A Research on the Effects of Pollution and Climate Change on Agriculture Production

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Abstract

A key factor in the economic growth of emerging nations is agriculture. Since most people in developing nations depend on agriculture for their livelihood, agriculture plays a critical role in economic growth. The effects of climate change on agricultural productivity and food security have been widely studied recently using crop simulation models. The impact of air pollution on various agricultural products is now the subject of much investigation. The findings unequivocally demonstrate that air pollution are seriously endangering food security by reducing agricultural food crop yields, decreasing soil fertility, raising soil alkalinity, and negatively affecting the nutritional content and safety of these products. This review examines how various air contaminants affect agricultural productivity. The percentage of agricultural land declines as a result of urbanisation and the unchecked growth of population. According to current estimates from a variety of sources, the emission and impact of gases such as O3 CO2 as an air pollutant is responsible for anywhere from 5% to 12% of the yield losses worldwide in staple crops, which include wheat, rice, maize, and soybean.

Keywords: -Air Pollution, Agricultural Crops, Soil Fertility, Pollution's Effects, Gases

I. INTRODUCTION

India's economy heavily relies on agriculture and agricultural production methods. As to the 2011 census, over 54.6% of the population works in agriculture and related fields, accounting for 17% of the nation's Gross Value Added. The national survey states that India's total rice output increased from 53.6 million tonnes in 1980–81 to 105.5 million tonnes in 2014–15.

Between 1980 and 2014, productivity increased as well, rising from 1336 kg/hectare to 2391 kg/hectare. Located in the country's center-east, Chhattisgarh is the ninth-largest state in India, with an area of 135,192 km2 (52,198 sq mi) and housing 25.5 million people (Census 2011). Counted among the state's primary economic occupations is agriculture. The state's total sown area is 5.788 million hectares, but its net sown area is estimated by the government to be 4.828 million hectares.[1-4]

Another term for Chhattisgarh is the "rice bowl" of central India. The principal crops are oilseeds like soybeans, sunflowers, and groundnuts (also known as peanuts), along with rice, maize, kodo-kutki, and other tiny millets and pulses. The majority of Chhattisgarh was still a monocrop belt in the mid-

1990s. There was only double cropping in one-fourth to one-fifth of the seeded area.[5–6] Approximately 96% of the State's total rice-growing acreage is situated in the low- and very-productivity areas. The State's average production is quite low. The State's biennial average rice production is 1,106 kg/ha, which is much below than the national average. Table 1 lists the area, output, and productivity of rice under various productivity categories in Chhattisgarh for the biennial that ended in 2000–2001.

SL	Productivity Groups	Number of Districts	Area (Million Ha.)	Percent of State's Rice Area	Production in Lakh Tonnes	Percent of State's Rice Production	Productivity (Kg/Ha.)
1	High Productivity (> 2,500 Kg/Ha)	2	0.90	2.4	2.20	5.3	2,700
2	Medium Productivity (2,000-2,500 Kg/Ha)	3	1.50	4.0	3.00	7.2	2,200
3	Medium-Low Productivity (1,500-2,000 Kg/Ha)	1	1.38	3.7	2.31	5.6	1,674
4	Low Productivity (1,000-1,500 Kg/Ha)	9	19.38	51.7	23.11	55.8	1,192
5	Very-Low Productivity (< 1,000 Kg/Ha)	6	16.70	44.6	16.02	38.6	959
6	TOTAL	16	37.46	100.0%	41.44	100.0%	1,106

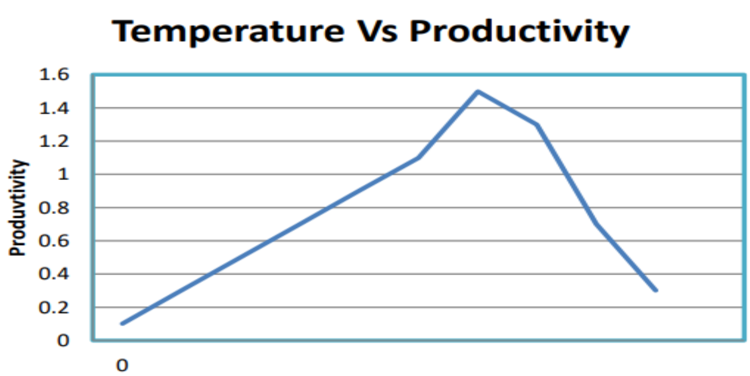
Crop production will be affected if the climate ultimately changes during the next decades. There is a lot of interest in predicting how agricultural production will be affected by the anticipated climate change. However, human management will have a much greater impact on output levels and harvested area than climatic change. As is well known, India has a significant position in terms of the total area under cultivation among the nations that cultivate paddy worldwide.

II. Research on Pollution and Climate Change's Effects on Crop Productivity

This research examined and evaluated the impact of climate change on agricultural productivity. Based on a 1.0 °C increase in temperature and a 50 ppm increase in ambient CO_2 concentration, prospective rice yields are expected to grow by a few percent on average in 2020. In the warmer places, there is the least rise. A good deal of ambiguity surrounds the results due to the lack of reliable climate change projections. However, the lacklustre reaction suggests that the difficulty of creating new irrigated tropical rice varieties with noticeably better yield potential is unaffected by climate change per se. The efficient use of irrigation water will become crucial for the production of rice.

1. A rise in the temperature: The concentrations of greenhouse gases are rising significantly due to human gas emissions, and global circulation models predict that this rise in gas concentrations will raise the average global temperature. The Intergovernmental Panel on Climate Change (IPCC) projects that, under its business-as-usual scenario, global mean temperatures would increase by 0.3°C per decade over the course of the next century, with an uncertainty of 0.2 to 0.5%. Therefore, by 2025, global mean temperatures should be 1°C higher than they are now, and by 2100, they should be 3°C higher.[7].

The yields of rice have been impacted by rising temperatures. As the temperature rises, rice yields will also grow. Both kinds of paddy fields—irrigated and rainfed—experience this problem. Every 1°C increase in temperature will result in a drop of about 11.1% in the national rice output from irrigated paddy fields and a 14.4% decrease from rainfed paddy fields. At high temperatures, the productivity of wheat and other crop species significantly decreases. According to Mackill et al. (1982; Zheng and Mackill, 1982), heat stress during anthesis in rice inhibits anther dehiscence and pollen discharge, which lowers pollination and grain counts.[8-9] Higher nighttime temperatures in 2003 caused respiration to outpace photosynthesis, resulting in a decrease in net gain. 10% less rice was produced for every degree Celsius that the lowest temperature rose.[10]



2. An increase in the amount of CO2: We already know that carbon dioxide (CO2) is a necessary gas for photosynthesis, but according to recent estimates, CO2 levels will rise from their current 371 ppm to 397–416 ppm by the 2010s, and then by 605–755 ppm by the 2070s. By 2020 and 2050, respectively, they predicted area-averaged yearly mean warming of between 1 and 1.4◦C and 2.23 to 2.87◦C. In contrast, a greater rise in temperature is anticipated during the Rabi crop growth season than the Kharif crop growing season. While rising CO2 concentrations would boost plant net primary output, other factors such as shifting climatic patterns and related disturbance regimes might result in either higher or lower net ecosystem productivity. For the majority of predicted temperature rises, potential yields are predicted to decline in many tropical and subtropical locations. The effects of elevated CO2 should be taken into account in relation to, among other things: (A) changes in air temperature, especially at night due to an increase in CO2 and other trace gases; (B) the need for more agricultural resources, such as fertilisers; and (C) the survival and dispersal of pest populations, which creates a new equilibrium between crops and pests. [11–13]

3. Impact of Ozone: - As a result of fast population growth, industrialization, and intensive global food production, Ozone concentrations are increasing in emerging nations like China and India. Because ground-level ozone affects the yield and quality of significant staple crops, it poses a danger to the production of food. The most ozone-sensitive crops are soybeans, wheat, and rice; maize and barley are just somewhat vulnerable. Ozone concentrations at ground level are created over time by a sequence of intricate chemical processes. To create more resistant cultivars, ozone sensitivity testing should be a part of crop breeding initiatives. Future crop management plans must to take into account techniques for lowering crop ozone absorption, such stopping watering during ozone occurrences. hazardous amounts of ozone are found in polluted air, downwind of NO2 sources, and particularly under high sunshine. Ozone is hazardous to people, animals, and plants. Plants absorb ozone from the environment via deposition, and it also forms NO2 when it reacts with nitric oxide (NO). To increase our capacity to measure and predict the impacts of ozone on agricultural production and quality, further research is required. In particular, field-based trials are needed to improve our understanding of how ozone affects crop quality, including protein yield and content, sugar content, and mineral content, in order to evaluate how ozone affects nutritional value.[14–16]

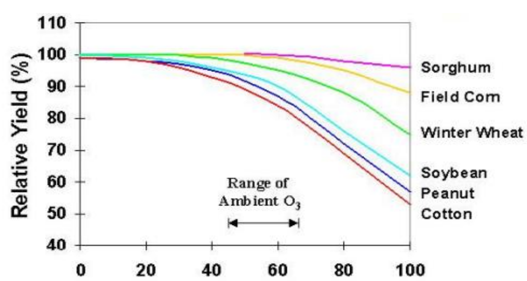


Fig 1: Effect of O_3 on Yield of Crop

4. Black Carbon: Black carbon (BC) is a portion of tiny particulate matter (PM) with an aerodynamic diameter of less than 2.5 µm. Black carbon is made up of many connected forms of pure carbon. It is created when biomass, biofuel, and fossil fuels are not completely burned. It is released into the atmosphere as both naturally occurring and man-made soot. Black carbon heats the atmosphere because it absorbs solar radiation. It lowers the albedo of snow and ice by darkening their surface as it falls to Earth as precipitation.[17]

Black carbon (BC) has the potential to have a major impact on nutrient retention and to be an important player in many different biogeochemical processes in soils, particularly nitrogen cycling. The direct effects of BC on radiation and crop development are simple to understand: as an absorbing aerosol, BC decreases the amount of direct and diffuse light that plants can receive, which should, in theory, result in reduced yields.[18–20]

IV. CONCLUSION

Climate change is gradually starting to impact agriculture, which is India's most vital economic driver. Rain-dependent agricultural systems are suffering greatly when the monsoon season turns into erratic and insufficient rainfall. One state where the effect is easy to discern is central India's Chhattisgarh. In Chattisgarh, agriculture and related industries provide income for around 80% of the rural population and account for 16% of the state's GDP. Out of this 80 percent, over half, or 46 percent, are small-scale farmers who primarily depend on monocrop agriculture based on the natural monsoon, which puts them at the most risk of the effects of climate change. This scoping research also shown how low market pricing have contributed to the loss of traditional knowledge practices in agriculture, such as raising indigenous cow breeds as hardiness practices in times of crop failure and cultivating millets like Kodo-Kutki and Ragi.

Climate-flexible agriculture is being considered globally as a potential solution that integrates catastrophe risk reduction strategies with sustainable agricultural methods. This integrated approach relies on site-specific evaluations to determine appropriate agricultural production technology and methods. It acknowledges that local contexts, capabilities, and the social, economic, and environmental conditions will influence the choices available.

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