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A study on climate change adaptation practices among the farmers of Imphal East District

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Abstract

Climate change significantly impacts agricultural performance, with farmers bearing the brunt as they constantly adapt to shifting climate conditions. Across the globe, farmers are experiencing the effects of climate change, from altered weather patterns to more frequent extreme events. These unpredictable weather events disrupt crop growth, damage infrastructure, and threaten food security, highlighting the need for adaptive agricultural practices. This study aimed to examine the socio-economic profile of the respondents, assess their knowledge on climate change, and identify the adaptation strategies they have adopted to cope with its impacts. within Imphal East District, Manipur. Primary data were collected from 120 respondents in the Imphal East District for the purpose of the study. The study found that majority of respondents (74.16%) possess a high level of knowledge on climate change, followed by (15.84%) of respondents who have a medium level of knowledge, which (10.00%) have a low level of knowledge, respectively. Based on the adaptation strategies identified for the study, (64.16%) of respondents have low adaptation, (30.00%) have medium adaptation, and (5.83%) have high adaptation. Through surveys conducted with farmers at Imphal East District, it was found that many farmers are aware of climate change and their adaptation practices based on their own experience rather than scientific knowledge. Therefore, the study suggests that action needs to be initiated to make the respondents understand better about the usage of adaptation strategies in accordance to climate change through extension agent, new policies, etc.

Keywords: Agriculture, climate change, knowledge, adaptation strategies, impacts

Introduction

Agriculture is going to be the sector most significantly impacted by climate change (IPCC, 2007) [4]. The official definition provided by the United Nations Framework Convention on Climate Change (UNFCCC) [6] defines climate change as "a change in the climate that is attributed directly or indirectly to human activity, which alters the composition of the global atmosphere and is in addition to natural climate variability observed over comparable time periods".

Climate change is a natural phenomenon, but human activities have significantly exacerbated it. While the Earth's climate has always experienced variations due to natural factors, the rapid increase in greenhouse gas emissions from activities such as burning fossil fuels, deforestation, and industrial processes has intensified these changes. This human influence has accelerated global warming and magnified the adverse effects on weather patterns, ecosystems, and sea levels. IPCC's Sixth Assessment Report released in 2021, revealed that human activities have already increased global temperatures by nearly 2 degrees Fahrenheit (1.1 degrees Celsius) compared to the period between 1850 and 1900. It also projects that the global average temperature could reach or surpass 1.5 degrees Celsius (approximately 3 degrees Fahrenheit) within the next few decades. These temperature changes are anticipated to impact every region around the world.

Climate change involves significant, long-term shifts in climate patterns, such as temperature and precipitation, occurring over decades or more. Global warming, a key aspect of climate change, refers specifically to the recent rise in Earth's average temperature due to increased greenhouse gases in the atmosphere. Greenhouse gases trap heat in the Earth's atmosphere, essential for warmth but problematic in excess. These changes impact agriculture by altering growing seasons, habitat ranges, and increasing the risk of extreme weather events like droughts and floods (EPA, 2024) [7].

The relationship between climate and agriculture is deeply intertwined with global systems. Even minor fluctuations in climate can have significant negative impacts on agriculture, leading to reduced production rates (Climate change and its impact in Agriculture, MANAGE)[3]. Extreme events, such as floods and heatwaves, will adversely affect agriculture by damaging crops and livestock health, leading to a significant threat to food security like never before (Kumar & Shivamurthy, 2021) [2].

Manipur is a state in northeastern India, which comprises eight states (Assam, Meghalaya, Manipur, Arunachal Pradesh, Mizoram, Nagaland and Tripura) and it is

characterized by its diverse topography and climate, which significantly influence its agricultural practices. The state's agriculture is predominantly reliant on the monsoon rains, which provide essential water resources for crop cultivation. However, climate change is increasingly impacting this delicate balance, posing challenges to agricultural productivity and food security. Over the last century, Manipur has seen a rise in temperatures, with minimum temperatures increasing by at least 1.75°C and maximum temperatures by 1.5°C. Additionally, average relative humidity has risen significantly, from (68%) in 1968 to (84%) in 2011. These changes impact agricultural practices, affecting crop growth and water availability. With (57.04%) of the population engaged in agriculture and allied industries, addressing the impacts of climate change on this sector has become critically important. Given that agriculture occupies only (1.04%) of the state's total land area while supporting a significant portion of the population, it is essential to prioritize attention and resources toward enhancing the resilience and sustainability of agriculture in the face of climate change (State climate change cell, Manipur) [1].

The agricultural sector is profoundly impacted by shifting weather conditions, with rainfall being a critical factor influencing agricultural production. In recent years, rainfall patterns have become increasingly erratic, contributing to significant challenges for farmers in Manipur. Adapting to changing weather patterns and adjusting management practices to achieve optimal harvests present ongoing challenges for the agricultural sector. Addressing these issues is crucial for sustaining and enhancing agricultural productivity in the face of evolving climatic conditions.

Methodology

The study was conducted in Imphal East District of Manipur. Ex-facto research design was followed for the present study. Purposive, Multi stage, simple random and proportionate sampling procedure procedures were followed in the present study for the selection of samples. Imphal East District was selected purposively from among the 16 districts of Manipur (as per latest division of the districts in Manipur state) due to its vulnerability to climate change and its upland and foothills terrain. This area is highly susceptible to climate variability, making it a priority for targeted adaptation efforts. There are 3 sub division in Imphal East District of Manipur, out of which Sawombung subdivision was selected randomly for the study. Out of 67 villages in Sawombung sub division, six villages- Yumnam Khunou, Khundrakpam, Keibi Khullen, Pungdongbam, Lamboikhul, and Uyumpok were selected randomly for the present study. A total of 120 respondents were selected from each selected village using the proportionate sampling method.

Method used for data collection

A pre-tested structured interview schedule directed towards the objective of the study was developed for data collection. Both primary and secondary data were collected. After fostering a positive relationship with the selected respondents, the questions and statements were presented in Manipuri to ensure they were understood clearly. The collected data from the respondents were scored, tabulated and analyzed to calculate frequency, percentage and correlation (using statistical tools).

Data statistical analysis

The data collected through the schedule were to coded, organized into tables, analyzed, and presented in a manner that makes the findings clear and easy to understand using various statistical methods to draw logical conclusions. The software used for data analysis included SPSS (22.0) and MS Excel. The statistical techniques (arithmetic mean, frequency and percentage) were utilized in the present study to classify and categorize the respondents into different groups based on the nature of the data.

Results and Discussion

The data presented in Table-1 shows that more than half of the total respondent 51.67 percent belonged to the middle age group (35-55 years) which was followed by 35.00 percent and thirteen percent 13.33 percent of the respondents belonged to old aged group (>55 years) and young aged group (<34 years) respectively. It was observed that majority of the respondent 24.17 percent belonged to the upper primary (up to class VIII) followed by higher secondary (up to class X) 19.17 percent, high school (up to class X) 20.00 percent, primary school (up to class V) 16.67 percent, can read only 6.67 percent, under graduate 5.83 percent, illiterate 4.16 percent, can read and write3.33 percent, and there was not a single respondent who had PG level of education. It was evident that majority of the respondents belonged to medium income group 60.84 percents of (below Rs. 1,00,000) followed by low income group 25.83 percent of (Rs. 81000-Rs.2,00,000) and high income group 13.33 percent of (Rs. 2,00,000) above respectively. The table above revealed that majority of the respondents about sixty nine percent 69.16 percent were marginal (less than or equal to 1 hectare or 2.5 acres and it was followed by twenty two percent 22.50 percent of small (greater than 2.5 Acres or 1 hectare &less than or equal to 5 acres or 2 hectares) and eight percent 8.34 percent of big (Greater than 5 Acres or 2 hectares). It was found that majority of the respondent 45.84 percent have high (20years & above) followed by average (10-20 years) 27.50 percent and low (1-10 years) of experience respectively. It was depicted that majority of the respondents have low training received on how to adapt climate change 79.16 percent followed by medium training received 12.50 percent and low high training received 8.34 percent. It indicated that majority of the respondents had medium exposure 47.50 percent followed by low exposer 30.84 percent and high exposure 21.66 percent. It was revealed majority of the respondents had medium level 72.50 percent followed by low level 16.67 percent and high level 10.83 percent of knowledge about local agro-climatic respectively.

Table 1: Socio-economic characteristic of the respondents

Sl. No.	Attributes	Characteristics	Frequency	Percentage
1	Age	Young (up to 36 years)	16	13.33
		Middle (36 to 55 years)	62	51.67
		Old (Above 55 years)	42	35.00
2	Education	Illiterate	5	4.16
		Can read only	8	6.67
		Can read and write	4	3.33
		Primary School (up to Class V)	20	16.67
		Upper Primary (up to Class VIII)	29	24.17
		High School (up to Class X)	24	20.00
		Higher Secondary	23	19.17
		Under Graduate	7	5.83
		PG and above	0	0
3	Total Annual Income	Low (below Rs.1,00,000)	31	25.83
		Medium (Rs.1,00,000-2,00,000)	73	60.84
		High (2,00,000 above)	16	13.33
4	Land Holdings	Marginal (less than or equal to 1 hectare or 2.5 acres)	83	69.16
		Small (Greater than 2.5 Acres or 1 hectare &less than or equal to 5 Acres or 2 hectares)	27	22.50
		Big (Greater than 5 Acres or 2 hectares)	10	8.34
5	Farming Experiences	Low (1-10 years)	32	26.66
		Average (10-20 years)	33	27.50
		High (20 years & above)	55	45.84
6	Training received on how to adapt climate change.	Low	95	79.16
		Medium	15	12.50
		High	10	8.34
7	Mass media exposure	Low	37	30.84
		Medium	57	47.50
		High	26	21.66
8	Knowledge about local agro-climate	Low	20	16.67
		Medium	87	72.50
		High	13	10.83

Knowledge level of respondents in relation to climate change

Data presented on Table:2 shows the frequency and percentage of respondents' responses to each factor, indicating whether they strongly know, know, undecided, don't know, or no change/strongly don't know about each climate variable.

Table:2 depicts that 58.34 percent "know" something on change in increase summer temperature. It shows that 60 percent "know" something on shorter temperature. From Table:2, majority of the respondent 47.50 percent "know" something on increase drought. In climatic variable "decrease rainfall quantity" majority of the respondents 50.83 percent "strongly know". It was also revealed that majority of the respondents 46.66 percent "know" something on climatic variable "frequent flood". The table reveals that 40 percent of the respondents response "no change" on climatic variable "decrease soil fertility". It shows that 50 percent "know" on climatic variable "unpredictable rainfall". The result obtained that a 60 percent "strongly know" on "increase heatwave in summer". The results depicted that 44.16 percent "know" on climatic variable "increase for intensity in winter". It shows that 42.5 percent "know" on climatic variable "hailstorm".

Table 2: Distribution of respondents according to their knowledge on climate change based on given variables.

Sl.no.	Climatic variables	Strongly Know on change in climatic variables		Know something on change in climatic variables		Undecided on change in climatic variables		Don't know on change in climatic variables (But tries to understand)		No change/ Strongly don't know on change in climatic variables	
		(F)	(%)	(F)	(%)	(F)	(%)	(F)	(%)	(F)	(%)
1.	Increase Summer temperature	50	41.66%	70	58.34%	-	-	-	-	-	-
2.	Shorter Winter	48	40.00%	72	60.00%	-	-	-	-	-	-
3.	Increase drought	29	24.16%	57	47.50%	13	10.83%	11	9.17%	10	8.33%
4.	Decrease rainfall quantity	33	27.50%	61	50.83%	10	8.34%	3	2.50%	13	10.83%
5.	Frequent Flood	26	21.66%	56	46.66%	20	16.67%	7	5.83%	11	9.16%
6.	Decrease soil fertility	11	9.16%	19	15.84%	14	11.66%	28	23.34%	48	40.00%
7.	Unpredicted rainfall	32	26.67%	60	50.00%	11	9.16%	7	5.83%	10	8.33%
8.	Increase heatwave in summer	40	33.33%	72	60.00%	4	3.33%	3	2.50%	1	0.84%
9.	Increase fog intensity in winter	42	35.00%	53	44.16%	12	10.00%	9	7.50%	4	3.34%
10.	Hailstorm	20	16.66%	51	42.50%	21	17.50%	13	10.83%	15	12.50%

Table 3: Distribution of respondents according to their knowledge on climate change.

Sl.no.	Category	Frequency	Percentage
1.	Low	12	10.00%
2.	Medium	19	15.84%
3.	High	89	74.16%
Total		120	100

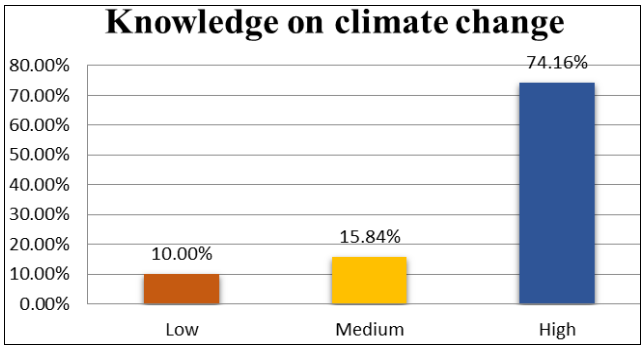

Fig 1: Graphical representations of respondents according to their knowledge on climate.

Table:3 shows the distribution of respondents based on their overall knowledge of climate change, categorizing them into three groups: low, medium, and high level of knowledge. The results indicate that the majority of respondents 74.16 percent possess a high level of knowledge about climate change. This is followed by 15.84 percent of farmers who have a medium level of knowledge, which 10.00 percent have a low level of knowledge. The high level of knowledge on climate change among the respondents is likely attributed to their many years of farming experience, which has enabled them to observe and recognize changes in the climate over time.

Adaptive measures taken by the respondents

This section focuses on identifying the adaptation strategies employed by farmers to mitigate the impact of climate change on agriculture. The study highlights several commonly adopted climate change adaptation practices, including: Crop diversification, crop rotation, resistant varieties, use of crop residues, water management, mulching, organic manure, adjusting sowing/planting time, climate resilient crop, short duration crop, intercropping, change in crop cultivar, new nutrient management practices, agroforestry, and cover crops. The adaptation levels are categorized for each practices as 'full adaptation' indicates respondents who are fully aware of the benefits of the practices and actively use them to mitigate the effects of climate change, 'partial adaptation' indicates respondents who have partial knowledge of the benefits or experimenting with the practices on a trial basis to determine their effectiveness in mitigating climate change, and 'no adaptation' indicates respondents who have no knowledge of the practices and no understanding of how they might be used to address climate change.

Table 4: Types of adaptation strategies adapted by the respondents on climate change in agriculture.

Sl.no	Adaptation Strategies	Full Adaptation		Partial Adaptation		No Adaptation	
		F	%	F	%	F	%
1.	Crop diversification	35	29.17%	10	8.33%	75	62.50%
2.	Crop Rotation	55	45.83%	8	6.67%	57	47.50%
3.	Resistant crop Variety	29	24.17%	10	8.33%	81	67.50%
4.	Used of crop residues	58	48.33%	16	13.34%	46	38.33%
5.	Water Management (Farmpond/Tubewell)	30	25.00%	12	10.00%	78	65.00%
6.	Mulching	52	43.33%	7	5.833%	61	50.83%
7.	Organic Manure (FYM/Vermicompost/kitchen waste)	46	38.34%	13	10.83%	61	50.83%
8.	Adjust sowing/planting time	79	65.84%	29	24.16%	12	10.00%
9.	Climate resilience crop (millet /coarse grain)	29	24.17%	10	8.33%	81	67.50%
10.	Short duration Crop	52	43.33%	7	5.84%	61	50.83%
11.	Intercropping	6	5.00%	13	10.83%	101	84.17
12.	Change in crop cultivar	42	35.00%	12	10.00%	66	55.00%
13.	New nutrient Management	42	35.00%	14	11.67%	64	53.33%
14.	Agroforestry	12	10.00%	24	20.00%	84	70.00%
15.	Cover crop	9	7.50%	6	5.00%	105	87.50%

From Table: 4 it indicates that the majority of respondents i.e.62.50 percent have shown no adaptation to crop diversification. The result showed that majority of the respondent 47.50 percent do not practice crop rotation. The data displayed in Table: 4 revealed that the majority 67.50 percent have not adopted resistant crop varieties. The table shows that the majority of respondents 48.33 percent use crop residues. The data revealed that the majority of the respondent 65.00 percent did not use any water management techniques. It was observed that majority of respondents did not adopt mulching practices 50.83 percent. The data revealed that the majority of respondents 50.83 percent have not adopted organic manure. It indicates that the majority of respondents 65.84 percent have adjusted their sowing/planting time. It shows that the majority of the respondent 67.50 percent do not practice climate-resilient cropping. It revealed that the majority of respondents 50.83 percent do not grow short-duration crops. It depicted that the majority of respondents 84.17 percent do not practice intercropping. It shows that the majority of respondents 55.00 percent did not change their crop cultivar. It depicted that the majority of respondents 53.33 percent do not follow any new nutrient management practices**.** It reveals that the majority of respondents 70.00 percent do not practice agroforestry. It reveals that the majority of respondents (87.50%) do not practice cover cropping.

Table 5: Distribution of respondents according to their adaptation measures taken up

Sl. No.	Category	Frequency	Percentage
1.	Low	63	52.50%
2.	Medium	39	32.50%
3.	High	18	15.00%
Total		120	100

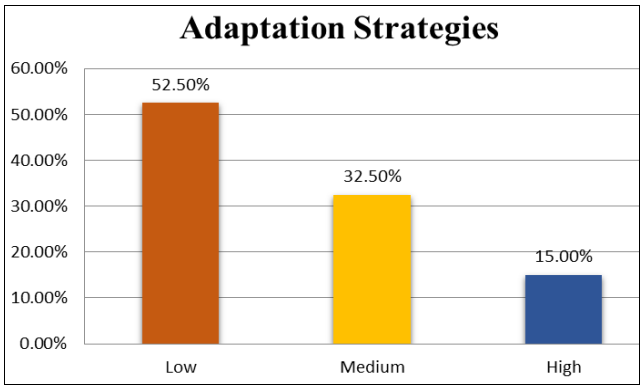

Fig 2: Graphical representation of distribution of respondents according to their adaptation measures taken up.

Table: 5 illustrates the overall distribution of respondents based on the adaptive measures they have implemented. It shows that 64.16 percent of respondents have low adaptation, 30.00 percent have medium adaptation, and 5.83 percent have high adaptation. This distribution may be attributed to the fact that while most respondents are aware of climate change, they still lack sufficient knowledge on how to effectively employ adaptation measures to address it.

Conclusion

It can be concluded that the socio-economic profile of the respondents, more than half of the total respondents (51.67%) belonged to the 'middle aged' group (35-55 years), majority of the respondents (23.33%) belonged to the upper primary (up to class VIII), most of the respondents belonged to medium income group (60.84%) of below Rs. 1,00,000, more than half of the respondents (69.16%) were marginal (less than or equal to 1 hectare or 2.5 acres, majority of the respondents (45.84%) have high farming experiences (20years & above), it was found that majority of the respondents have low training received on how to adapt climate change (79.16%), medium level of mass media exposer (47.50%) was noticed among the respondents, most of the respondents poses medium level of knowledge on local agro-climate (72.50%). The overall result of the respondents shows 74.16 percent possess a high level of knowledge about climate change. The overall distribution of respondents based on the adaptive measures they have implemented shows that 64.16 percent of respondents have low adaptation. Effort can be made by conducting awareness programs and demonstration sessions, either through social participation or village farmer clubs, to educate and support farmers effectively. It is essential to integrate climate change issues into long-term policy and planning, especially in terms of education and awareness, so that they can be fully understood and valued by the public, with a particular focus on the farming community.

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