



## CLIMATE CHANGE AND AGRICULTURAL IMBALANCE: A STUDY IN KAPURTHALA DISTRICT, PUNJAB, INDIA

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### Abstract

This paper tried to understand the agricultural imbalances due to the climate change in Kapurthala district of Punjab. The background of the study lies to the suffering of people from Indian farming industry due to the changing climate pattern. Proper policy implications are most significant to stabilize the issues existing due to the climate change. The current research thoroughly examines the field level reality from farmers' precipitation. The existing literature pointed that most Indian framers face an increased variation in temperature as well as irregular and decreased rainfall, which is compatible with the weather data. Indian farmers appeared to have adopted a broad variety systemic and modest adaptation.

**Keywords:** Agricultural Imbalance, Climate Change, Climate Mitigation, Farmers, Punjab

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## Introduction

Climate change is a major problem in today's world. It could have a significant effect on food costs in addition to posing a serious threat to the capacity of food supply systems to fulfil rising demand. Targeted research and development initiatives, beginning at the farm level with alternative crop types, will be sparked by the consequences of climate change adaptations on international trade and consumption patterns. Climate change has a substantial impact on agricultural production systems, which presents unique issues for the entire human community. They involve major changes to the location or the organization of the region's capability for generating food, as opposed to changes that are more gradual in character. Examples include the significant expansion of irrigation in an area, the extension of the rail network into a new farming zone, or the relocation of a substantial processing facility in response to a decline in output in the nearby area. These adaption alternatives may also be costly to implement, perhaps partially reversible, or long-lasting, necessitating advance planning. Global trade and consumption patterns will be impacted by climate change adaptations, which will also encourage targeted research and development (Campbell, 2016). Agriculture production systems are significantly impacted by climate change, which creates special problems for the entire human race. Instead of more gradual alterations, they require significant adjustments to the location or structure of the region's capacity for food production. Examples include the major increase in irrigation in a region, the extension of the rail system into a new farming area, or the relocation of a sizable processing facility in reaction to a drop in output in the neighbourhood. These adaptation options might be expensive to deploy, possibly partially reversible, or long-lasting, requiring ahead preparation. Climate change adaptations will have an impact on global trade and consumption patterns, which will promote focused research and development. Transformations that are later found to be insufficient or misguided may be unable to be undone because of their limited reversibility, making agricultural systems more susceptible to climatic fluctuations, and converting investments into sunk costs. Furthermore, delaying reforms is encouraged by the possible future usefulness of greater knowledge (Raza, 2019). Current studies are producing more and more solutions to this issue. While some approaches promote 'hard' adaptations, such as the incorporation of robust decision-making processes into pre-existing choice frameworks, others promote 'soft' adaptations,

such as minimizing regret or maximizing flexibility by creating adaptations with tighter safety margins and shorter lifespan. Given the uncertain but potentially significant changes that agricultural systems must go through, it is imperative to visualize and understand the many uncertainties at play in order to mitigate the disempowering effects of uncertainty by breaking down the decision-making process into manageable phases. The impact of this phenomena, which is manifesting itself virulently in numerous parts of the world, is affecting the way of life for millions of people. Climate change is destroying crops, slaughtering herds, and making traditional lifestyles impossible in many regions of the world. Climate change is currently considered to be a more important factor driving migration than economic and political difficulties in the countries of origin because of its effects.

## Background of the Study

Climate change is predicted to reduce maize and cotton yield in Punjab by 13 per cent and 11 per cent by 2050, according to a new study conducted by agriculture economists and scientists at Punjab Agricultural University (PAU). Punjab accounts for around 12 percent of the total cereals produced in the country. The study published in the *Mausam* journal of the India Meteorological Department earlier this month used rainfall and temperature data collected between 1986 and 2020 to project the impact of climate change on five major crops: rice, maize, cotton, wheat, and potato in the agrarian state. The researchers collected climate data from five weather observatories of Punjab Agricultural University, i.e., Ludhiana, Patiala, Faridkot, Bathinda, and SBS Nagar. According to a study published in the most recent issue of the India Meteorological Department's journal 'Mausam,' rising average temperatures as a result of climate change are predicted to reduce the yield of all major crops in Punjab by 2050, with maize projected to suffer the greatest loss of 13 percent. Cotton is predicted to suffer the next greatest loss, at 11 percent, followed by wheat and potatoes at 5 percent each, and rice is predicted to suffer a loss of over 1 percent (Kumar et.al, 2022). The researchers (agricultural economist) Sunny Kumar, scientist Baljinder Kaur Sidana and PhD scholar Smily Thakur said that "long-term changes in climatic variables show that the rise in temperature is driving most of the changes, rather than the change in rainfall pattern."

Populations in the developing world, which are already vulnerable and food insecure, are likely to be the most seriously affected. In 2005, nearly half

of the economically active population in developing countries 2.5 billion people-relied on agriculture for its livelihood. Today, 75 percent of the world's poor live in rural areas. Farmers are the first to experience the harshest effects of the changing climate and agricultural production systems, which will have an impact on food security (Soubry et al., 2020). In order to highlight key areas of uncertainty, this paper reviews recent literature on a variety of processes that could potentially affect global-scale agricultural productivity as a result of climate change. It also presents projections of changes in relevant meteorological, hydrological, and plant physiological quantities from a climate model ensemble. Climate change is expected to have significant impacts on agriculture, including changes in temperature, precipitation patterns, and extreme weather events. These changes will affect crop yields, water availability, and soil quality, with potentially negative consequences for food security and rural livelihoods. In this review, we summarize recent research on the impacts of climate change on agriculture, including studies on crop productivity, water management, and adaptation strategies. We also discuss the challenges of addressing climate change in agricultural systems, including the need for more resilient crops and sustainable land management practices. Overall, our review highlights the urgent need for action to mitigate and adapt to the impacts of climate change on agriculture, and the importance of interdisciplinary research and collaboration in addressing this complex challenge.

### Important Issues Related to Climate Change

One key area of research has been the potential impact of temperature and precipitation changes on crop yields. A study by Lobell and colleges (2011), found that the negative impacts of temperature increase on crop yields outweighed any positive effects of increased CO<sub>2</sub> concentration, and projected a decline in global yields of major crops, including wheat, rice, and maize, under future climate scenarios. Similarly, a meta-analysis by Zhao et al (2017), found that increases in temperature and changes in precipitation had negative impacts on crop yields in most regions of the world. Another area of research has been the impact of climate change on water resources for agriculture. A study by Wada et al. (2016), found that climate change was projected to exacerbate water scarcity in many regions of the world, particularly in areas that were already experiencing water stress. This could have significant implications for agriculture, as irrigation accounts

for around 70% of global freshwater use (Fao, 2021).

The potential impact of climate change on pests and diseases in agriculture has also been a topic of research. A study by Newton et al. (2015), found that climate change was likely to increase the range and activity of many pests and diseases, particularly in temperate regions. This could lead to increased crop losses and the need for more frequent and intensive use of pesticides. In addition to these impacts, climate change is also likely to have significant socio-economic consequences for agriculture. A study by Burke et al. (2015), found that climate change was likely to have a negative impact on global food security, particularly in low-income countries, and could lead to increased poverty and inequality. In response to these challenges, there has been increasing interest in developing climate-smart agriculture practices that can help farmers adapt to and mitigate the impacts of climate change. These include practices such as conservation agriculture, agroforestry, and improved water management (Fao, 2017).

By going through Global agriculture, is being significantly impacted by climate change. Agriculture productivity, food security, and the lives of farmers and rural people are all being impacted by the shifting climatic trends. Here are a few ways that agriculture is being impacted by climate change:

- a) **Changes in temperature and rainfall patterns:** Climate change is causing changes in temperature and rainfall patterns, which affect crop growth and development. For example, changes in temperature can alter the timing of plant growth stages, while changes in rainfall patterns can lead to droughts or floods, both of which can negatively impact crops.
- b) **Increased pests and diseases:** Rising temperatures and changing weather patterns can create favorable conditions for pests and diseases that can damage crops. This can result in reduced crop yields and quality.
- c) **Changes in water availability:** Climate change is also affecting the availability of water for irrigation and crop growth. In some areas, increased evaporation rates and decreased rainfall are reducing water availability for agriculture, while in others, changing weather patterns are leading to increased flooding and soil erosion.
- d) **Soil degradation:** Extreme weather events such as floods and droughts can cause soil erosion, nutrient depletion, and loss of soil fertility. This can lead to decreased crop yields

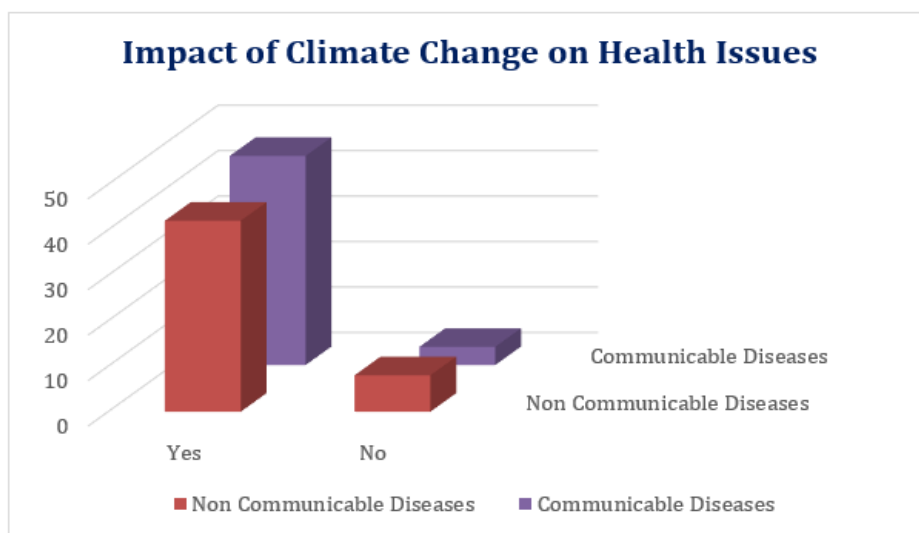
and the need for increased use of fertilizers, which can contribute to greenhouse gas emissions.

- e) **Impacts on livestock:** Changes in temperature and rainfall patterns can also affect livestock production, particularly in regions where pastureland is relied upon for grazing. Droughts and heat waves can reduce the quality and quantity of pasture, leading to malnutrition and illness in livestock.

### Methodology

The present study is adopted a mixed research method that encompasses both primary and secondary data. Snowball sampling was employed to determine the samples. Key informant interview as well as survey were used for collecting primary data from the farmers in the district. Key informants among some elderly people using some traditional ways/methods to keep their crops away from pests, while frequency table and thematic analysis method were used for data analysis. The secondary data has been collected from the existing literature from various journals, books, newspapers, study reports and other academic documents.

### Impact of Climate Change on Health Issues:



**Figure 1- Source:** Prepared by the researcher

The Figure:1, is exploring that 82% of the respondents agreed that change in climate has made significant impact on health issues as it is increasing non- communicable diseases but 16% of people are disagreed with this. On the other hand, 92% of them agreed that climate change has leads to increase in communicable diseases while 8%

### Climate Change: Grassroot Level Reality in The Socio-Economic Sphere

Climate change is a global challenge that has significant impacts on agriculture. It affects various aspects of agriculture such as crop yields, pest and disease outbreaks, water availability, and soil fertility. These impacts can lead to food insecurity, reduced income for farmers, and increased food prices. However, there are adaptation strategies that can help mitigate the effects of climate change on agriculture. These strategies include the development of drought-tolerant and climate-resilient crops, the adoption of climate-smart agricultural practices such as conservation agriculture, and the implementation of improved water management practices. The impact of climate change on agriculture is a complex issue that requires urgent attention. By implementing adaptation strategies and prioritizing climate change in agricultural policies, we can help ensure food security and sustainable agriculture for future generations.

disagreed with this statement. Because of the climate change the farmers are facing various health issues. These health issues may be restricting them from involving day to day agricultural practices. It will be affecting their economic status as well.

### Impact of Climate Change on Economy

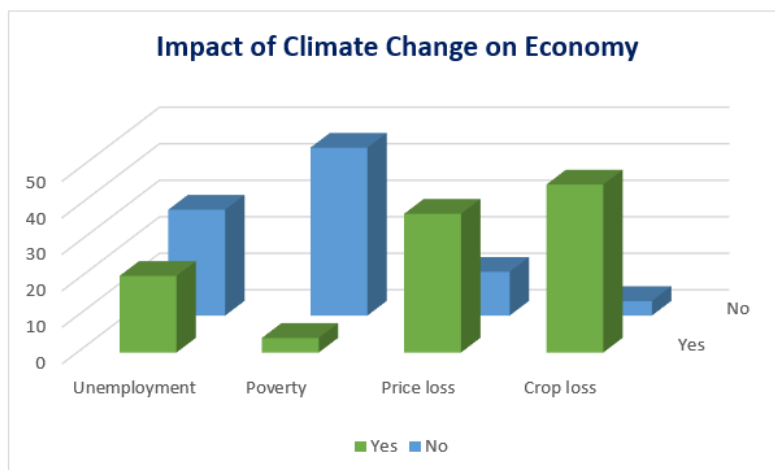


Figure: 2- Source: Prepared by the researcher

The Figure 2, is showing that 42% of the respondents opined that unemployment is existing because of the climate change. At the same time 58% of them never believed climate change will be making any kind of unemployment in agricultural sector. On the other hand, 8% of them believed that poverty is also getting increased due to climate change. Majority of the farmers i.e., 92% had an opinion such as climate change is not making any kind of poverty in the families of farmers. The researcher analysed the data and identified that majority of the respondents (76%) had experienced price loss for their agricultural product but only few (24%) never affected the price loss. Climate Change may also be contributed in the loss of crop as well.92% of the farmers had loss in their crop due to climate change but 8% of them did not experience any loss.

### Temperature Variation and Agriculture Productivity: A Reflection from the Field

Temperature variation is an increasing challenge faced by the agricultural farmers as well as workers in India. The agricultural production is closely related to the climate. Seasonal cultivation practice is largely adopted by the farmers in Punjab as well. During the time of winter, the cultivation of wheat will be taking place. The harvesting practice may be taking place during the time of summer. If the changes in climate occurs, definitely it will adversely affect the socio-economic and cultural condition of the people who are directly or indirectly close to the agricultural system.

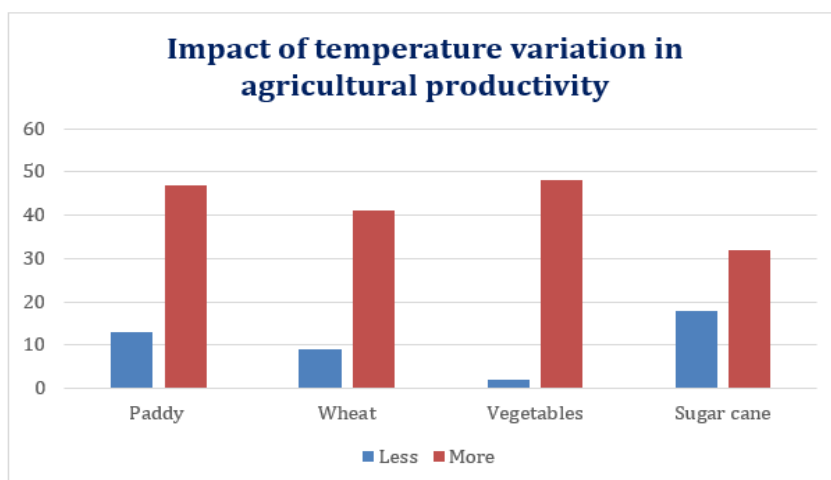


Figure: 3- Source: Prepared by the researcher

The Figure 3, researcher analysed how variation in temperature has affected agricultural productivity.

Around 26% of the respondents believed that paddy production has been increased due to change



in temperature but majority (94%) of the farmers opined that productivity has been decreased. Climate change has also contributed in the disbalanced production of wheat. Most of the respondent's (82%) agreed that climate change has affected more on wheat production while few of them (18%) still believe that it has not such impact on wheat production. In case of Plant and vegetables production, majority of the respondents (96%) observed that change in temperature has declined the productivity of vegetables and only 4% of them still believe that temperature change has not affected the growth and productivity of vegetables and grass. As we know Punjab produces most of the sugarcane, 64% of our respondents observed and told us that change in temperature has decreased the production of sugarcane on the other side 36% of them totally disagreed with that.

### Effect of Pesticide Usage in Changing Climate Condition

Usage of pesticide is another important issue faced by the farmers in Punjab. The organic pesticides are not effective in some cases, as a result of the climate change. From the historic time onward, they have been using these organic pesticides, but recently as a result of this climate change, the result is not a positive one. From the analysis of the data also it is clear. People are largely focusing on the chemical pesticides. The immediate result is one of the important reasons why they are adopting these chemical pesticides. The crop loss may adversely affect the economy of the agricultural farmers as well.

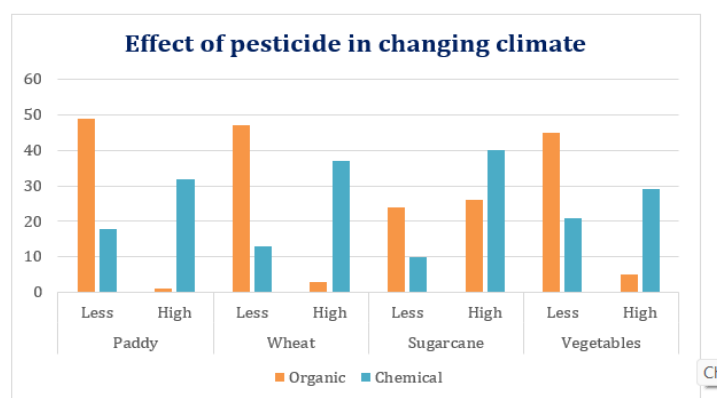


Figure: 4- Source: Prepared by the researcher

The Figure 4<sup>th</sup> is highlighting the effects of each pesticide varies in the drastically changing climate scenario. The data collected from the farmers related to the use of pesticides and it is effectiveness on different crops shows the temporary effectiveness of chemical pesticides. As per the analysis report while using the organic pesticide in paddy field, the effectiveness is very less. 98% of the respondents opined that the organic pesticides are not effective in the changing climate scenario. 64% of the respondents shared that the effectiveness of chemical pesticides is there in the agrarian social structure now a day. In the case of wheat only 6% of the respondents witnessed the organic pesticides are effective. From this analysis report 94% do not believe so. But still, it reflected from the response of the 74% it denotes while using the chemical pesticide the effectiveness is higher. In case of sugarcane, 80% of the respondents believed that chemical pesticides are more effective in keeping the pests away from the sugarcane. 84% of the respondents believed that organic pesticides are less effective in keeping the pests away from the sugarcane. The

farmers who are involved in vegetable farming shared their opinion related the use of organic as well as chemical pesticides. 58% of them shared that the use of chemical pesticides is making a positive impact on the growth of vegetables. On the other hand, 10% of respondents shared their views that organic pesticides are much effective than chemical pesticides.

From this analysis the chemical pesticide usage is more common among the farmers in Kapurthala district of Punjab. They believe that the chemical pesticides are much effective and enhance the growth of crop faster than the usage of organic pesticides. This may also affect the life expectancy rate of the people and cause for various severe lifestyle diseases as well.

### Climate mitigation and perception of farmers

Farmers have a critical role to play in climate mitigation efforts, as agriculture and land use change account for a significant proportion of global greenhouse gas emissions. However, the perception of farmers towards climate mitigation

can vary depending on a range of factors, including their location, farming practices, and socioeconomic status. This is often driven by government policies and incentives, as well as consumer demand for sustainable products. Many farmers in these regions are actively implementing measures such as reduced tillage, precision farming, and agroforestry to reduce their carbon footprint. In contrast, in some developing countries, farmers may be less aware of climate change and its potential impacts, and may have fewer resources available to implement mitigation measures.

One of the older farmers opined;  
“In my childhood days, my grandparents used organic pesticides, but now a day, it is not applicable. Spring, summer, winter seasons are changed. Because of that we cannot rely upon traditional methods only. It will affect the economy as well. We have so many festivals as well related to harvesting, cultivation etc. If the climate change, it will affect our entire routine”

In many cases, farmers in these regions are struggling to adapt to the effects of climate change, such as droughts and floods, which can make it difficult to prioritize long-term mitigation efforts. Overall, the perception of farmers towards climate mitigation is complex and can be influenced by a range of factors. However, as awareness of the urgency of the climate crisis grows, it is likely that more farmers will become engaged in efforts to reduce emissions and adopt sustainable practices (Kumar, 2014)

#### **Traditional ways to get rid of insects:**

1. Fire: After the harvesting period, farmers used to burn the residual material. Meanwhile, the insects in the fields got killed before the plantation of the new crop.
2. Shaking the plant: Farmers used to shake their crops in order to get rid of insects.
3. Barriers and Repellents: Barriers and repellents helps in the keeping bugs and insects away from the crop e.g., Barriers helps in preventing the entry of crawling insects in the crop or vegetative land.
4. Crop Rotation: With the method of Crop Rotation, the farmers changed their crops every season or each specific year, this can help or prevent the attack of the bugs and insects that are going to impact the crops at the same time or we can say one another time.
5. Greasing Material: Farmers use the vegetable oil to spray the natural pesticide into the field.

This vegetable oil prevents the hatching of the insect's egg.

#### **Result and Discussion**

The study analyzed various issues related to climate change on agrarian society. The changing climate is adversely affecting the education, health, economy, agricultural productivity, and it influences the effect of organic as well as chemical pesticides. Important policy implications are putting forward after analyzing the field level data. Since most growth issues in developing nations are local in nature, grassroots efforts are crucial to advancing sustainable development. It has been believed that municipal institutions can play a crucial role in fostering socio-political development, economic growth, and environmental protection to achieve sustainable development at the base of the social structure. To promote sustainable development in India, rural government institutions have been given new roles and responsibilities, and flagship rural development projects have also been given an environmental flavour. As a result, it is important to strengthen local institutions' ability to contribute significantly to the cause of sustainable development. Threats from climate change loom big and have the potential to change how development is currently going. It has been predicted that developing nations, including India, are more susceptible to vulnerabilities caused by the environment. Because they are least equipped to deal with climate-related vulnerabilities, impoverished and marginalized groups in developing nations are the ones most affected by climate change.

#### **Conclusion**

The projected effects of climate change could seriously cause damage to the ability of the agricultural sectors to feed the globe and significantly complicate efforts to end hunger, malnutrition, and poverty. To get the agricultural industries ready for the possibility of quickly changing environmental circumstances, action is urgently required. Reducing agricultural emissions is essential since the agricultural sectors contribute to the buildup of Greenhouse gases in the atmosphere that causes climate change. Global agriculture and food security still confront significant obstacles even in the absence of climate change. Demand for food and other agricultural goods has reached to the such levels which results in the increasing use of chemical fertilizers and pesticides to boost up the growth of crops and that directly or indirectly causes lifestyle diseases to humans that lead to increase in population and

rising incomes in most of the developing world. To solve the challenges of achieving sustainability, ensuring food security, and combating climate change, agriculture production and food systems must undergo considerable adjustment. Long term food security enhancement and protection as well as considerable climate change and mitigation depend on increasing resource efficiency. Efficiency must be considered in concert at all scales and from the environmental, economic, and social perspectives due to the high risk from the effects of the climate change.

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