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Climate change effect & farmers adaptation strategies in turmeric cultivation in Thoubal district of Manipur

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Abstract

Agriculture is extremely vulnerable to climate change because it is one of the sectors hardest to hit by adverse climate conditions. In addition, as climate change is influencing turmeric and output of turmeric is declining. Adaptation strategies to cope up with the climate change and the related impacts have drawn a considerable attention. This research was carried out to study the observed climate change effects in turmeric by the sample turmeric farmers, to identify the farmers adaptation strategies on climate change followed by turmeric farmers. Data for the study were collected from 111 turmeric growing farmers through personal interview. The total research sampling was done purposively. The changes in climatic variables have visible impacts on turmeric crop such as decreased rhizome formation, increased life span etc. The study found that only 88 farmers were using adaptation strategies and 23 farmers were not adopting anything in accordance with the climate change. Farmers observed there is a decrease in around 25% of productivity in turmeric. It is shown that majority of the farmers having medium level of adaption of adaptation strategies (44.14%) followed by low level (35.14%) and high level (20.72%) of adaption of adaptation strategies in turmeric cultivation.

Keywords: Climate change, turmeric, adaptation strategies, majority

Introduction

Climate change has recently become the subject that is most widely discussed in all spheres of society. Everyone has already felt the effects of climate change in some way. On a local or regional scale, we have observed changes in the distribution and pattern of rainfall, an increase in high intensity rainfall events that cause drought or drought-like conditions, heat waves in the summer, shorter winters, etc. For the almost 700 million Indians living in rural areas whose life and livelihoods are directly dependent on climate-sensitive industries including agriculture, forests, fisheries, and natural resources etc., in order to maintain productivity in the event of extreme climatic variability in our country, a robust agricultural production system is necessary.

In India, North-Eastern states have experienced more issues as a result of climate change. For example, in 2009, North-Eastern states experienced one of the most severe droughts; in 2012, 2014, and 2017 these states experienced severe floods; in 2018, the majority of these states were affected by large hailstorms and a lack of rainfall; and most recently, in 2019, the monsoon arrived later than usual (Saikia and Hazarika, 2020). International Panel on Climate Change (IPCC) has projected that by the end of the 21st century, overall rainfall in India will increase by 10-21% with more frequent and heavy rainfall days while the mean annual temperature will rise by 3-6 degree centigrade (IPCC,2012).

India is struggling to maintain its rapidly expanding agricultural sector while addressing the threat posed by global climate change. There are two main strategies for policy involvement in agriculture in response to these dangers and difficulties. The first strategy is to slow down the pace and severity of climate change by reducing emissions that contribute to it, such as greenhouse gas reduction, soil erosion prevention, and other human-caused climate change-related activities. The second alternative/strategy is to encourage adaptation to climate change in order to lessen effects and seize new opportunities. For instance, improve current production systems by utilising new procedures (such as altering sowing patterns) and technological advancements (e.g., irrigation systems, adapted varieties etc.)

Turmeric is an important cash crop in North-East region and shares about 8.30% of the total production in the country. In terms of area, turmeric is the 3rd largest crop in this region. However, its productivity in the region is only 1.5 tonnes as against 3.9 tonnes per hectare in the country. In terms of area and production, Manipur (15.40 thousand MT) is the 3rd largest turmeric growing state in the north east region, after Mizoram (29.82 thousand MT) and Meghalaya (16.50 thousand MT) (GoI, 2018). The country is not only the largest producer and consumer but is also the largest exporter of turmeric in the world. India dominates the world production scenario contributing 78% followed by China (8 5%), Myanmar (4%), Nigeria and Bangladesh together contributing to 6% of the global production (Viraja *et al.*,

2018) [16]. NEH Region is home to some niche spice crops like Lakadong turmeric, Bird's eye chilli, King chilli and Nadia ginger which has high market demand for their unique features (Momin *et al.*, 2018) [11].

The Inter-governmental Panel for Climate Change (IPCC, 2007) defines adaptations as adjustments in natural and human systems in response to actual or expected climatic stimuli or effects which moderates harms or exploits impacts to reduce the adverse effects that can cause from the climate change. Although farmers are aware of the long-term effects of climate change, many do not implement the solutions because of the lack of knowledge of immediate results. A major challenge is that climate change adaptation is not a one-size fits all phenomenon; adaptation strategies and farmers responses will vary across regions (Berry *et al.*, 2006) [4] based on agro-ecological contexts and socio-economic factors (Adger *et al.*, 2009) [3]. Adjusting to climate change is a way to deal with feelings of vulnerability and lower dangers to farming operations (Arbuckle *et al.* 2013) [2].

Materials and Methods

The research study was conducted in order to study the farmers observed effects on turmeric cultivation and to identify the adaptation strategies adopted by the farmers in accordance with the climate change in Thoubal district of Manipur. From the 3 blocks of Thoubal, Wangjing CD block is selected. From this block, 6 villages were selected as per information obtained from Krishi Vigyan Kendra (KVK), Thoubal. A total of 111 farmers were also chosen according to the received information.

A research design known as ex-post-facto design was used for the investigation. The semi-structured interview schedule was prepared with the objectives in mind and presented to the farmers.

The extent of the farmers adaptation strategies was studied on a three-point range i.e., low adoption, medium adoption, high adoption of adaptation strategies. The scores 3, 2, 1 were assigned respectively. The total score ranged from "15" to "45," the minimum and maximum obtainable scores. The respondents were divided into groups based on mean and standard deviation. Using the semi-structured schedule information was collected through personal interviews. The statistical tools - mean, standard deviation, frequency and percentage were applied to interpret the information gathered (data).

Results and Discussion

The survey studies, observed climate change effects in turmeric by the sample turmeric farmers over the past 10 years and to identify the farmers adaptation strategies on climate change followed by turmeric farmers.

Effect of climate change in turmeric in the last 10 years

The changes in various climatic variables have affected the turmeric in various ways which has visible impacts on the turmeric cultivation. Several farmers reported the decrease in turmeric yield due to several reasons in which climate change contributes directly or indirectly to the cause. Descriptive analysis of the visible changes observed by the farmers in turmeric cultivation in the last 10 years is presented in Table 1.

Table 1: Distribution of farmers according to the observed changes in turmeric in the last 10 years

Sl. No.	Particular	Observed decrease; observed at early stage (%)	Observed decrease; observed at late stage (%)	Observed no change (%)	Decrease in productivity (%)
1	Flowering	28.26	15.41	56.33	15-25
2	Rhizome formation	12.58	68.77	18.65	35-45
3	Crop period	-	77.63	22.37	35-45
4	Shade requirement	-	7.45	92.55	5-10
	Overall decrease in productivity				Around 25

Flowering

Majority of the farmers (56.33%) found no change in the flowering of turmeric in the last 10 years. However, 28.26% of farmers observed in early stages and 15.41% of farmers observed in late stage of the crop flowering that flowering of turmeric had decreased which is associated with the decline in the crop productivity. The average percentage of decrease in productivity was about 15-25% as reported by farmers.

Rhizome formation

Although majority of the farmers found no change in flowering of the turmeric, about 81.35% (12.58% at early + 68.77% at late stage) of them reported decrease in rhizome formation due to less rainfall during the flowering time. The decrease in rhizome formation has reduced the productivity of the turmeric by 35-45%.

Crop period: Over 77.63% farmers witnessed decrease in the life span of the crop. The crop period of the turmeric was normally 9 months in the study area. The farmers reported that the yield of the turmeric decreases up to 35-45% due to the increase in the crop period due to the delay in ripening of the rhizome. Another major cause of decrease in the production was mainly due to diseases and pests which indirectly or directly related with the change in climatic variables.

Shade requirement

Turmeric generally requires more-light but in the study area because of more temperature's turmeric is more effected with scorching disease and turmeric crop requires 50% shade to give more yield. However, it was reported that the shade requirement in growing turmeric has decreased that they can grow the crop in the open area. About 7.45% of the farmers had observed the changes in the study area (Table1).

Table 2: Distribution of farmers, according to the observed crop damage in turmeric due to diseases and pests

Category	Damage	Do you think it is due to climate change?					
		Yes (f)	Yes (%)	No (f)	No (%)	Not sure (f)	Not sure (%)
Diseases	30-40	63	56.75	7	6.31	41	36.94
Pests	20-30	39	35.14	12	10.81	60	54.05

The above table 2. reveals that the diseases have caused damage up to 30-40% while pest up to 20-30%. Also, majority of the farmers (56.75%) felt that the diseases were due to climate change while some of them claimed that it could be pollution due to increase in number of vehicles in the village and may be because of some unknown factors and 54.05% of the farmers were not sure about the cause of the pest increase or attack.

The observed pests by the farmers were stem borer, rhizome borer, rhizome flies etc. and the observed diseases were curcuma fungal disease, cercospora leaf blotch, scorching etc.

Farmers adaptation strategies undertaken in turmeric cultivation

This section deals with the identification of the adaptation strategies taken up by the farmers against the climate change impact on the turmeric cultivation. OECD (2010) elaborated adaptation to climate change is typically characterized as an adjustment in ecological, social or economic systems in response to observed or expected changes in climate stimuli and their effects and impacts in order to alleviate adverse impact of climate change or take advantage of new opportunities.

From the descriptive analysis, it was found that majority of the farmers (79.28%) had taken up various adaptation strategies against the impact of climate change while the remaining 20.72% of the farmers had not taken any adaptation measures. Similar findings were reported by Destaw and Fenta (2021) [5] who indicated 93.9 per cent of the households employed various adaptation measures to the adverse effects of the climate change. Further, the study identified 15 adaptation strategies in the study area and they were assigned rank based on the frequency of adoption by the farmers. The list of which is given below in Table 3.

Table 3: Types of adaptation strategies adopted by farmers on climate change in turmeric cultivation (Total no: 88)

S. No	Category	Low adaptation strategy		Medium adaptation strategy		High adaptation strategy		Rank
		F	%	F	%	F	%	
1	Adjusting sowing time	32	36.36	45	51.13	11	12.51	IX
2	Water management techniques	11	12.50	43	48.86	34	38.64	II
3	Reduced tillage	37	42.04	36	40.91	15	17.05	XI
4	In-situ residue management	36	40.91	38	43.18	14	15.91	X
5	Alley or intercropping	22	25.00	46	52.27	20	22.73	VI
6	Conservation agriculture	21	23.86	48	54.54	19	21.60	IV
7	Cultivating smaller area than usual	24	27.27	43	48.86	21	23.86	VII
8	Leave complete fallow	49	55.68	36	40.91	3	3.41	XIII
9	Change in cropping sequence	-	-	49	55.68	39	44.32	I
10	Change in crop cultivar	60	68.18	25	28.41	3	3.41	XV
11	Change in harvesting time	20	22.73	40	45.45	28	31.82	III
12	New land management technique	46	52.23	31	35.23	11	12.50	XII
13	Land preparation	22	25.00	45	51.14	21	23.86	V
14	New rhizome health management technique	51	57.95	20	22.73	17	19.32	XIV
15	New nutrient management technique	31	35.23	37	42.04	20	22.73	VIII

Among the identified adaptation strategies, change in cropping sequence was the most popular strategy as it was adopted by majority of the farmers i.e., 44.32 per cent in the study area. The second most adapted strategy was using water management techniques to cover the water scarcity of the crop followed by change in harvesting time as there is the delay in maturation or ripening of the rhizome. Conservation agriculture, land preparation, alley or inter cropping with taro or other gourds were also among the important adaptation strategies. There was also reduction in turmeric cultivation area because of the reduction in the yield than previous times. In the same way, farmers adopted other adaptation strategies like new nutrient management techniques, new rhizome health management technique, new land management technique, leaving the land complete fallow, in-situ residue management, reduced tillage, change in crop cultivar (Lakadong and Megha turmeric 1. were popular varieties used in the study area. If one variety does not perform well in a particular season they would switch to the other variety in the next season) and adjusting sowing time as depicted in the above table 3 (Zizinga *et al.* 2017) [17]. Farmers knowledge on climate change increased the usage of adaptation practices by the respondents *viz*., planting ahead of rains (97.78%) and planting of cover crops (80.00%) respectively (Idrisa *et al*. 2012) [7].

Majority of the farmers participated in FGDs (Farmer Group Discussions) reported that the area under turmeric has decreased considerably. From the table above, it is evident that about 75.00 per cent of the farmers cultivated smaller area than usual turmeric area. The main reason of cultivating smaller area than usual was decrease in the turmeric productivity. The productivity of the crop has decreased due to diseases and pests caused by intermittent heavy, low rainfall and high temperature. Some of the farmers used bio-fertilizers and bio-pesticides to control the diseases and pests. Many of them managed diseases and

pests by uprooting, cleaning and burning the disease and pest infected plants.

Farmers were changing their agricultural practices (adaptation strategies) without concrete knowledge about the climate variability and extreme climatic events. The changes included changing sowing and harvesting timing, cultivation of crops of short duration varieties, intercropping, changing cropping pattern, investment in irrigation, and agro-forestry (Tripathi and Mishra, 2016) [15]. Logging bunds, tree planting, agricultural intensification, protected areas, zoning (for land use), supply networks and agriculture/forest policy were among the agriculture-forest landscape interventions associated to the mitigation and adaptation of climate change (Agrawal *et al*. 2014) [1].

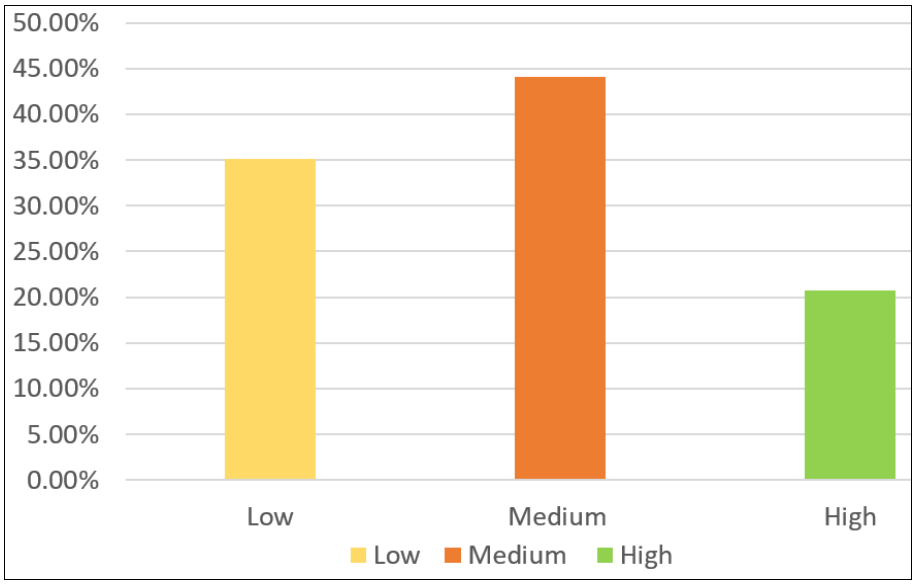

Fig 1: Final distribution of turmeric farmers based on adaptation strategies

The above fig 1. depicts the overall distribution of the farmers according to the adoption of the adaptation strategies and it follows as 44.14%, 35.14% and 20.72% as medium, low, and high adoption of adaptation strategies respectively. The present findings were similar with Muthulaxmi (2016) [12] however, contradictory with Meghwal (2016) [10] findings.

Conclusion

The study on observed effects on turmeric and adaptation strategies followed by the turmeric farmers in accordance with climate change revealed that farmers observed the decrease in productivity around 25% in turmeric and majority of the farmers had medium level of adaption in following adaptation strategies. However, 20.72% of the farmers were not following any of the adaptation strategies. This can be changed through proper education from extension agents and related departments on the importance of adaptation strategies in accordance with the climate change.

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