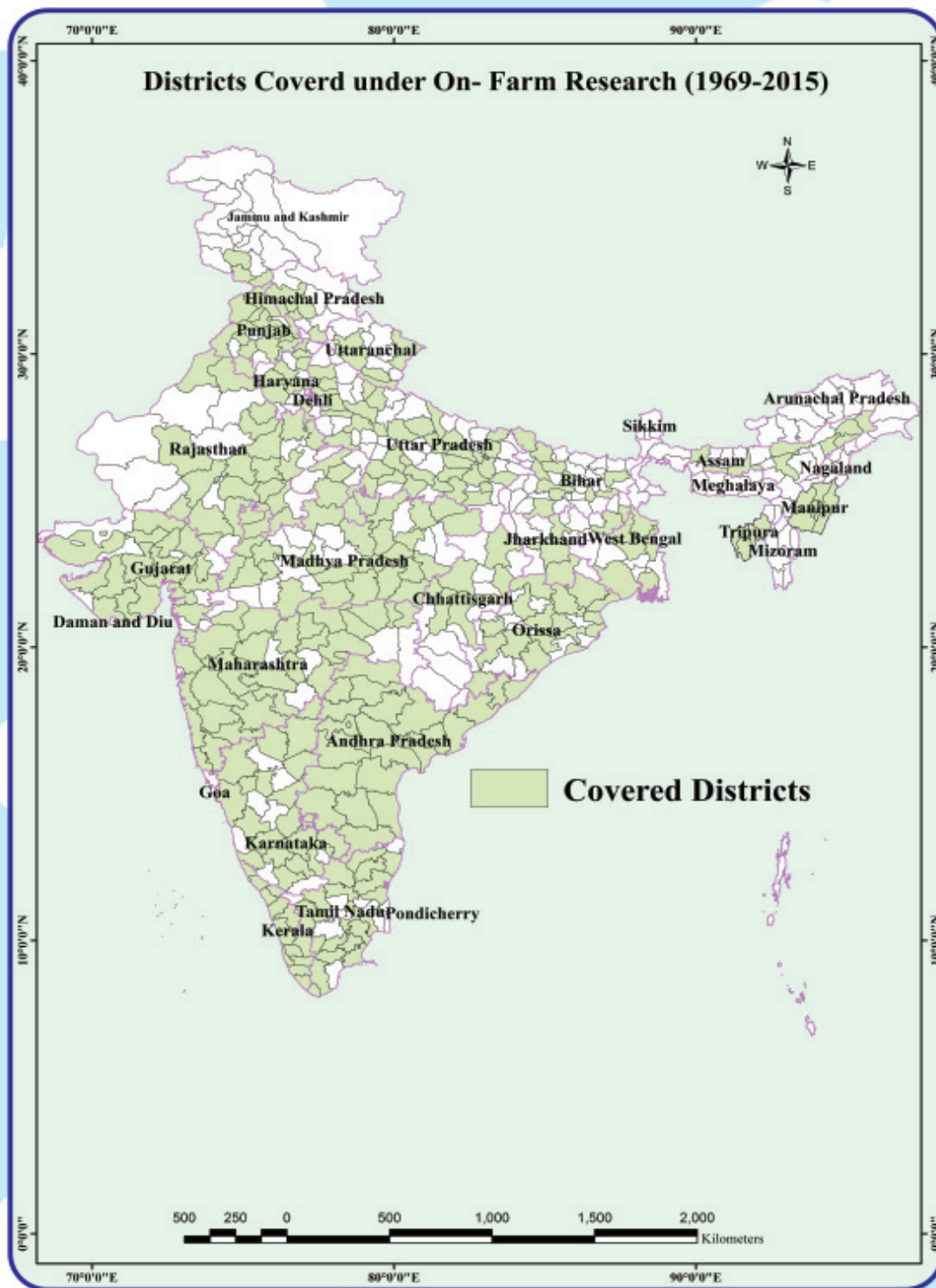


Fig. 1: Adaptation index of the farmers towards changing climate for different components of the farming systems



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