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A study on the impact of climate change on Agro productivity in Karnataka

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Abstract:

Karnataka is an agrarian economy and majority of the working population are dependent on agriculture. Life on earth is sustained by several climatic factors, which have undergone with numerous transformations. Climate change refers to changes in factors such as Temperature, Humidity, Air pressure, Wind, Clouds and Precipitation patterns over time. The imprints of climate change are observed clearly across the world. Changes in Climatic factors that occur over a longer period of time, is termed as 'Climate Change'. Extreme weather conditions such as floods, droughts, heat waves, raising temperatures, landslides, hail storms and many of these natural disasters are outcome of the same climatic changes. There are many "Natural" and "human-induced" factors that contribute to the climate change. Over time, enhanced greenhouse effects have resulted in "global warming" - an increase in the earth's average temperature. Global warming is one type of climatic change and it drives other changes in the climate, such as changes in the rainfall patterns and the frequency and distribution of weather events such as droughts, storms, floods and heat waves etc. Although the terms climate change and global warming are often used interchangeably, climate change is a broader term that incorporates both global warming and other observed changes in climate. These climatic changes have brought disastrous effects on agriculture. This is the primary effect. Therefore, due to climatic change, when agricultural sector is affected, even industrial sector, dependent on it, also gets affected. Many scientists argue that the impacts of climate change will be devastating for natural and human systems and that climate change poses an existential threat to human civilisation. This paper highlights the importance and impact of such Climate Changes on Agro Based industrial development in Karnataka from past two decades.

Key words: Climatic changes, Agricultural output, Industrial development, Global warming.

Introduction:

The term 'Climate Change', was proposed by the World Meteorological Organization (WMO) in 1966 to encompass all forms of climatic variability on time-scales longer than 10 years, regardless of cause. The effects of climate fluctuations, especially during crucial stages, will have major impact on the yield of agriculture. It is observed that severe climate changes leading to natural and manmade calamities, like floods, droughts, cyclones, hailstorms, landslides etc. affects the agriculture productivity most unfavorably. Even small temperature increase in arid and semi-arid tropical regions could well lower agricultural productivity. The water scarcity will dramatically increase vulnerability and threaten food supplies. In addition, vector-borne diseases such as malaria and dengue fever and water-borne diseases such as cholera could increase. The increase in vulnerabilities would further result in higher susceptibility of poor and other communities which contribute to one fourth and half of the population of most Indian cities. Climate variations have started to degrade India's economic growth rates, adversely affecting the livelihood of millions of people. Keeping in mind its importance for the survival of civilizations, it is indispensable for the agriculture institutions, government and the policy makers to address these issues and strengthen the agriculture sector maintaining its growth as it is an increasingly important strategic, economic and political concern.

Agricultural crops are extremely susceptible to fluctuations in climatic factors such as rainfall and temperature conditions, especially their seasonality and unpredictability. Climate change has significant economic effects on agriculture including changes in farm productivity, cropping pattern, profitability, price, supply and trade. The variability of climate poses major challenge for the large peasantry and small farmers of the country. Agricultural productivity is sensitive to global climatic changes in the country and therefore, its impacts needs to be evaluated. As climate affects many aspects of plant and animal biology, the effects of climatic elements and their extremes will significantly alter the productivity in agriculture. The disturbance to 'eco-systemic balance' may generate negative impacts on the socio economic conditions of many societies, specially for the developing countries, where agriculture contributes significantly to the country's Gross Domestic Product (GDP).

Despite technological advances, such as improved varieties, genetically modified organisms, and irrigation systems, weather is still a key factor in agricultural productivity. The effect of climate on agriculture is related to variabilities in local climates rather than in global climate patterns. A 2008 study published in Science suggested that, due to climate change, "southern Africa could lose more than 30% of its main crop, maize, by 2030. In South Asia losses of many regional staples, such as rice, millet and maize could top 10%".

The Intergovernmental Panel on Climate Change (IPCC) has produced several reports that have assessed the scientific literature on climate change. The IPCC Third Assessment Report, published in 2001, concluded that the poorest countries would be hardest hit, with reductions in crop yields in most tropical and sub-tropical regions due to decreased water availability, and new or changed insect pest incidence. Many rainfed crops are near their maximum temperature tolerance, so that yields are likely to fall sharply

for even small climate changes; falls in agricultural productivity of up to 30% over the 21st century is projected. Marine life and the fishing industry will also be severely affected in some places.

In the report published in 2014 the Intergovernmental Panel on Climate Change says that the world may reach "a threshold of global warming beyond which current agricultural practices can no longer support large human civilizations." by the middle of the 21st century. In 2019 it published reports in which it says that millions already suffer from food insecurity due to climate change and predicted decline in global crop production of 2% - 6% by decade. Climate change induced by increasing greenhouse gases is likely to affect crops differently from region to region.

Karnataka State has sub-humid to humid climate on the West Coast and Western Ghats region and semiarid to arid climate in central, southern and northern districts of plateau region. The year is divided into four seasons viz., Winter (January-February), Summer (March to May); South-West Monsoon (June to September) and North East monsoon (October to December). The state receives a normal annual rainfall of about 1150 mm, in which about 73 % of the rainfall occurs during the South West Monsoon season, 15 % during North East Monsoon and 10% during Pre-Monsoon season. There is a substantially high variability in spatial and temporal distribution of the rainfall over the state. Taluk wise normal rainfall of the state vary from 477 mm to 4747 mm. Rainfall contribution is very high, from Southwest Monsoon Season (around 80% of the state rainfall), it is seen that the annual rainfall is lowest (477mm) in the eastern parts of Chitradurga district and highest (4747mm) over the Western Ghats. More than 2/3rd of the state receives less than 750 mm of rainfall. Taluk wise Annual variability (CV) of the rainfall ranges from 16 to 40%. The atmospheric temperature in the state ranges from 23°C to 43°C in summer and 9°C to 27 °C in winter.

Karnataka State is divided into four regions namely: (a) South Interior Karnataka (b) North Interior Karnataka (c) Malnad and (d) Coastal Karnataka. These are further divided into ten Agro-Climatic Zones by University of Agricultural Sciences, Bengaluru under NARP program. Among these Agro-Climatic Zones, there are five dry zones with relatively low rainfall and more erratic distribution. Similarly, along the eastern part of the hill zones to the west of the dry zones with relatively more rainfall with less erratic distribution and a small portion in the north-eastern part of the State were also identified as transitional zones. The hill and Coastal belts cover the two distinct zones. Karnataka is one of the 16 states in India, which is frequently affected by drought and flood simultaneously in different regions.

According to the Intergovernmental Panel on Climate Change (IPCC)'s Fifth Assessment Report, climate change is already negatively affecting global crop production and is expected to continue doing so unless adaptive measures are taken (IPCC, 2014a). After reviewing many studies covering a large number of crops and regions, the IPCC concluded that the negative effects of climate change on yields have been more common than the positive ones, the latter occurring mainly in high-latitude regions (IPCC, 2014a). The IPCC also concluded that, without adaptation, local temperature increases of 2°C or more will likely cause decreases in the yields of major crops in tropical and temperate regions (IPCC, 2014a).

Statement of the problem:

Climate change may adversely affect the water balance leading to serious water scarcity and management problems, thus shrinking agricultural land use and the potential effects on agricultural production. Agriculture is one of the predominant sectors of Karnataka's economy, which accounts for 10% per cent of the GDP. This sector supplies nearly half of the total employment and export earnings. Over 80 per cent of the rural population directly or indirectly depends on agriculture as a major source of income and livelihood.

In recent years, Karnataka's agriculture has suffered serious setbacks from abnormal weather conditions. Climate change and its variability could be the main reasons for the sustained yield fluctuations and almost every crop sub-sector has experienced sluggish growth due to it, especially due to rainfall decline. Positive growth in one year has been followed by decline in the succeeding year. Consequently, major crop production declined drastically that resulted in a sudden decrease in export-earnings, deficiency in food supply and a massive increase in import of foodstuffs. Climate change research in Asia reveals the possibility of adverse future impacts on agriculture of the country. Therefore, it is necessary to study the impact of climate change on agricultural production with special reference to Karnataka.

Review of Literature:

IPCC Fourth assessment report, Climate Change 2007, on the other hand forecasts that there is a 2 to 5 percent chance of decline in the wheat and rice production in India for a rise in temperature between 0.5 and 1.5 degree Celsius. Further, studies have found that between 2010 and 2035, there is a possibility of decline in the productivity by 4.5 to 9 percent. This fall in the productive levels can amount to 1.5 percent of the Gross Domestic Product of the country. Indian agriculture sustains the livelihood of approximately 55 percent of the total population of the country and therefore, it seems obvious that any small variation in the climate will influence agriculture productivity and thus, the food security of several people dependent on agriculture for livelihood. Due to increasing carbon dioxide emissions and release of Greenhouse Gases, there is a high possibility of the occurrence of global warming in the near future. Weather shocks and changes in precipitation will have an impact on productivity resulting in alteration in prices, demand and supply, profitability and trade. These changes can become a major challenge and hinder the capability of the country to feed its multiplying population.

S.A Khan et al., (2009). Kumar and Parikh (2001) predicted that climate change would have a huge impact on the production of rice and wheat by 2060, which would in turn affect the livelihood and food security one million people in India. Excessive rainfall and drastic weather changes have adversely affected the production of Jowar, impacting the life of those dependent on farm in Karnataka.

Cline (2008) looked at how climate change might affect agricultural productivity in the 2080s. His study assumes that no efforts are made to reduce anthropogenic greenhouse gas emissions, leading to global warming of 3.3°C above the pre-industrial level. He concluded that global agricultural productivity could be negatively affected by climate change, with the worst effects in developing countries.

Lobell *et al.* (2008a) assessed how climate change might affect 12 food-insecure regions in 2030. The purpose of their analysis was to assess where adaptation measures to climate change should be prioritized. They found that without sufficient adaptation measures, South Asia and South Africa would likely suffer negative impacts on several crops which are important to large food insecure human populations.

Battisti and Naylor (2009) looked at how increased seasonal temperatures might affect agricultural productivity. Projections by the IPCC suggest that with climate change, high seasonal temperatures will become widespread, with the likelihood of extreme temperatures increasing through the second half of the 21st century. Battisti and Naylor (2009) concluded that such changes could have very serious effects on agriculture, particularly in the tropics. They suggest that major, near-term, investments in adaptation measures could reduce these risks.

Aggarwal (2009), there can be a 3 to 7% decrease in the productivity of wheat, soybean, mustard, groundnut and potato due to a 1 degree Celsius rise in the temperature. Consequently, a predicted rise in the temperature between 2.5 degree and 4.9 degree Celsius by the year 2099 would lead to 10 to 40 percent destruction of these crops.

Objectives of the Study:

- To study the present climate changes and the fluctuations, annual and seasonal variability of rainfall and temperature conditions
- To study the area, production and yield changes within the study area, in respect of the principal crops like Paddy, Ragi and Coconut
- To study the impact of climate changes on the broad Agro-Climatic Zones
- To study the response of varied farming communities to perceived threats of climate change and its consequences.

Analysis of the research:

Productivity in the agricultural sector in the recent past shows decreasing trend. This is evident in both plantation and the non-plantation sector, despite the fact that initially yields were rising since the introduction of Green Revolution technology. The low level of productivity of plantations is evident from their low yield. Rice is cultivated in Karnataka under rain-fed as well as irrigated conditions. Paddy is cultivated under different water supply systems. Nearly, 38 per cent of the paddy acreage is cultivated under rain-fed conditions, 33 under major irrigation works and the balance 29 per cent m minor irrigation schemes.

The intensity of cultivation (cropping intensity) of Paddy and other seasonal crops, during the respective seasons is primarily a function of water availability, although institutional and management factors may have a role to play. Normally, except for areas with adequate irrigated water supplies, the percentage of cultivable land that is cultivated in any one season, is influenced by the distribution of rainfall. Agricultural production will be mostly affected by the severity and pace of climate change, not so much by gradual trends in climate. Rapid climate change, however, could harm agriculture, especially those that are already suffering from rather poor soil and climate conditions, because there is less time for optimum natural selection and adaption. Changes in crop phenology provide important evidence of the response to recent regional climate change. Phenology is the study of natural phenomena that recur periodically, and how these phenomena relate to climate and seasonal changes.

Impact of Climatic Change:

Climatic change could affect agriculture in several ways:

- Productivity, in terms of quantity and quality of crops.
- Agricultural practices, through changes of water use (irrigation) and agricultural inputs such as herbicides, insecticides and fertilizers.
- Environmental effects, in relation of frequency and intensity of soil drainage (leading to nitrogen leaching), soil erosion, reduction of crop diversity
- Rural space, through the loss and gain of cultivated lands, land speculation, land renunciation, and hydraulic amenities.
- Adaptation, organisms may become more or less competitive, as well as humans may develop urgency to develop more competitive organisms, such as flood resistant or salt resistant varieties of rice.

Conclusion:

Climate change is very likely to affect food security at the global, regional, and local level. Climate change can disrupt food availability, reduce access to food and affect food quality. For example, projected increases in temperatures, changes in precipitation patterns, changes in extreme weather events and reductions in water availability may all result in reduced agricultural productivity. Increases in the frequency and severity extreme weather events can also interrupt food delivery and resulting spikes in food prices after extreme events are expected to be more frequent in the future. Increasing temperatures can contribute to spoilage and contamination. The impact of unprecedented rainfall was such that it changed the geomorphology, course of river sand drainage of the region. The entire fertile top soil has been washed away and trees were uprooted adversely affecting the local ecology. The distribution of the rainfall has been skewed and the excessive rainfall has been confined to parts of North Interior Karnataka, Malnad and Coastal region. Stabilization and growth of agricultural production results in rapid advancement in output and employment in agro-industries. Further, the cumulative effect of agricultural growth and growth of

agro-industries creates greater opportunities for industrial growth as well as integration of the different sectors of the economy.

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