Available online at **www.joac.info**

ISSN: 2278-1862

Journal of Applicable Chemistry

2020, 9 (6): 885-890

(International Peer Reviewed Journal)

Review

Study on Climate Change, Pollution and their effect on Agriculture Production

Prasanna Kumar Sharma*

Amity School of Applied Sciences, Amity University Chhattisgarh, **INDIA**

Email: pksharma@rpr.amity.edu, sharma.prasanna@rediffmail.com

Accepted on 2nd November, 2020

ABSTRACT

Agriculture plays a vital role in economic development of developing countries. The role of agriculture in economic development is crucial because a majority of the population of developing countries make their living from agriculture. In recent times, the crop simulation models have been used extensively to study the impact of climate change on agricultural production and food security. Many researchers are now focusing their study on effect of air pollution on different agriculture products. The results clearly shows that air pollutants are damaging the yield of agricultural food crops, soil fertility, increase soil alkalinity, their nutritional quality and safety, and imposing a major risk to food security. Effect of different air pollutants on agricultural production are studied in this review. The uncontrolled increasing population and hence urbanization decreases the proportion of agricultural land. Current estimates from different sources indicates that emission and effect of gases like O_3 CO_2 as air pollutant are causing between 5% and 12% yield losses globally in staple crops, which include wheat, rice, maize, soybean.

Keywords: Air Pollutants, Agriculture Crops, Soil Fertility, Effect of pollutants, Gases.

INTRODUCTION

Agriculture and practices of agricultural productions plays a fundamental role in India`s economy. According to the census 2011, about 54.6 per cent of the population is engaged in agriculture and associated activities, and it contributes 17 per cent to the country`s Gross Value Added. As per the national survey, total rice production in India enlarged from 53.6million tones in 1980-81 to 105.5 million tons in the year 2014-15. Productivity also enhanced from 1336 kg ha^{-1} to 2391 kg ha^{-1} during 1980-2014. Chhattisgarh located in the centre-east of the country and the ninth-largest state in India, with an area of 135,192 km^2 (52,198 sq mi) with a population of 25.5 million (Census 2011). Agriculture is counted as the chief economic occupation of the state. According to a government estimate, net sown area of the state is 4.828 million hectares and the gross sown area is 5.788 million hectares [1-4].

Chhattisgarh is also called the "rice bowl" of central India. The main crops are rice, maize, kodo-*kutki* and other small millets and pulses, oilseeds, such as groundnuts (peanuts), soybeans and sunflowers, are also grown. In the mid-1990s, most of Chhattisgarh was still a monocrop belt. Only one-fourth to one-fifth of the sown area was double-cropped [5, 6]. About 96% of total area under rice in the State is concentrated in low and very low productivity groups of the State. Average productivity of the State is very poor. Biennial average productivity of rice in the State is 1,106 kg ha^{-1} which is very much below the national average. Area, production and productivity of rice under different productivity groups in Chhattisgarh during biennial ending 2000-2001 are given in table 1.

Table 1. Productivity of rice under different groups in Chhattisgarh during 2000-2001

S. No.	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 $Ha.^{-1}$)
1.	High Productivity (> 2,500 Kg Ha^{-1})	-	-	-	-	-	-
2.	Medium Productivity (> 2,000-2,500 Kg Ha^{-1})	-	-	-	-	-	-
3.	Medium-Low Productivity (> 1,500-2,000 Kg Ha^{-1})	1	01.38	03.7	2.31	05.6	1,674
4.	Low Productivity (1,000-1,500 Kg Ha^{-1})	9	19.38	51.7	23.11	55.8	1,192
5.	Very-Low Productivity (< 1,000 Kg Ha^{-1})	6	16.70	44.6	16.02	38.6	959
	TOTAL	**16**	**37.46**	**100.0%**	**41.44**	**100.0%**	**1,106**

An ultimate change of the climate in the next decades will have an impact on productivity of crops. Predicting effects of coming expected climate change on crop yields receives much attention. Yet, yield levels and area harvested will be affected much more by our management than by climate change. As we know that among the paddy growing countries in the world, India occupies an important place in terms of total area under cultivation.

Study of Climate Change and pollutants on Crop Productivity: The effect of climate change on the crop yield was investigated and reviewed in this paper. For 2020, with a rise in ambient CO_2 concentration of 50 ppm and in temperature of 1.0°C, potential rice yields will increase on average by a few percent. The increase in the warmest regions is smallest. Lack of accurate predictions of climate change contributes to a fair amount of uncertainty of the conclusions. Yet, the small response implies that climate change in itself is not an issue in relation to the challenge of developing new varieties of irrigated tropical rice with a significantly higher yield potential. Optimal use of irrigation water will become an important issue for rice production.

Increase in temperature: Gaseous emissions from anthropogenic activities are substantially increasing the concentrations of greenhouse gases, and as per Global circulation models these increased concentrations of gases will increase average world temperature. Under the business-as-usual scenario of the Intergovernmental Panel on Climate Change (IPCC), global mean temperatures will rise 0.3°C per decade during the next century with an uncertainty of 0.2 to 0.5%. Thus global mean temperatures should be 1°C above the present values by 2025 and 3°C above the present value by 2100 [7].

Temperature rise has been affecting the rice yields. The rice yields will decrease together with temperature rise. This matter occurs to both of the types of paddy field, irrigated and rainfed. The nationally rice yield for irrigated paddy field will decrease for about 11.1% while rainfed paddy field is for about 14.4% for every 1°C of temperature rise. Productivity of wheat and other crop species falls markedly at high temperatures. In rice, heat stress at anthesis prevents anther dehiscence and pollen shed, to reduce pollination and grain numbers (Mackill *et al.*, 1982; Zheng and Mackill, 1982) [8, 9].

Due to higher night temperatures during 2003, the respiration over ruled the photosynthesis causing reduction in net gain. Rice grain yield declined 10% for each 1ºC increase in minimum temperature [10].

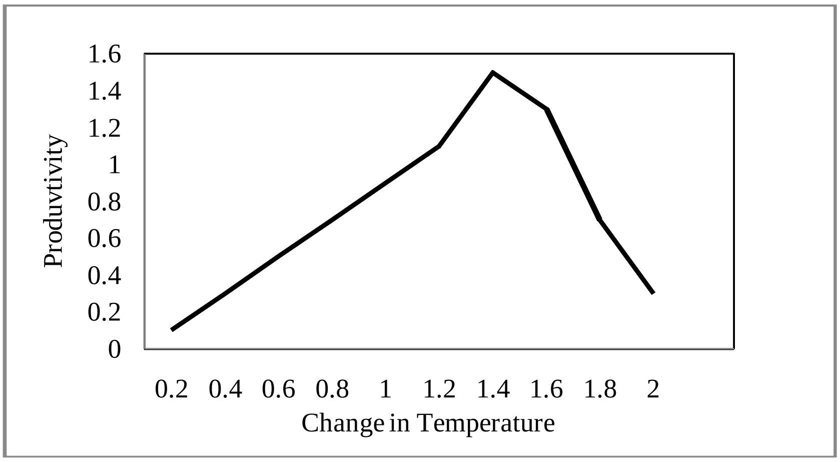

Figure 1. Change in Temperature and Productivity

Increase in CO_2 concentration: We know that CO_2 is essential gas for photosynthesis, but recently, it is estimated that CO_2 level will increase to 397–416 ppm by 2010s from the present CO_2 level of 371 ppm and this would further increase by 605–755 by 2070s. They projected between 1 to 1.4°C and 2.23 to 2.87°C area-averaged annual mean warming by 2020 and 2050 respectively. Comparatively, increase in temperature is projected to be more in *rabi* than in *kharif* crop growing season. Although, the effect of increasing CO_2 concentrations will increase the net primary productivity of plants, but climate changes, and the changes in disturbance regimes associated with them, may lead either to increased or decreased net ecosystem productivity. In many tropical and subtropical regions, potential yields are projected to decrease for most projected increases in temperature. The impacts of elevated CO_2 should be considered among others, in the context of, (A) changes in air temperature, particularly nocturnal temperature due to increase in CO_2 and other trace gases and changes in moisture availability and their effect on vegetative versus reproductive growth; (B) need for more farm resources (e.g. fertilizers) and (C) survival and distribution of pest populations, thus developing a new equilibrium between crops and pests [11-13].

Effect of Ozone: Ozone concentrations are rising in developing areas of the world (e.g. India and China) due to rapid increases in population and industrialization, aggressive global food production. Ground-level ozone is a threat to food production as it has a negative impact on the yield and quality of important staple crops. Soybean, wheat and rice are the most sensitive to ozone, with maize and barley being moderately sensitive. Ground-level ozone is formed by a series of complex chemical reactions which take time to build up ozone concentrations. Crop breeding programmes should include a test for ozone sensitivity to develop more resistant varieties. Future crop management strategies should consider ways of reducing ozone uptake into crops, for example by withholding irrigation during ozone episodes. Ozone is toxic to plants, animals and humans; toxic concentrations are found in polluted air, downwind of NO_2 sources and especially in strong sunlight. Ozone is removed from the atmosphere by deposition to plants, and also by reaction with nitric oxide (NO) to form NO_2. Further research is needed to improve our ability to quantify and forecast effects of ozone on crop yield and quality. Field-based experiments are required specially to enhance our knowledge on the impacts of ozone on crop quality, such as protein yield and content, sugar and mineral content, to assess the impacts of ozone on nutritive value [14-16].

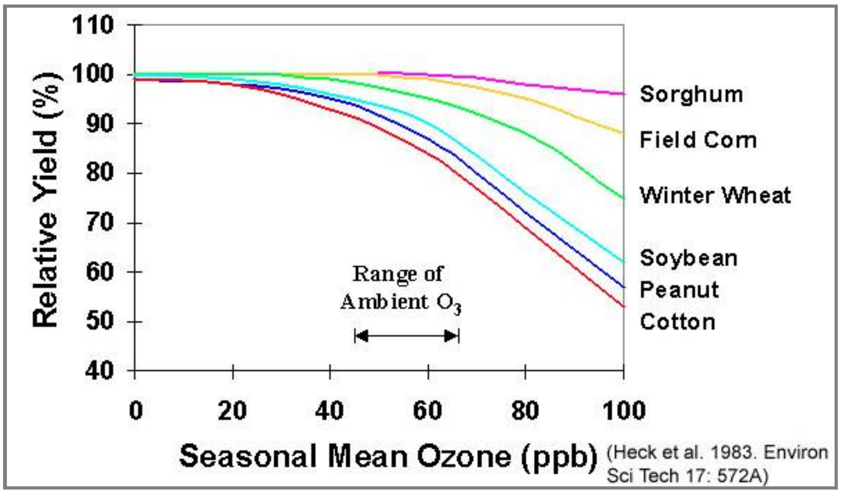

Figure 2. Effect of O_3 on yield of corps.

Black Carbon: Chemically, black carbon (BC) is a component of fine particulate matter (PM ≤ 2.5 µm in aerodynamic diameter). Black carbon consists of pure carbon in several linked forms. It is formed through the incomplete combustion of fossil fuels, biofuel, and biomass, and is emitted in both anthropogenic and naturally occurring soot. Because black carbon absorbs solar energy, it warms the atmosphere. When it falls to earth with precipitation, it darkens the surface of snow and ice, reducing their albedo [17].

Black Carbon (BC) may significantly affect nutrient retention and play a key role in a wide range of biogeochemical processes in soils, especially for nutrient cycling. The direct impacts of BC on radiation and crop growth are straightforward: BC is an absorbing aerosol that reduces both direct and diffuse light available to plants and all else equal should therefore lower yield [18-20]

APPLICATION

The main production of Indian state like Chhattisgarh, is production of rice. The economy of state is mainly depending upon the gross productivity of rice. As climate change directly affecting the productivity of rice, so each state and the climate of state needed specific adaptation strategies like essential modification in seeding of rice, provide supplement irrigation, alternate wetting and drying, modified rice intensification. These studies directly help to increase the reproductivity of traditional rice of Chhattisgarh which are capable to fight against climate change. This analysis will help for the planning of future rice productivity scheme and modification in existing technology and practices in India.

CONCLUSION

Climate change is slowly beginning to affect the most important component in the economic steering wheel of India – agriculture. Rain dependent agriculture systems are taking a hard hit with monsoons becoming unpredictable and rain inadequate. Chhattisgarh in central India is among the states where the impact is simple to see. Agriculture and its associated sectors provide income to around 80 percent of the rural population in Chhattisgarh and compose 16 percent of state's Gross Domestic Product (GDP). Of this 80 percent, more than half, around 46 percent, are minor farmers and a majority of them rely on natural monsoon-based mono-crop agriculture, making them most exposed to the impact of climate change. This scoping study also highlighted how traditional knowledge practices in agriculture like growing millets like Kodo-Kutki and Ragi and rearing indigenous cow breed as toughness practices in times of crop failure are now lost due to poor market prices. The world over climate-flexible agriculture is being looked at as a solution that combines sustainable agriculture practices with measures for disaster risk reduction. It is an incorporated approach based on site-specific assessments to identify suitable agricultural production technologies and practices, recognizing that options will be shaped by local contexts and capacities and by the social, economic, and environmental situation

REFERENCES

[1]. Official site of the Ministry of Statistics and Programme Implementation, India, Archived from *the original* on 3 December, **2013**, Retrieved 20 July, **2013**.

[2]. Chhattisgarh Profile (PDF). Census of India. Archived (PDF) from the original on 18 April, **2018**. Retrieved 27 May, **2016**.

[3]. State of Literacy (PDF), Census of India. p. 114, Archived from the original (PDF) on 7 May, **2012**.

[4]. Agriculture in Chhattisgarh, Archived from the original on 21 July **2011**, Retrieved 22 July, **2011**.

[5]. P. Oudhia, Positive (inhibitory) allelopathic effects of some obnoxious weeds on germination and seedling vigor of pigeon pea (*Cajanus cajan L.*), *Research on Crops*. **2000**, 1(1), 116–118.

[6]. P. Oudhia, Stimulatory allelopathic effects of *Ageratum conyzoides L.* on soybean, *Agric. Sci. Digest*, **2001**, 21(1), 55–56.

[7]. J. T. Houghton, B. A. Collander, J. J. Ephraums, (eds.). *Climate Change -The IPCC Scientific Assessment*, Cambridge University Press, Cambridge, 1990, 135 p.

[8]. D. J. Mackill, W. R. Coffman, L. J. Rutger, Pollen shedding and combining ability for high temperature tolerance in rice, *Crop Sci.*, **1982**, 20, 730-733.

[9]. D. R. Kothawale, K. Rupa Kumar, Tropospheric temperature variation over India and links with the Indian summer monsoon, **1971-2000**, Mausam, 53.

[10]. Shaobing Peng, Jianliang Huang, John E. Sheehy, Rebecca C. Laza, Romeo M. Visperas, Xuhua Zhong, Grace S. Centeno, Gurdev S. Khush and Kenneth G. Cassman, Rice yields decline with higher night temperature from global warming. Proceedings of National Academy of Sciences of United States of America, **2004**.

[11]. M. Lal, K. K. Singh, G. Srinivasan, L. S. Rathore, A. S. Saseendran, Vulnerability of rice and wheat yields in NW-India to future change in climate, *Agric. Forest Meteorolog*, **1998**, 89, 101–114.

[12]. M. Lal, K. K.Singh, G. Srinivasan, L. S. Rathore, D. Naidu, C. N. Tripathi, Growth and yield response of soybean in Madhya Pradesh, India to climate variability and change, *Agr. and Forest Meteorology*, **1999**, 93, 53–70.

[13]. K. Rupakumar, R. G. Ashrit, Regional Aspects of global climate change simulations: Validation and assessment of climate response over Indian monsoon region to transient increase of greenhouse gases and sulphate aerosoles, *Mausam*, **2001**, 52, 1, 229–244.

[14]. www.ozone-net.org.uk.

[15]. J. Fishman, J. K. Creilson, P. A. Parker, E. A. Ainsworth, G. G. Vining, J. Szarka, F. L. Booker, X. Xu, An investigation of widespread ozone damage to the soybean crop in the upper Midwest determined from ground-based and satellite measurements, *Atmospheric Environment*, **2010**, 44, 2248-2256.

[16]. F. L. Booker, R. Muntifering, M. McGrath, K. O. Burkey, D. Decoteau, E. L. Fiscus, W. Manning, S. Krupa, A. Chappelka, D. A. Grantz, The ozone component of global change: Potential effects on agricultural and horticultural plant yield, product quality and interactions with invasive species, *Journal of Integrative Plant Biology*, **2009**, 51, 337-351.

[17]. S. C. Anenberg, J. Schwartz, D. Shindell, M. Amann, G. Faluvegi, Z. Klimont, G. Janssens-Maenhout, L. Pozzoli, R. Van Dingenen, E. Vignati, L. Emberson, N. Z. Muller, J. J. West, M. Williams, V. Demkine, W. K. Hicks, J. Kuylenstierna, F. Raes, V. Ramanathan, Global air

quality and health co-benefits of mitigating near-term climate change through methane and black carbon emission controls, *Environ Health Perspect*, **2012**, 120 (6), 831–839.

[18]. L. M. Mercado, Impact of changes in diffuse radiation on the global land carbon sink, *Nature* **2009**, 458(7241), 1014–1017.

[19]. Asha Verma, Agriculture is taking the hardest hit of climate change in Chhattisgarh, Mongabay Series: *Environment and Elections*, 23 April, **2019**.

[20]. T. C. Bond, Bounding the role of black carbon in the climate system: A scientific assessment, *J Geophys Res Atmos*, **2013**, 118(11), 5380–5552.