



## ADAPTATION STRATEGIES FOLLOWED BY THE FARMERS OF NAGALAND STATE TO OVERCOME THE ADVERSE EFFECTS OF CLIMATE CHANGE IN AGRICULTURE IN NAGALAND, INDIA

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### Abstract

Climate has played a significant role in the agricultural economic development of Nagaland. Nagaland state has tremendous reasons to be concerned about the impact of climate change. It is a tribal populous state depending on climate-sensitive sectors like agriculture and forestry for livelihoods. Agricultural is facing ecological and economical challenges. Climate change is one which is adversely affecting agriculture for several years. In order to sustain the life, farmers are taking many alternatives strategies to mitigate the ill effects of the climate change. In this regard some important adaptation measures initiated by farmers of Nagaland state in response to climate change were studied. Adaptation strategies such as strategies of crop production, strategies of soil and water conservation measures, strategies of pest and disease management, strategies of harvest and post harvest management and strategies of other income generating activities are practised by the farmers. The extent of adoption of these strategies is discussed in this paper.

**Keywords:** Adaptation; Adverse effects; Climate change; mitigate.

### Introduction

Climate change has dramatic impacts on natural resources, economic activities, food security, health and physical infrastructure. India is one of the countries very much affected by climate change. The threat is especially great wherever people's livelihoods are particularly dependent on natural resources. Climate adaptation measures are of central importance for the protection of rural livelihoods and for ensuring sustainable development.

Climate and agriculture are interrelated processes with climate change significantly affecting agriculture development and production. Scientific evidence indicates abnormal variations in the climate and the effects of these variations on crop production. Revising the past and present climates help the researchers to understand a wide range of climate processes. They can also assist in assessing the existing climatic conditions in regions with a high risk of crop failures. In this study adaptation is operationally defined as adjustments or alterations which are introduced by farmers in their farming. With technology development and knowledge in the present era, several mitigations and adaptation options like changing planting dates, using tolerant varieties, alternatives crops, resource management, intercropping, livestock management, agro forestry, etc. are available that the agriculture sector can undertake to cope with existing and future climate change.

The impacts of climate change are being felt all over the world. It is becoming warmer, rainfall is more erratic, the sea level is slowly rising and extreme weather events are becoming more frequent and intense. Prolonged periods of drought, floods and shifting climatic zones are endangering development process. The poor and marginalized are the most affected by climate variability and change. Thus, climate change is now a serious problem to be addressed immediately and regularly for sustainable development of the region. The objective of this study was taken up to analyze the practice-wise adaptation strategies followed by farmers

to overcome the impact of climate change. An attempt has been made and the results are presented.

### Materials and Methods

The present investigation was carried out in Chunlikha block of Kohima district, Nagaland state in India. Three hundred respondents were identified from six villages from Chunlikha Rural development blocks using proportionate random sampling techniques. The data were collected using a well-structured and pre-tested interview schedule. In the study area five major aspects of adaptation strategies were identified viz., (i) strategies for crop production (ii) strategies of soil and water conservation (iii) strategies of pest and disease management (iv) strategies of post harvest management and (v) strategies of other income generating activities. Each individual respondent was asked about adaptation strategies adopted against each item. A score of two (2) was given for adoption, while non-adoption received one (1) score. The scores for these entire items were added-up for each respondent and his total adoption score was arrived. Percentage analysis and cumulative frequency method were done for drawing conclusions and inferences.

### Results and Discussion

#### 1. Overall adaptation strategies followed by the farmers to overcome the adverse effects of climate change in agriculture

**Table 1 :** Distribution of respondents according to their overall adaptation strategies followed by the farmers to overcome the adverse effects of climate change on agriculture (n= 300)

S.No.	Level of adaptation	Frequency	Percentage (%)
1	Low adaptation	110	36.67
2	Medium adaptation	120	40.00
3	High adaptation	70	23.32
<b>Total</b>		<b>300</b>	<b>100.00</b>

The data in Table- 1 reveals that two-fifth (40.00 per cent) of the respondents had medium level followed by low (36.67 per cent) and high (23.32 per cent) levels of adaptation strategies or measures followed by the respondents.

## 2. Practice- wise adaptation strategies followed by the farmers to overcome the adverse effects of climate change on agriculture

The practice- wise adaptation strategies followed by farmers to overcome the adverse effects of climate change are presented in the following Table 2.

**Table 2 :** Practice wise adaptation strategies followed by the farmers to overcome the adverse effects of climate change on agriculture. (n= 300)

S.No.	Statement	Adopted	Percentage (%)
<b>I</b>	<b>STRATEGIES OF CROP PRODUCTION</b>		
1	Practising mixed cropping with as many as 4-6 different varieties of crops to avoid crop failure.	285	95.00
2	Adopting organic farming in crop production.	270	90.00
3	Altering of sowing dates and time.	256	85.33
4	Intercropping of crops with the leguminous crops.	205	68.33
5	Using of high yielding varieties.	135	45.00
6	Selecting of drought and heat tolerant varieties	48	16.00
7	Selecting of short duration crop varieties.	46	15.33
8	Practicing IFS (Integrated Farming System) model of farming.	38	12.66
9	Selecting of crop varieties which can withstand the flood situation.	34	11.33
<b>II</b>	<b>STRATEGIES OF SOIL AND WATER CONSERVATION</b>		
1	Making pole/ bamboo barriers across the slope to prevents soil erosion.	295	98.33
2	Applying of more FYM and manure and less chemical fertilizers.	270	90.00
3	Making ridges and furrows for crop cultivation.	137	45.00
4	Mulching with dried weeds.	108	36.00
5	Developing bench terracing in sloping field.	74	24.00
6	Planting of cover crops.	60	20.00
7	Constructing of water harvesting pond (WHP).	30	10.00
8	Constructing for rejuvenation and recharging of farm ponds / underground water.	28	9.33
9	Practising drip irrigation	25	8.33
<b>III</b>	<b>STRATEGIES OF PEST AND DISEASE MANAGEMENT</b>		
1	Keeping sound producing devices to scare away insects / pests and also birds and animals.	292	97.33
2	Making a fire in and around the field at evening to repel insects and pests instead of using chemicals.	282	94.00
3	Keeping the sundried seeds nearby the fire to avoid further insects and diseases attack.	280	93.00
4	Dusting of wood ashes to control diseases and pests in standing crop.	215	71.66
5	Intercropping to minimize insects and disease attack.	187	62.33
6	Mixing ash with water and sprayed on crops infested with insects.	90	30.00
7	Adopting of IPM method	52	17.33
8	Cultivating disease resistant varieties.	35	11.66
9	Applying of bio pesticides.	30	10.00
<b>IV</b>	<b>STRATEGIES OF HARVEST AND POST HARVEST MANAGEMENT</b>		
1	Constructing of low cost storage structure using locally available materials like bamboo etc.	270	90.00
2	Drying to maintain optimum moisture for longer storage.	259	86.33
3	Harvesting at the correct maturity stage without delay.	254	84.66
4	Grading and sorting of fruits / pods for seed extraction.	126	42.00
5	Arranging for value addition and processing of food crops	67	22.33
6	Packaging and storing in cold storage	25	8.33
<b>V</b>	<b>STRATEGIES OF OTHER INCOME GENERATING ACTIVITIES</b>		
1	Bee keeping.	165	55.00
2	Tree beans plantation ( <i>Parkia speciosa</i> ) common name : Yonchak	152	50.66
3	Animal husbandry like diary, poultry, piggery, goatery and rabbit farming etc.	145	48.33
4	Diversifying the crop cultivation like coffee plantation etc.	129	43.00
5	Maintaining orchard like orange, pineapple, banana etc.	108	36.00

6	Practicing agro- forestry.	90	30.00
7	Sericulture.	78	26.00
8	Fish culture in ponds.	51	17.00
9	Cottage industries like weaving etc.	30	10.00
10	Mushroom cultivation.	21	7.00

### (I) Strategies for crop production

The adaptation strategies practised by the farmers in crop production are 'practising mixed cropping with as many as 4 to 6 different varieties of crops to avoid crop failure' (95.00 per cent), 'adopting organic farming in crop production' (90.00 per cent), 'altering of sowing dates and time' (85.33 per cent), 'intercropping of crops with leguminous crops' (68.33 per cent), 'using of high yielding varieties' (45.00 per cent), 'selecting of drought and heat tolerant varieties' (16.00 per cent), 'selecting of short duration crop varieties' (15.33 per cent), 'practicing IFS (Integrated Farming System) model of farming' (12.66 per cent), and 'selecting of crop varieties which can withstand the flood situation' (11.33 per cent).

### (II) Strategies of soil and water conservation

The adaptation strategies practised by the farmers in soil and water conservation are 'making pole/bamboo barriers across the slope to prevents soil erosion' (98.33 per cent), 'applying of FYM and manure instead of chemicals' (90.00 per cent), 'making ridges and furrows for crop cultivation' (45.66 per cent), 'mulching with dried weeds' (36.00 per cent), 'developing bench terracing in sloping field' (24.66 per cent), 'planting of cover crops' (20.00 per cent), 'constructing of water harvesting ponds' (10.00 per cent), 'constructing for rejuvenation and recharging of farm ponds/underground water' (9.33 per cent), and 'practising drip irrigation' (8.33 per cent).

### (III) Strategies of pest and disease management

The adaptation strategies practised by the farmers in pest and disease management are 'keeping sound producing devices to scare away insects/pests and also birds and animals' (97.33 per cent), 'making fire in and around the field at evening to repel insects and pests instead of using chemicals' (94.00 per cent), 'keeping the sundried seeds nearby the fire to avoid further insects and disease attack' (93.33 per cent), 'dusting of wood ashes to control diseases and pests in standing crops' (71.66 per cent), 'intercropping to minimize insects and disease attack' (62.33 per cent), 'mixing ash with water and sprayed on crops infested with insects' (30.00 per cent), 'adopting of IPM method' (17.33 per cent), 'cultivating disease resistant varieties' (11.66 per cent), and 'applying of bio pesticides' (10.00 per cent).

### (IV) Strategies of harvest and post harvest management

The adaptation strategies practised by the farmers in harvest and post harvest management are 'constructing of low cost storage structure using locally available materials like bamboo etc.' (90.00 per cent), 'drying to maintain optimum moisture' (86.00 per cent), 'harvesting at the correct maturity stage without delay' (84.66 per cent), 'grading and sorting of fruits / pods for seed extraction' (42.00 per cent), 'Arranging for value addition and processing of food crops like candy, jam, jelly, pickle etc.' (22.00 per cent), and 'packaging and storing in cold storage' (8.33 per cent).

### (V) Strategies of other income generating activities

The adaptation strategies practised by the farmers in other income generating activities are 'bee keeping' (55.00 per cent), 'tree beans plantation (*Parkia speciosa*)' (50.66 per cent), 'animal husbandry like dairy, poultry, piggery, goatery and rabbit farming etc.' (48.33 per cent), 'diversifying crop cultivation like coffee plantation' (43.00 per cent), 'maintaining orchard like orange, pineapple, banana etc.' (36.00 per cent), 'practising agro forestry' (30.00 per cent), 'sericulture' (26.00 per cent), 'fish culture in ponds' (17.00 per cent), 'cottage industries like weaving etc.' (10.00 per cent), and 'mushroom cultivation' (7.00 per cent). Similar findings were also reported by Nhemachena and Hassan (2007).

### Conclusion

The North- east region of India as whole is a global biodiversity hotspot, as well as being home to many different ethnic groups with a rich cultural heritage and traditional knowledge of the environment. Adaptation in the agriculture sector addresses to reduce the farmers' vulnerability and improve their adaptive capacity. Adaptation strategies practised by the farmers as response strategy to cope with impact in agriculture cannot be avoided or overlooked by the planners, scientists and development department and funding agencies of Government and NGOs. It is high time for the planners and researchers to look into the details of the adaptation measures to strengthen them further to overcome the impact of climate change.

### Acknowledgement

I thank our Almighty God for His grace and mercy and protecting me throughout my research work. I express my sincere thanks to my guide **Dr. K. Kanagasabapathi** Professor, Department of Agricultural Extension, Faculty of Agriculture, Annamalai University for his guidance, suggestions and corrections which are instrumental in preparing this research paper.

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