**Knowledge of Farmers on Climate Change: A study among Farm Families of Jorhat District, Assam, India**

**Abstract**

The environment and the societies are under a great deal of stress due to climate change, which is one of the biggest problems of the present time. The present study aims to assess the level of farmers' understanding on climate change. The study was conducted in Jorhat district of Assam state, India. In this study a multistage sampling procedure was followed. Thirty per-cent development blocks of Jorhat district were selected purposively which included two blocks. Seventy five respondents were selected from each block by using equal allocation sampling technique and thus sample size was 150. Data were collected through Interview Schedule and a knowledge test and analysed using appropriate statistical tests i.e., frequency, percentage, mean, standard deviation, category interval, t-test and correlation coefficient. The study reveals that highest percentage (43.33%) respondents were in the age group of 41 to 51 years and were high school passed (52.00%). Regarding land holding, 54.67 per cent had 1-5 acres of land while 80.00 per cent had farming as primary occupation. Majority of the respondents had medium level of knowledge (72.67%) on climate change followed by 14.66 per cent with high and 12.67 per cent with low level of knowledge on climate change. The data revealed that respondents had greater understanding of the indicators, causes and effects of climate change compared to their knowledge on mitigation and adaptation strategies. In order to empower farmers for taking a proactive role in addressing climate change, it is essential to enhance farmers' knowledge on climate change, its causes, affects, management and adaptive capacity. Various stakeholders may come together for generating awareness among farmers regarding climate change and its management and may advocate for policy frameworks

*Key words:* Knowledge, climate change, management, farmers

**Introduction**

Climate change refers to significant and long-term alterations in the Earth's climate patterns, including temperature, precipitation, wind patterns, and other indicators. “Climate change" means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (United Nations Framework Convention on Climate Change,UNFCCC).The environment and the societies are under a great deal of stress due to climate change, which is one of the biggest problems of the present time. Agriculture is a significant contributor to global greenhouse gas (GHG) emissions and is both a cause and a victim of climate change. Climate change has become a significant threat to the livelihoods of farmers in developing countries including India. While climate change is a global issue, its impacts are felt locally. In India, climate change has caused widespread suffering and substantial economic losses, adversely affecting agriculture, food security, public health, water resources, and biodiversity.

Climate change is a multifaceted issue that confuses not just the general public but also educated individuals who struggle to differentiate between important environmental concepts. Terms like climate change, global warming, ozone depletion, weather patterns, and climatic variability often lead to misunderstandings. Greater awareness and understanding can empower the society to address these pressing challenges effectively (Bostrom et al., 1994). Most of the farmers lack a clear understanding of the causes of climate change and its possible future impacts. Many of them respond to climate change issues solely based on their daily experiences, which may not provide the complete picture. Farmers can effectively adapt to climate change only if they have adequate knowledge about its issues. It is essential to equip them with comprehensive knowledge to effectively address these challenges. The present research paper aims to assess the level of farmers' knowledge on climate change. In this context, knowledge of climate change is defined as the farmers' comprehension of its indicators, causes, effects, adaptation and mitigation strategies. Identification of knowledge gap may contribute to policy formulation and designing right strategy for educating the farmers on the issue.

**Review of literature**

Majumder *et al.*(2019) in their research study ‘Farmers’ perception to Climate Change in Barak Valley Zone of Assam: An Empirical Study’ found that the majority of the respondents could identify major indicators of climate change in the form of erratic rainfall, increase in temperature, high winds and prolonged drought. Only 10.00 per cent respondents agreed to the occurance of drought due to climate change, while 77 per cent responded in favour of erratic rainfall.

# **A study conducted by Biswas *et.al.* (2020) on ‘Understanding Farmers’ Perception of Climate Change and Adaptation Strategies: A case study in Jhargram District of West Bengal, India’ found that** the farmers' readiness to adapt to climate change by thinking about changing their cultivation and production practices was significantly influenced by their perception of the phenomenon. The results indicated that farmers possessed high level of perception on climate change.

# Bojang*et al*.(2020) in their research study ‘Farmers Perceptions about Climate Change, Management Practice and Their On-Farm Adoption Strategies at Rice Fields in Sapu and Kuntaur of the Gambia, West Africa’ found that based on local experiences, the majority of respondents (77%) felt that reduced rainfall brought about by climate change would result in a decrease in forest trees; many also thought that there would be significant forest loss in the future. Nearly all of them (85%) reported that rising temperatures brought about by climate change would have a negative impact on rice production, particularly extreme temperatures, during the flowering and heading stages, sharply reduce rice productivity.

Fahad *et al.* (2020) in their research study ‘Farmers’ awareness level and their perceptions of climate change: A case of Khyber Pakhtunkhwa province, Pakistan’ revealed that a significant majority of participants (73%) recognized and were aware of climatic variations, while nearly 27.00 per cent were unaware of these changes. Most of the respondents reported a noticeable increase in temperatures during both winter and summer seasons (Rabi and Kharif).

# Das and Ghose(2020) in their research study ‘Factors driving farmers’ knowledge on climate change in a climatically vulnerable state of India’ stated the degree of farmers' awareness and understanding of climate change.The study identified the attributes like education, number of earning family members, income from farm activity, weather ranking, assets holding etc. influencing their knowledge in the coastal (Balasore) and non-coastal (Khurda) districts of Odisha, which is a vulnerable state of India. Although majority of the farmers were aware about the problems caused by climate change, their level of knowledge about various phenomena was found to be below average, with overall climate knowledge index values of 45.33 percent in Khurda district and 46.60 percent in Balasore district, respectively.

# A study ‘Sustainable agriculture in Northeastern India: how do tribal farmers perceive and respond to climate change?’ conducted by Bhalerao *et al.* (2022) found that a significant majority of farmers in the Northeastern Region (NER) of India were aware of climate change and its adverse effects on both agriculture and socio-economic conditions. Most farmers across the eight states of the NER had experienced abnormal climatic events, such as irregular rainfall patterns, extreme temperatures, and unpredictable seasonal variations, particularly over the past 10 to 15 years. Their awareness is primarily centered on key agricultural concerns, with many reporting a decline in water availability and soil fertility.

# Madaki *et.al.* (2023) in their study ‘Climate Change Knowledge and Perception among Farming Households In Nigeria’ found that only 15.00 per cent farmer had knowledge on the fact that methane emissions from livestock production contributes to climate change, 20.74 per cent in dry AEZs had knowledge on this while the corresponding percentage from humid AEZ was only 10.5 per cent. Only 17 per cent of farmers knew that inappropriate manure management could cause climate change because of methane and nitrous oxide emissions.

# Below *et al.* (2015) In the study ‘Farmers’ knowledge and perception of climatic risks and options for climate change adaptation’ revealed that farmers in both villages have observed long-term changes in local climatic processes. These observations offer crucial insights into the local experience of climate change impacts, rooted in the farmers' lived experiences and interactions with the environment. The findings reflect a significant alignment with global studies on the impacts of climate change in rural agricultural settings.

Tripathi and Mishra (2017) in their research studies ‘Knowledge and passive adaptation to climate change: An example from Indian farmers’ which was conducted in eastern Uttar Pradesh revealed that although farmers are aware of long-term changes in meteorological variables (such as rainfall and temperature), they are unable to recognize these changes as being caused by climate change.  Despite the fact that farmers are altering their farming and agricultural methods, they are not taking proactive measures to address the perceived climate change.

Jain and Mazhar (2024) conducted a research on ‘Study on Knowledge Level of Farmers towards Climate Change on Crop Production at Udaipur District, Rajasthan, India’. The findings of this study revealed a concerning trend. Farmers were largely unaware of climate change and were only beginning to confront its realities. While most farmers displayed a basic understanding of climate change, the lack of exposure prevents them from gaining comprehensive knowledge. Moreover, there was a notable correlation between the farmers' understanding and certain independent variables. Unfortunately, a significant number of farmers fall short of achieving even a moderate level of climate change knowledge.

**Methodology**

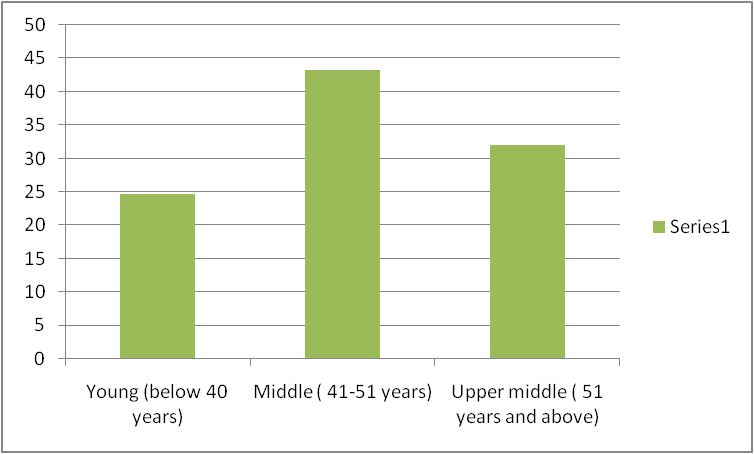
The study was conducted in the Jorhat district of Assam. To fulfill the objective of the study, multistage sampling and simple random sampling was adopted. Out of all the districts of Assam, Jorhat district was selected randomly for the present research. There are six development blocks in Jorhat district. Out of six development blocks two blocks i.e. Jorhat Development block and Central Jorhat Development block were selected randomly. Two villages from each block were selected. Dharigaon and Dakukurachuwa Gaon from Chipahikhola block and Borbheta Gaon and Sirotia Gaon from Baghchung block were included by using simple random sampling. For each village, a list of farming households was prepared. From the list, 150 respondents were selected by using equal allocation of simple random sampling method. Considering the objectives of the study as well as after reviewing the relevant literature for the investigation, variables were selected for the present study. The independent variables that included in the study are age, education, marital status, caste, family type, type of house, annual income, occupation, material possession, communication and media possession, organizational membership, land holding and the dependent variable that included in the study was knowledge.

**Construction of the knowledge test**

The knowledge test containing 82 number of statements was constructed to assess the knowledge of the respondents with four different sub categories. First part includes basic knowledge on climate change and indicators of climate change. The second part of the knowledge test was constructed to assess the knowledge related to the causes of climate change among the farm families. The third part included knowledge statements related to effects of climate change while fourth part was constructed to assess the knowledge related to adaptation and mitigation strategies of climate change among farmers. The knowledge test was then sent for expert advice. One pilot study had been conducted by administrating the tests to 30 non-sample respondents. According to the judges’ comments, recommendations and suggestions and as per responses received from the pilot study, the knowledge test was finalized for data collection. In the knowledge test, the responses were recorded as “fully known”, “partially known” and “not known” and assigned with scores “2”, “1” and “0”.

1. **Result and discussion**
   1. **Background profile of the respondents**
      1. **Age**

The data in Figure 1 shows that 43.33 per cent of the total respondents belonged to the middle-age group (41–51 years), while 32.00% fell into the upper middle-age category (51 years and above). These findings are align with studies by Ashrit and Joshi (2024) and Islam et al. (2019), which reported that the majority of farmers belonged to middle or old age groups. Regarding educational qualifications, 52.00 per cent of the respondents had completed high school. A large majority (79.33%) was married, highest percentage (56.67%) belonged to the Other Backward Caste (OBC), and 54.66 per cent came from nuclear families. In terms of occupation, as high as 80.00 per cent of respondents reported farming as their primary occupation, while the highest percentage (47.33%) lived in semi-pucca houses. Similar findings were reported by Majumder *et al.*(2019) conducted in Assam where it was reported that more than 80.00 per cent respondents had agriculture as their primary occupation. Findings on family income revealed that 58.00 per cent respondents had an annual income of up to Rs. 100,000. These results are in line with the findings of Islam et al. (2019), where it was found that majority of the respondents had low to medium annual income level (87.60%).



**Fig.1:** Distribution of respondents according to age

**Table 1. Distribution of respondents according to their background profile**

n = 150

|  |  |  |  |
| --- | --- | --- | --- |
| **Attributes** | **Category** | **Frequency** | **Percentage** |
| Educational qualification | Primary school passed  Middle school passed  HSLC passed  Higher secondary school passed  Graduate and above | 16  18  78  32  6 | 10.67  12.00  52.00  21.33  4.00 |
| Marital status | Married  Unmarried  Widow | 119  24  7 | 79.33  16.00  4.67 |
| Caste | General  OBC  SC  ST | 38  85  15  12 | 25.33  56.67  10.00  8.00 |
| Type of house | Kutcha house  Semi pucca  Pucca | 27  71  52 | 18.00  47.33  34.67 |
| Annual income | Upto Rs. 100000  Rs. 100001-300000  Rs. 300001-500000 | 87  49  14 | 58.00  32.67  9.33 |
| Primary occupation | Business  Farming  Daily wage earner  service | 9  120  15  6 | 6.00  80.00  10.00  4.00 |
| Land holding  (1 hecter = 2.47 acres) | Less than 1 acre  1-5 acre  6-10 acre  11-15 acre | 31  82  25  12 | 20.67  54.67  16.66  8.00 |

Regarding land holding, slightly more than 50 per cent respondents had land holding of 1-5 acre. Though in the present study the land holding was reported in acre it is observed that it shows similar trend with NABARD, 2024 which reported the average land holding in Indian farm families to be 0.74 hectare in the year 2021-22.

**Material possession**

Material possession was asked in terms of possession of farm assets, different livestock, transportation assets, mass media and household assets and results are presented in Fig 2. It shows that a large majority (81.00 %) of the respondents fall in the medium level of material possession whereas 17.00 per cent and 2.00 per cent respondents had high and low level of material possession respectively.

**n=150**

**Fig. 2. Pie chart showing Distribution of respondents according to the level of material possession**

The findings presented in table 2 shows that more than fifty per cent respondents possessed tubewell or pump set. They also possessed sprayers(14.00 %),desi plough (19.33%), hoe (18.66%) , hand tools like khurpi, spade, etc.( 23.33%) and a small percentage (3.33%) of respondents possessed tractor and power tiller (1.33%) as farm assets in their households. Regarding possession of livestock a large percentage (74.66%) possessed cow followed by buffalo(14.00%) . Regarding transportation assets, bicycle was possessed by more than 50.00 per cent (58.00%) respondents whereas 43.33 per cent of the respondents owned motor bike or scooter, 8.66 per cent owned three wheelers and a small percentage (8.00%) of respondents also owned four wheeler. In terms of possession of mass media, it is observed that most of the respondents owned mobile phone (94.66%) and television (91.33%) while 23.33 per cent subscribed to newspaper and 16.66 per cent possessed radio. More than 70.00 per cent were using different social media.

**Table 2. Distribution of respondents according to the material possession**

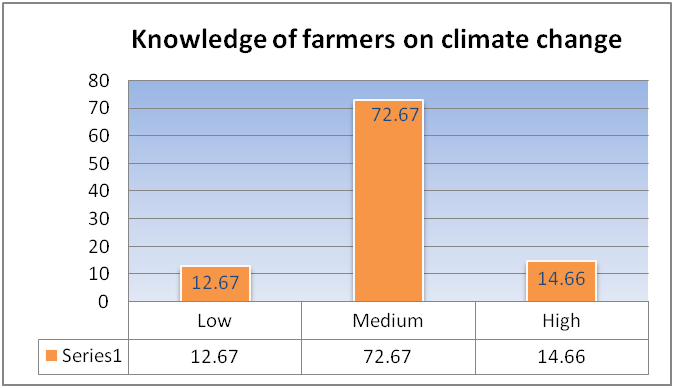
**n=150**

|  |  |  |
| --- | --- | --- |
| **Farm assets\*** | **Frequency** | **Percentage** |
| Tractor  Power tiller  Tubewell/ pumpset  Sprayer  Desi plough  Hoe  Hand tools (khurpi, spade etc.) | 5  2  85  21  29  28  35 | 3.33  1.33  56.66  14.00  19.33  18.66  23.33 |
| **Possession of livestock\*** | | |
| Cow  Buffalo  Goat  Poultry  Pig  Duck  Pet animals | 112  21  65  12  8  76  34 | 74.66  14.00  43.33  8.00  5.33  50.66  22.66 |
| **Transportation assets\*** | | |
| Four wheelers  Three wheelers  Motor bike/ scooter  Bicycle | 12  13  65  58 | 8.00  8.66  43.33  38.66 |
| **Possession of mass media** | | |
| Newspaper  Radio  Television  Mobile  Social media  Megazine | 35  25  137  142  109  11 | 23.33  16.66  91.33  94.66  72.66  7.33 |
| **Household assets \*** | | |
| Electric fan  Gas stove  Sewing machine  furniture  Pressure cooker  Kerosine stove | 150  150  54  125  150  23 | 100.00  100.00  36.00  83.33  100.00  15.33 |

**3.1.11 Farmers’ knowledge on climate change**

The data on respondents' knowledge of climate change (Fig. 3) indicate that 72.67 per cent had a medium level of knowledge, followed by 14.66 per cent high level and 12.67 per cent with low

level of knowledge. Majority demonstrated medium to high knowledge, which may be due to their access to basic information sources such as media and informal discussions with peers. Table 2 on mass media ownership shows that, a significant percentage of respondents possessed televisions (91.33%) and mobile phones (94.66%) and many reported occasionally listening to programmes related to agriculture, climate change, and its management, which may have contributed to their knowledge. However, the rapidly changing climate demands high level of knowledge by the farmers and society at large in order initiate climate action. These findings align with those of Islam *et al.* (2019) in Bangladesh, where 78.80 per cent of respondents exhibited medium to high knowledge of climate change effects on agriculture. Similarly, a study by Fahad *et al. (*2020) in Pakistan found that 73.00 per cent of farm households were aware of climate change.



**Fig. 3. Distribution of the respondents according to their level of knowledge on climate change**

**Ranking of basic knowledge on climate change**

Basic knowledge of climate change was assessed to evaluate farmers' fundamental understanding of the subject. The mean score of each statement was calculated based on the scores obtained, and statements were ranked accordingly (Table 3).

The statement "Climate change may shift the onset of seasons and alter the distribution of weather patterns globally" ranked I with a mean score of 2.00, followed by "The term climate change includes both global warming and its broader effects on the planet," which ranked II with a mean score of 1.29.This ranking suggests that farmers are particularly aware of seasonal shifts, as these directly impact planting, harvesting, and crop yields. Delays in the onset of seasons or unexpected weather patterns can disrupt traditional agricultural cycles, leading to economic and food security concerns.

**Table 3. Ranking of basic knowledge on climate change**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl no.** | **Statements** | **Mean score** | **Ranking** |
|  | **Climate change** may shifts the onset of seasons and the distribution of weather patterns globally | 2.00 | I |
|  | The term **climate change** includes both global warming and its broader effects on the planet | 1.29 | II |
|  | **Global warming** refers to the long-term rise in Earth's average surface temperature | 1.10 | III |
|  | Climate change is a long-term shift in temperature. | 0.98 | IV |
|  | **Climate change** involves increased concentrations of greenhouse gases | 0.84 | V |
|  | Characterized by significant changes in average weather conditions over decades or longer | 0.65 | VI |
|  | Trapping of heat by g**reenhouse gases** causes global warming | 0.42 | VII |

**3.1.12 Ranking of knowledge according to indicators of climate change**

 Statements pertaining to various climate change indicators had been ranked based on the obtained mean scores.  The data (table. 4) reflects that, among all the statements on indicators of climate change, 5 statements obtained mean score 2.00 and ranked as I. The statements with rank I are - ‘Increase in temperature’, ‘Heat wave’, ‘Irregular and erratic rainfall’, ‘Frequent flood’, and ‘Frequent drought’. This could be attributed to the fact that farmers frequently observe direct indicators of climate change, such as temperature fluctuations, erratic rainfall, droughts, and floods, which directly impact their crops and livelihoods.

**Table 4. Ranking of knowledge statements related to climate change indicator**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl no.** | **Statements** | **Mean score** | **Rank** |
|  | Increase in temperature | 2.00 | I |
|  | Heat wave | 2.00 | I |
|  | Irregular and erratic rainfall | 2.00 | I |
|  | Frequent drought | 2.00 | I |
|  | Frequent flood | 2.00 | I |
|  | Decline of soil productivity | 1.95 | II |
|  | Long summer | 1.74 | III |
|  | Short winter | 1.73 | IV |
|  | Heavy fog | 1.64 | V |
|  | Increase in melting of glaciers | 1.51 | VI |
|  | Cold wave | 0.96 | VII |
|  | Changes in intensity and frequency of storm | 0.86 | VIII |
|  | Changes in water level | 0.85 | IX |

**3.1.13 Ranking of knowledge on the basis of causes of climate change**

The data (table 5) indicate that four statements obtained mean score of 2.00 and were ranked I. Statements such as ‘Climate change can result from both natural processes and human activities’, ‘Deforestation leads to climate change,’ ‘Industries and factories contribute to climate change,’ and ‘Increased use of pesticides is harmful to the environment.’ The high ranking of these statements reflects their fundamental role in respondents' understanding of climate change. They encompass both global and local causes, ranging from industrial pollution to land use practices, which are highly observable and relevant to farmers' experiences.

The statement ‘Rice cultivation releases methane’ was ranked XVI with a mean score of 0.07, indicating a low level of knowledge among farmers regarding this cause of climate change. Although methane emissions from rice paddies are scientifically well-documented, this factor may not be as immediately recognized or understood as more prominent contributors like deforestation or industrial pollution. Since farmers are generally more familiar with carbon dioxide emissions from transportation and factories than methane emissions from agriculture, they may not perceive rice cultivation as a significant contributor to climate change. Raising awareness about such facts could encourage farmers to adopt crop diversification and sustainable practices. Therefore, adequate attention should be given to educating farmers about these critical aspects of climate change.

**Table 5. Ranking of knowledge statements on the basis of causes of climate change**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl no.** | **Statements** | **Mean score** | **Ranking** |
|  | **Climate change** can result from both natural processes and human activities | 2.00 |  |
|  | Deforestation leads to climate change | 2.00 | I |
|  | Industries and factories contribute to climate change | 2.00 | I |
|  | Increased use of pesticides is harmful for the environment | 2.00 | I |
|  | Overpopulation is a reason of climate change | 1.93 |  |
|  | Burning of plastic can cause climate change | 1.81 |  |
|  | Increase in number of vehicle releases carbon di oxide, methane, nitrous oxide | 1.78 |  |
|  | Overuse of electric bulbs, fans, refrigerator, air cooler produces compressed carbon di-oxide, chlorofluorocarbons, carbon monoxide | 1.6 |  |
|  | Rapid urbanization is a reason of climate change | 1.5 |  |
|  | The agricultural sector is one of the largest producers of greenhouse gases | 0.88 |  |
|  | Poultry farming contributes to methane emission | 0.80 |  |
|  | **Production of oil and gas leads to emission of greenhouse gases** | 0.88 | VIII |
|  | Carbon di oxide, methane, nitrous oxide, chlorofluorocarbons etc. are different green house gases | 0.57 |  |
|  | Use of fuel wood produce green house gases | 0.48 |  |
|  | Excessive greenhouse gases cause global warming | 0.34 |  |
|  | Livestock sector produces carbon di oxide and methane | 0.33 |  |
|  | Traditional chulha produces carbon di oxide, carbon monoxide, sulfur oxides | 0.31 |  |
|  | Tillage practices can increase soil erosion | 0.16 |  |
|  | **Meat consumption has significant affect on green house gas emissions** | 0.16 | XIV |
|  | Destruction of wetlands accelerate global warming | 0.08 |  |
|  | Rice cultivation releases methane | 0.07 |  |

**3.1.14 Ranking of knowledge on effects of climate change**

   Table 6 shows that among all the statements related to effects of climate change, six statements obtained mean score 2.00 and ranked as I. The statements ‘Climate change increases the global warming’, ‘Changing rainfall patterns can disrupt agricultural system’,‘Climate change can reduce agricultural productivity’, ‘Many species are migrating to new areas due to changing temperatures’,‘Climate change can have severe impacts on agriculture including reduced crop yields and food security’,‘Climate change can affect human health,leading to increased risks of heat-related illnesses and diseases’ all these statements were known by all the respondents and  ranked as I .

They highlight widely acknowledged and observable effects of climate change that significantly impact agriculture and human health. Global warming is a central topic in climate discussions, widely covered in media and education. Additionally, the increased frequency of heatwaves and rising temperatures are noticeable phenomena that farmers often associate with shifts in local weather patterns.

On the other hand the statement- “Climate change can lead to displacement of population” ranked VIII with mean score 0.10 since it had less immediate and direct impact on the farmers of the present study. Farmers prioritize the direct and immediate impact of climate change, such as changes in temperature, rainfall, crop yields, and food security. Population displacement, though significant, is often a long-term or indirect consequence of climate change and does not always have an immediate impact on farmers' daily agricultural activities. The statement "Climate change can cause soil pollution by altering natural processes" was ranked IX among all the statements.

**Table 6. Ranking of respondents according to knowledge on effects of climate change**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl no.** | **Statements** | **Mean score** | **Ranking** |
|  | Climate change increases the global warming | 2.00 | I |
| 2. | Changing rainfall pattern can disrupt agricultural system | 2.00 | I |
| 3. | Climate change can reduce agricultural productivity | 2.00 | I |
| 4. | Many species are migrating to new areas due to changing temperature | 2.00 | I |
| 5. | **Climate change** can have severe impact on agriculture, including reduced crop yields and food security | 2.00 | I |
| 6. | **Climate change** can affect human health, leading to increased risks of heat-related illnesses and diseases | 2.00 | I |
| 7. | Biodiversity and ecosystems is affected by climate change | 1.79 | II |
| 8. | Climate change affects agriculture by altering growing time | 1.74 | III |
| 9. | Climate change leads to food shortage, malnutrition, and micro nutrient deficiencies | 0.93 | IV |
| 10. | Climate change increases water level | 0.50 | V |
| 11. | Changes in intensity and frequency of storm is the impact of climate change | 0.28 | VI |
| 12. | Soil productivity is decreasing due to climate change | 0.24 | VII |
| 13. | **Climate change** can lead to the displacement of population | 0.10 | VIII |

**3.1.15 Ranking of Knowledge related to adaptation and mitigation**

Table 7 shows that the among all the knowledge statements related to adaptation and mitigation,  two statements i.e. “Through rain water harvesting water can be conserved”, ranked I with mean score 2.00. Rainwater harvesting is a simple and well-known method for conserving water. Many communities understand its effectiveness in addressing water scarcity, especially in areas affected by climate change. The technique is low-cost, sustainable, and can be implemented at the household level, making it a popular choice for individuals interested in climate resilience. However, another statement related to water conservation i.e. ‘Water conservation helps in climate’ ranked XVII with mean score 0.08 reflecting their basic understanding about relationship between water conservation and climate. Plantation of trees may be a doable activity for which farmers may be motivated with their high level of knowledge on the fact that ‘Planting trees around homes may mitigate the effects of climate change on a local scale” which ranked I. The study reveals that many respondents lacked sufficient knowledge about a number of feasible climate change adaptation and mitigation strategies that might help farmers in adapting to a changing climate. Although these strategies are doable, putting them into practice takes some time and money. Further the results show that farmers lack awareness and comprehension of these approaches, despite their potential advantages. This is reflected in the mean score obtained by the statements- ‘Use of bicycle or walking instead of carpooling can reduce green house gas emissions’( II, mean score 1.78), ‘Renewable energy sources like use of solar energy instead of electricity can reduce green house gas emissions’(III, mean score 1.71) ‘Use of LED bulbs’ (IV, mean score 1.66), ‘Reducing, reusing, and recycling household waste can minimize the generation of greenhouse gas emissions’(V, mean score 1.60), ‘Installing solar panels or wind turbines on residential properties can generate clean, renewable energy’( VI, mean score 1.53), ‘Switching to sustainable agricultural practices can help in adapting climate change’( VII, mean score 1.37).Through proper interventions knowledge may be imparted which may lead to action since these are simple activities. It only requires time and awareness of farmers to adhere to mitigation and adaption approaches. Though it seems resource-intensive and hard to follow, proper knowledge will empower them to take action.

The results reflect lack of knowledge or understanding among respondents about the connection between waste minimization and greenhouse gas emissions as the statement “Minimizing waste can help in the emission of greenhouse gases” could achieve the rank XIX with  mean score 0.04. People may not fully grasp how waste reduction, particularly at the household level, contributes to reducing emissions.

**Table 7. Ranking of Knowledge related to adaptation and mitigation**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl no** | **Statement** | **Mean score** | **Ranking** |
|  | Through rain water harvesting, water can be conserved | 2.00 | I |
|  | Planting trees around homes may mitigating the effects of climate change on a local scale | 2.00 | I |
|  | Use of bicycle or walking instead of carpooling can reduce green house gas emissions | 1.78 | II |
|  | Renewable energy sources like use of solar energy instead of electricity can reduce GHG emissions | 1.71 | III |
|  | Use of LED bulbs | 1.66 | IV |
|  | Reducing, reusing, and recycling household waste can minimize the generation of greenhouse gas emissions | 1.60 | V |
|  | Installing solar panels or wind turbines on residential properties can generate clean, renewable energy | 1.53 | VI |
|  | Switching to sustainable agricultural practices can help in adapting climate change | 1.37 | VII |
|  | Opting for walking, biking, carpooling, or using public transportation instead of driving alone can reduce carbon emissions | 1.28 | VIII |
|  | Purchasing reusable products can minimize waste | 1.13 | IX |
|  | Using fuel-efficient vehicles | 0.74 | X |
|  | Reducing energy consumption can help in emission of greenhouse gases | 0.66 | XI |
|  | Manure management practices can result in less methane emission | 0.58 | XII |
|  | Use of efficient cooking fuel can minimize green house gas emission | 0.54 | XIII |
|  | Using renewable energy sources can help mitigate climate change | 0.32 | XIV |
|  | Bamboo farming can be an approach to climate change mitigation | 0.24 | XV |
|  | **Adaptation** refers to the actions taken to manage the impacts of climate change | 0.12 | XVI |
|  | Water conservation helps in climate management | 0.08 | XVII |
|  | Use of biofuel can reduce the emission of greenhouse gases | 0.05 | XVIII |
|  | Adopting conservation tillage practices such as mulching, crop rotation can reduce soil erosion | 0.05 | XVIII |
|  | **Mitigation refers to reduce the effects of climate change by reducing the amount of greenhouse gases** | 0.04 | XIX |
|  | Minimizing waste can help in the emission of greenhouse gases | 0.04 | XIX |

**Conclusion**

It is well evident from the present study highest percentage (72.67) of the respondents had medium level of knowledge followed by 14.66 per cent with high and 12.67 per cent with low level of knowledge on climate change**.** From the findings of the present study it may be concluded that the respondents' knowledge related to climate change were at a moderate level. However, variation is observed in terms of knowledge regarding different dimensions of climate change. The respondents demonstrated a greater understanding of the indicators, causes and effects of climate change compared to their knowledge on mitigation and adaptation strategies. To empower farmers for taking a proactive role in addressing climate change, coordinated interventions from various stakeholders are essential. Government agencies, research institutions, non-governmental organizations (NGOs), and community-based organizations must collaborate to enhance farmers' knowledge and adaptive capacity. Targeted awareness programmes, access to climate-resilient technologies, financial support, and policy frameworks should be implemented to strengthen their ability to mitigate and adapt to climate challenges. Based on the conclusion following recommendations are put forwarded-

Multimedia production, including posters, audio messages, video messages, and traditional media such as puppetry, should be used to depict local examples of climate impacts (e.g., changes in rainfall patterns, crop failures, and soil degradation). Universities, the Ministry of Environment, Forest and Climate Change, and the Ministry of Agriculture and Farmers’ Welfare may take the lead in disseminating such knowledge.

Community-focused awareness programmes should be developed to explain the causes and effects of climate change, as well as climate management practices such as mitigation and adaptation. Farmers should be encouraged to start with small, easily actionable activities.

**Disclaimer (Artificial intelligence)**

Option 1: No

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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