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# Climate Change's Effect On Kerala's Agriculture Sector

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**ABSTRACT**

The world's shifting climate is one of the most significant environmental issues facing the planet. The average temperature of the earth's surface has risen by 0.6°C since the late 1800s, and it is predicted to climb by an additional 1.4 to 5.8°C by 2100. This is concerning. Even if the minimal expected increase materializes, it will surpass any trend spanning a century in the previous 10,000 years. The sea level has risen by 10 to 20 cm on average over the 20th century, and by 2100, it is predicted to have risen by an additional 9 to 88 cm. "There is new and stronger evidence that the majority of the warming over the last 50 years is mainly due to human activities," the Intergovernmental Panel on Climate Change's Third Assessment Report (TAR), released in 2001, said. Global warming, acid rain, ozone layer depletion, nuclear accidents, the Holocaust, and other occurrences are all closely related to climate change. This essay will examine how Kerala's agriculture industry is affected by climate change. The variables influencing climate change are another main emphasis of the research.

**Key words:** Climate change, Adaptation, Agriculture, Global warming, Acid Rain

## I INTRODUCTION

Climate change is now threatened by the temperature increase, which is now unavoidable. Given the dire circumstances, the majority of nations have ratified the United Nations Framework Convention on Climate Change (UNFCCC) in order to discuss ways to mitigate global warming. Adopted in May 1992, the UNFCCC went into effect on March 21, 1994, and India is a party to it. Stabilizing the amount of greenhouse gases in the atmosphere to a level that would avoid harmful anthropogenic (human activity) interaction with the climate system is the aim of the UNFCCC convention.

The treaty requires the many nations to safeguard the climate system based on equity, in line with their individual capacities and shared but distinct duties. In 1997, the Kyoto Protocol was agreed by the Convention's parties in acknowledgment of the need to strengthen industrialized economies, especially those in transition, and to cut greenhouse gas emissions by an average of 5.2% below 1990 levels between 2008 and 2012. February 16th, 2005, marked the implementation of the Kyoto Protocol. A party to this Protocol is India.

The acceptance of several decisions, now known as the Marrakech Accords, was a historic accomplishment of the Eleventh Conference on Parties of the UNFCCC, which took place in Montreal from November 28 to December 9, 2005. The Indian government has begun providing funds for climate change-related projects and planning events such as conferences, seminars, workshops, and awareness campaigns.

Would a developed nation with quantifiable emission limitation and reduction commitments undertake a greenhouse gas reduction project in a developing nation under the Kyoto Protocol's Clean Development Mechanism (CDM)? By encouraging environmentally friendly investment from developed nations, the CDM seeks to help poor nations achieve sustainable development.

252 projects in a variety of areas, including biomass-based cogeneration, energy efficiency, municipal solid waste, renewable energy sources like wind, small hydro projects, etc., have been approved by the National CDM Authority as of March 10, 2006. Under numerous climate change projects, the Indian government is taking into account a number of factors, including research, education, public awareness, extreme climate events, sea level rise, forestry infrastructure, agriculture, and water.

Because of a natural cycle, the earth's climate is dynamic and constantly shifting. These days, the globe is more concerned about the changes that are happening more quickly as a result of human activity. The two types of causes of climate change are those caused by man-made factors and those caused by natural processes. In the majority of our cities, the main means of moving people and commodities are cars, buses, and trucks. These are mostly powered by fossil fuels like gasoline and diesel. Plastics are one of the many waste products we produce, and they harm the environment for many years. In our work in workplaces and schools, we utilize a great deal of paper. enormous tracts of forest must be cleared for the construction of homes since timber is required in such enormous amounts. There are an increasing number of mouths to feed due to population growth. High-yielding crop varieties are being cultivated to maximize the agricultural production from a given area of land because there is a limited amount of land accessible for agriculture. These high-yielding crop varieties, however, demand a lot of fertilizer, and more fertilizer equals more nitrous oxide emissions from the fertilizer factory as well as the field where it is applied. Additionally, fertilizer runoff into water bodies causes pollution.

## II STATEMENT OF THE RESEARCH PROBLEM

In terms of cropping patterns and land use, Kerala's agricultural system is different from that of other states. The state's main crop production systems are homesteads, food crops, and plantation and income crops. Five agro-ecological zones and 23 highly variable agro-ecological units with notable yield gaps were identified as a consequence of the examination of Kerala's agro-ecology, which was mainly focused on climate, geomorphology, land use, and soil variability. Numerous elements, such as location-specific technology, irrigation infrastructure, natural resource endowments like rainfall, and the economic environment with its price signals and institutions, all have an impact on the supply-side performance of agriculture in these agro-ecological units. Agriculture output is often seasonal and cyclical, and it is susceptible to natural occurrences like diseases, pests, and drought. Aside from technology, all of these elements make agricultural production risky and heavily reliant on the presence of strong input supplies, adequate infrastructure, and price signals. Kerala's agriculture has experienced substantial structural changes, as evidenced by the drop in its GSDP share, which shows that the state is moving away from an agrarian economy and toward one that is dominated by the service sector. Agriculture's share of the state's gross state product (GSDP) has been gradually decreasing, falling from 39.99 percent in 1980–1981 to 8.95 percent in 2012–2013. On all time scales, the earth's climate is inherently fluctuating. However, the equilibrium between incoming and outgoing energy, which establishes the Earth's energy balance, controls its long-term condition and average temperature.

Climate change can be caused by any factor that results in a persistent shift in the amount of energy entering the system or leaving it. These elements are called "climate forcers" because they are not part of the climate system; this suggests that they push or force the climate to a new long-term state, which may be warmer or cooler depending on the cause of the shift. Not all of the elements that have influenced the earth's climate in the distant past are pertinent to the current climate shift, and different components function on different time

frames. Thus, this paper's main contention is to examine how Kerala's agriculture industry is affected by climate change.

## III OBJECTIVES OF THE STUDY

1. To analyse the impact of climate change on agriculture sector in Kerala.
2. To evaluate the factors affecting climate change.

## IV METHODOLOGY

The present study on "climate change's effect on Kerala's agriculture sector'' is based on secondary data compiled from various published and unpublished sources.

## V REVIEW OF LITERATURE

**Reena Joshi and Verma (2013),** regional climates are impacted by global climate change, which has a significant effect on the region's water supplies, agriculture, and economy. Understanding the causes of climate change in a place is therefore important.

**Upayana and Vijay (2013)** describe an effort to acquaint readers with the different effects that climate change has had on agriculture. And the key to effective adaptation is developing the capacity to recognize change and assess potential changes.

**Jamie and Sardar's (2007)** Global climate change is too complicated, too unpredictable, or too big of an issue, in research of the economic effects of the phenomenon and potential adaptations.

## VI RESULTS

A long-term change in weather statistics, including averages, is referred to as climate change. It might manifest, for instance, as a shift in climatic normal, or the anticipated average values of temperature and precipitation, for a specific location and season, from one decade to the next. Long-term changes in weather patterns, as evidenced by variations in temperature, precipitation, winds, and other variables, are referred to as climate change. Both average conditions and variability, such as extreme events, can alter as a result of climate change.

### Natural Reasons

Natural elements outside of the climate system, like variations in solar output, volcanic activity, and the Earth's orbit around the Sun, can have an impact on the climate. Among them, variations in solar radiation and volcanic activity are the two elements that are pertinent to the timelines of current climate change. These elements mostly affect the amount of incoming energy in terms of the Earth's energy balance. The climatic consequences of volcanic eruptions are comparatively short-lived and episodic. Climate patterns throughout the past century have been influenced by changes in solar irradiance, but since the Industrial Revolution, the impact of greenhouse gas additions to the atmosphere has been around ten times greater than that of changes in the Sun's output.

### Human Factors

Human actions like burning fossil fuels and converting land for agriculture and forestry can also contribute to climate change. These human impacts on the climate system have grown significantly since the start of the Industrial Revolution. These activities alter the ground surface, release different compounds into the atmosphere, and have other effects on the ecosystem. These in turn can affect the quantity of energy that enters the system and the amount that leaves, which can cause the climate to warm or cool. The main greenhouse gas produced by burning fossil fuels is carbon dioxide. Emissions of carbon dioxide and other greenhouse gases have been the main drivers of the warming impact caused by human activity since the Industrial Revolution.

The natural greenhouse effect has been intensified as a result of the accumulation of greenhouse gases in the atmosphere. Because continuous emissions of greenhouse gases have the potential to warm the globe to levels never seen in human civilization, this human-induced intensification of the greenhouse effect is concerning. Wide-ranging and/or uncertain environmental, societal, and economic repercussions could result from such climate change.

**Short-lived and long-lived climate forcers**

Both short-term and long-term climate factors

The primary source of climate change brought on by humans is carbon dioxide. Because it is a highly long-lived gas and has been released in large quantities by the burning of fossil fuels, it continues to have an impact on the climate system for as long as it is present in the atmosphere. However, other compounds that also operate as climate forcers are released by industrial operations, the burning of fossil fuels, and activities related to forestry and agriculture. Like carbon dioxide, some, like nitrous oxide, are long-lived greenhouse gases that cause long-term climate change. Due to their rapid removal from the atmosphere, some chemicals have shorter atmospheric lifetimes. Their impact on the climate system is therefore likewise transient. A large portion of the current climate forcing from anthropogenic chemicals can be attributed to these transient climate forcers together. "Positive climate forcers" are those that have a warming influence on the climate, while "negative climate forcers" have a cooling effect.

Short-lived climate forcers continue to exert a climate forcing effect if their atmospheric levels are continuously restored by continuous emissions. However, lowering emissions will immediately result in lower concentrations of these compounds in the atmosphere. After carbon dioxide, a variety of short-lived climate factors contribute to global warming and collectively are the most significant human-induced contributors to the greenhouse effect. Among these are the greenhouse gases methane and tropospheric ozone, as well as black carbon, a tiny solid particle created when carbon-based fuels (such as coal, oil, and wood) burn incompletely.

Sulfate aerosols and other short-lived climate forcers have the ability to chill the climate. Along with carbon dioxide, sulfur dioxide is released into the atmosphere after the burning of fossil fuels. It then combines with water vapor to form small droplets called aerosols, which reflect sunlight. Sulfate aerosols do not have the same long-term impact as greenhouse gases since they are only in the atmosphere for a few days before being washed off by what is known as acid rain. However, part of the warming caused by other substances has been counterbalanced by the cooling caused by sulfate aerosols in the atmosphere. That is, if there had not been high concentrations of sulfate aerosols in the atmosphere, the warming we have already witnessed would have been substantially greater.

Since crop development is primarily influenced by temperature, precipitation, and solar radiation, agriculture has always been heavily reliant on climatic patterns and fluctuations. Humans have been altering the climate since the industrial revolution by releasing large quantities of greenhouse gases into the atmosphere, which raises global temperatures, modifies hydrological regimes, and increases climatic unpredictability. It is anticipated that agricultural conditions, the food supply, and food security would all be significantly impacted by climate change.

All things considered, climate change may have a range of effects on agriculture. Among these effects are those that are biophysical, ecological, and economic, such as:

- A move toward the poles in agricultural zones and climate
- Modifications to production schedules brought on by warmer temperatures
- A rise in agricultural output as a result of atmospheric carbon dioxide levels
- Modifications to precipitation patterns
- The destitute and landless are more vulnerable.

However, one-third of climate change is thought to be caused by agriculture alone. It is well acknowledged that agricultural activities, primarily deforestation, the use of fertilizers derived from fossil fuels, and the burning of biomass, account for around 25% of carbon dioxide emissions. While 70% of the nitrous oxides in the atmosphere are caused by conventional tillage and fertilizer use, the majority of the methane is produced by domestic ruminants, forest fires, wetland rice farming, and waste products. The Intergovernmental Panel on Climate Change states that land use, agriculture, and fossil fuels have been the three primary drivers of the rise in greenhouse gases over the previous 250 years.

Due in part to population growth, scientific advancements in agriculture over the past few centuries have enabled a significant increase in agricultural yields. It has been stated that intensive agriculture practices negatively impact the environment.

One of the primary drivers of gas emissions and the effects of land usage is now the agricultural sector. For instance, there are various ways that agriculture uses land to boost greenhouse gas emissions:

• Methane emissions from rice farming and cattle enteric fermentation; • CO2 emissions associated with deforestation in temperate regions: where forests and woodlands are destroyed to create farmland and pastures.

• Emissions of nitrous oxide from fertilizer use

These agricultural practices collectively account for almost all land-use-related carbon dioxide emissions, around 80% of nitrous oxide emissions, and 54% of methane emissions. Regional carbon reuptake is also impacted by deforestation for land cleansing, which may raise concentrations of CO2, the main greenhouse gas. 30% of the Earth's geographical area, or 70% of all agricultural land, is used for cattle production worldwide.

**Impacts of Climate Change on Agriculture**

Direct impacts:

- Increased variability in weather
- Extreme conditions
- Sea level rise & surge – inundating & ruining coastal agricultural lands
- $CO_2$ fertilization

Indirect impacts:

- Changing crop-weed competition dynamics
- Range changes of pests & pathogens
- Expanded range predicted for many pathogens
- Less-cold winters allow increase in pests
- Different range changes between pests & pathogens and natural controls
- Decreased biodiversity in natural ecosystems

**Solutions**

- Increasing carbon sequestration through land management
- Agroforestry
- Rotations with cover crops, green manure

- Conservation tillage
  - Could reduce global $CO_2$ emissions by 5-15%
- Organic farming (but limited benefits)
  - Enhances carbon storage in soil

**Other solutions and adaptations**

- Changing inputs
- Biofuels
- Reduce agrochemicals
  (e.g., N fertilizers)
- Reduce pumped irrigation and mechanical power
- Reduce high energy-consuming feedstuffs for livestock

## CONCLUSION

Numerous variables, including air pollution, excessive water consumption, deforestation, sewage, non-biodegradable materials like polythene, and more, are contributing to climate change. Global temperatures have been gradually increasing since the turn of the 20th century. However, it is still unclear how much of this global warming is caused by human actions like burning fossil fuels and forest destruction, and how much is a result of natural factors. Kerala has begun to observe the effects of climate change on several geographical areas and economic sectors. These are really important. Appropriate adaptation and mitigation strategies must be implemented to address these issues.

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