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Impact of Air Pollution on the Productivity of Rice with Special Reference to Raipur District of Chhattisgarh

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ABSTRACT: A study using open-top chambers ventilated with ambient or charcoal filtered air in the vicinity of Raipur district of Chhattisgarh in Rajasthan demonstrated reductions of 42% and 37% in the grain yield of two cultivars of rice (*Oryza sativa* L.). This yield reduction was primarily due to the reduction in mean panicle number per plant, although significant effects of filtration on 1000 grain weight and the number of filled grains per panicle were also detected. The 6-h daily mean O₃ concentrations were only 10–20 nl litre⁻¹ during the monsoon season, but increased to 30–55 nl litre⁻¹ later in the growing season, while the mean NO₂ concentration during the experiment was 12 nl litre⁻¹. On the basis of experience in other places, the reductions in yield in the present investigation are substantially greater than might be predicted. The reasons for this discrepancy together with the implications for effects on rice yield in Raipur district of Chhattisgarh in Rajasthan is revealed.

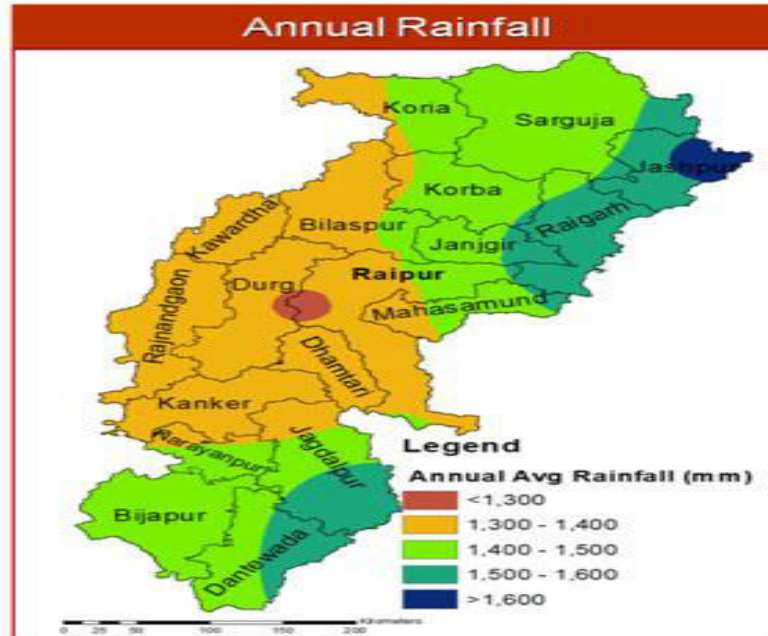
Presently, air pollution becomes apocalypse for living beings (human, animals and crops). Air pollutants have the potential to reduce both nutritional quality and yield of crops. Raipur district of Chhattisgarh in Rajasthan was selected to assess the impacts of particulate matter deposition on rice crops at a different distance within 1-8 km radius. The results indicated that aerial deposition on crop canopy was ranged from 0.54 to 1.44 mg/cm² in rice crop at vegetative stage and flowering stage deposition was 1.08 to 2.20 mg/cm² to 0.64 to 2.07 mg/cm² in rice. We found that effect of air pollutants on rice crops was maximum at 2-6 km area on the leeward side. The particulate matter deposition reduced the photosynthetic rate which leads to decrease in leaf area and transpiration rate in rice crops and finally had an adverse impact on rice crop yield. This leads to significant reduction in rice grain yield of 8.46% and 9.52% in rice and 11.08% and 12.24% reduction of straw yield in rice.

KEYWORDS: air pollution, rice, Chhattisgarh, Raipur, impact, *Oryza sativa*

I. INTRODUCTION

In India, air pollution is cutting yields of rice crops in half, according to a study. Researchers mostly attribute this to ground level ozone (O₃), a short-lived pollutant that exists in the atmosphere for weeks or months. O₃ gas is formed when nitrogen oxides, which are produced in combustion processes and mostly released from power stations and vehicles, react with air pollutants, including vehicle exhaust, oil refining, petrochemicals and bushfires during sunlight. Researchers found that yields were up to 36% lower than what they would have been without air pollution trends. In this loss was the equivalent of more than 24 million tonnes of rice in India, worth around \$5 billion. A main precursor of O₃ is vehicle pollution in cities, and levels of O₃ are much greater in hot sunny conditions. As the earth's temperature increases with global warming, this will further increase levels of O₃. The polluting industries are often moved out of cities into areas surrounded by agriculture, where emissions are closer to crops and therefore have a more immediate impact on yields.[1]

Fig. 1: Annual rainfall variability in Chhattisgarh state



In case of Raipur district of Chhattisgarh in Rajasthan, these high levels of pollutants – which, often surpass the safe limit – don’t look set to change any time soon. An increasing proportion of agricultural land is being affected by air pollution in Raipur district of Chhattisgarh in Rajasthan as they expand and agriculture land use is interspersed with built-up areas and industry.[26]

Ozone has a damaging impact on plants. When O₃ is absorbed via the pores on the leaf surface, it forms free radicals that attack cell membranes. This causes yellowing, cell injury, irregular spots, bronzing and reddening that affects the flowering and growth of crops, reducing their yield. It is thought to be the most important air pollutant affecting crop growth and productivity.[2]

“Current estimates suggest that O₃ is causing between 5% and 12% yield losses globally in staple crops, which rice in case of Raipur district of Chhattisgarh in Rajasthan. The findings in Raipur district of Chhattisgarh in Rajasthan showed that air pollution reduces the yield of rice by up to many million tonnes a year. The highest production losses caused in Raipur district of Chhattisgarh in Rajasthan for rice, are in India. The most affected areas are also often at risk of high losses from pests and diseases and heat stress.[25]

“The highest ozone levels are in many areas of Raipur district of Chhattisgarh in Rajasthan. Ozone concentrations are increasing rapidly in these regions – for example, basic Rajasthan and are predicted to continue to increase over the coming decades.[3]

This is detrimental to food security in Raipur district of Chhattisgarh in Rajasthan since it would directly impact farmers who do subsistence farming, growing enough food to feed themselves and their families.[24]



Air pollution in Raipur , Chhattisgarh

“Crop losses due to ozone may reduce the likelihood to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture by 2030. “It is anticipated that considerably greater production of grain crops such as rice would be affected. Our research shows that the total ozone effects on rice yield were twice as high in Raipur district of Chhattisgarh in Rajasthan, as compared to Uttar Pradesh areas where more yield is urgently needed to feed the growing population.”[4]

The future damage to food security caused by O₃ depends on how emission reduction is implemented in future decades. Research has found that Raipur district of Chhattisgarh in Rajasthan ozone levels have increased rapidly since the 19th century, although peak concentrations recorded in 2003 and 2006 were around half that of levels recorded in 1976.[23]

“Cause for concern is that in many parts of Rajasthan, where O₃ impacts are high in important agricultural regions such as the Indo-Gangetic plain of UP emissions look to continue for the next few decades, which may exacerbate already high O₃ levels and associated yield losses. [5]

“Ozone pollution is a global problem requiring investments from industry and Rajasthan governments. “Further Indian agreements on reducing ozone pollution are urgently needed, however, this is a long-term goal which will take time to be implemented.”Researchers are also looking at short-term solutions, including breeding new varieties of crop that are more resilient to ozone; better timing of irrigation, which has been found to promote ozone uptake; and the development of non-toxic agrichemicals, as toxic agrichemicals generate pollution. They say most crop breeding programmes have been targeted at increasing or maintaining the yield rather than increasing stability of yield under stress. Researchers and farmers can also work together to avoid high levels of O₃. [22]

II. OBSERVATIONS

“Under certain conditions such as warm, sunny, weather, ozone episodes can occur, with ozone concentrations in the air peaking for several days at a time. It may be possible for researchers to forecast when an ozone episode may be about to occur and advise farmers to reduce irrigation during this time.”Another short-term option, , is to routinely screen rice varieties that are going to be grown in polluted areas for air pollution resistance, alongside other tests for tolerance to drought or salinity, enabling resistant varieties to be developed basically in Raipur district of Chhattisgarh in Rajasthan.[6,21]



Super rice developed in Raipur , Chhattisgarh

“Local farmers who are able to select their own seed may be already selecting those that are resistant to air pollution, but this won’t be the case for the increasing proportion of farmers that are dependent on large-scale seed suppliers. In Raipur district of Chhattisgarh in Rajasthan some farmers are finding they are unable to save their seeds and plant the varieties they want, due to their contracts with agribusiness. Hence there needs to be more field research to help quantify the impacts of air pollution on crop yield and quality – but says it won’t be easy. “We need to know more about how it affects different types of crops basically varieties of rice and farming practices, and the implications for different groups of people, in terms of food security.”[7]

“A first step is to have a more formal recognition of the threat that air pollution poses to rice yield, and potentially to nutritional value and quality. As a largely invisible threat, this is challenging.”[20]

Approximately many acres of land devoted to rice production in Raipur of Chhattisgarh also produce three to four tons of rice straw per acre that remain standing in the field after the grain has been harvested. Historically, much of this residue was disposed of by open field burning. Many crops like rice benefit from burning because it is an efficient, effective, and inexpensive method to remove crop residue and is also an effective means of controlling disease and pest problems. The benefits of rice straw burning include:[19]



Paddy farmers in Chhattisgarh

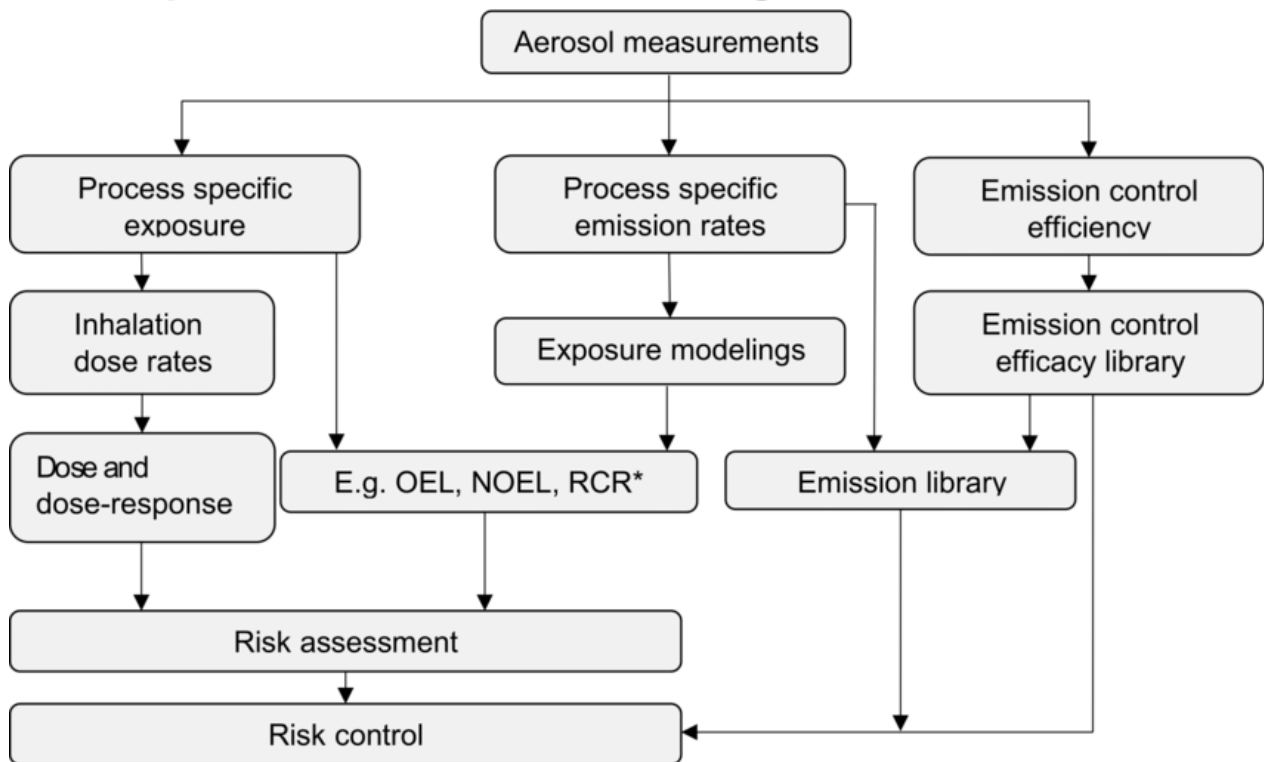
- Control of the fungal diseases of rice, stem rot (*Sclerotium oryzae*) and aggregate sheath spot (*Rhizocronia oryzae sativae*)[8]
- Disposal of rice straw



- Facilitation of soil tillage and seedbed preparation

The disadvantages of agricultural burning are primarily related to air quality and the generation of air pollutants and irritants that can impact human health at high concentrations basically in Raipur district of Chhattisgarh. These pollutants include: Nitrogen oxides (NO_x) – precursor to ozone and particulate matter formation, Volatile Organic Compounds – precursor to ozone and particulate matter formation, Particulates – directly emitted particles and smoke that can include some air toxics, Carbon monoxide (CO) – gas impacting human breathing at high concentration, Sulfur dioxide (SO₂) – precursor to particulate matter formation etc. [9,18]

Core expertise of Air Pollution Management



*OEL: Occupational Exposure Limit; DNEL: Derived No Effect Level; RCR: Risk Characterization Ratio

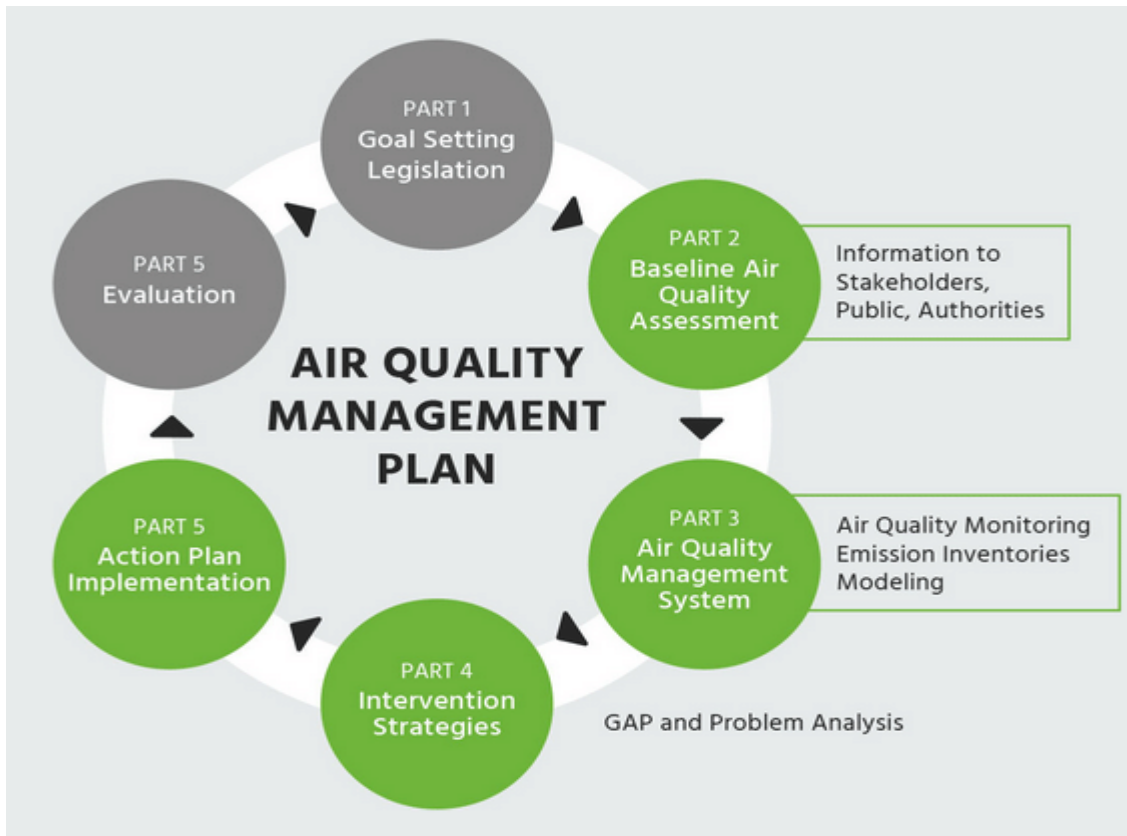
To address concerns about smoke impact on the growing population in the Raipur district of Chhattisgarh Air Pollution Control Council now implements the Smoke Management Program under the Burn Plan (Burn Plan) in strong coordination with the state Air Resources Board. The Burn Plan, is renewed annually, requires that certain air quality and meteorological data be collected and evaluated on a daily basis. Assembled data includes presence of haze, surface and upper air winds, temperature and rainfall. The data are evaluated for anticipated rate of smoke dispersion, and the results dictate how many acres within the Raipur district of Chhattisgarh are allocated for burning on a given day and where those acres may be burned. Because the Burn Plan only allows limited burning during periods of favorable meteorological conditions, it has significantly reduced the effects on the residents living in urban centers throughout the city. Complaints lodged against burning declined substantially under the Burn Plan, and the percentage of smoky hours measured at monitoring stations during the agricultural burn season dropped by 80 percent. The Smoke Management Program would not work without the participation and collaboration of the rice industry and individual rice growers. The rice industry purchased the original network of weather monitoring stations in the Raipur district of Chhattisgarh and continues to maintain and operate that network that provides local air districts and weather information for making air quality decisions (right).[10,17]

III. RESULTS AND DISCUSSION

Another energy and sustainability development that occurred in the Raipur district of Chhattisgarh has been the advancement of renewable energy facilities associated with rice production. The first rice-based energy plant was the in the Raipur district of Chhattisgarh that uses rice hulls from the region as a renewable biomass fuel to produce



electricity. This plant uses about 50 percent of the rice hulls produced by the rice industry to produce an equivalent amount of electricity to that required for all of rice production operations. This form of biomass power is an example of how agriculture can improve its energy footprint by using byproducts for energy production. In the future, there is the potential for additional rice hulls or rice straw to be used for energy production in the Raipur district of Chhattisgarh. [11,16]



Air quality performance has been improved substantially as indicated by reductions in overall emissions for the three major criteria pollutants: NO_x, VOC, and Particulate Matter (PM). This decrease is due to state regulations in Raipur district of Chhattisgarh requiring the reductions in the practice of open-burning of rice straw and from improvement of equipment emissions from fleet turnover to cleaner burning EPA Tier certified engines. In addition, the temporal profile of rice emissions shows that the vast majority of current emissions occurring during spring field preparation and fall harvest are outside of the windows when peak measurements of ozone and particulate matter occur in the Raipur district of Chhattisgarh. [12,15]



Air pollution control device



IV. CONCLUSION

These results indicate that efforts to further reduce in these emissions will not help reduce periods of unhealthy air quality in the Region. Improved rice yield and energy use efficiency are also indicators that the impact of rice on the environment is being reduced. Energy use has been reduced by 22 percent over the last 30 years as indicated by the energy requirements to produce a unit of rice. Since fossil energy use is closely related to emissions, this also indicates a reduced impact on emissions.[27] The rice industry also supports a number of renewable energy projects including a major biomass facility that uses rice hulls for fuel and a number of solar energy projects at rice drying and milling facilities. There is the potential to implement more renewable energy projects in the future including solar projects on rice properties or biomass energy projects utilizing the hull and straw byproducts, giving the rice industry the potential to be net-energy producers in Raipur district of Chhattisgarh, Rajasthan.[13,14]

REFERENCES

- 1) Agrawal, M., Singh, B., Rajput, M., Marshall, F., and Bell, J. N. B. 2003. Effect of air pollution on peri-urban agriculture: a case study. *Environmental Pollution*, 126(3), 323-329.
- 2) Alastuey, A., Querol, X., Chaves, A., Ruiz, C. R., Carratala, A., & Lopez-Soler, A. 1999. Bulk deposition in a rural area located Raipur district of Chhattisgarh, Rajasthan.
- 3) Environmental pollution, 106(3), 359-367. Anda, A., 1986. Effect of cement kiln dust on the radiation balance and yields of plants. *Environmental Pollution Series A, Ecological and Biological*, 40(3), 249-256.
- 4) Ashenden, T. W., and Williams, I. A. D. 1980. Growth reductions in *Lolium multiflorum* Lam. and *Phleum pratense* L. as a result of SO₂ and NO₂ pollution. *Environmental Pollution Series A, Ecological and Biological*, 21(2), 131-139.
- 5) Ashmore, M.R., Marshall, F.M. 1999. Ozone impacts on agriculture: an issue of global concern. *Advances in Botanical Research* 29, 32– 49.
- 6) Chakrabarti, B., Singh, R., Bhatia, A., Singh, S. D., and Singh, B. (2014). Impact of aerial deposition from thermal power plant on growth and yield of rice (*Oryza sativa*) and wheat (*Triticum aestivum*). *The Indian Journal of Agricultural Sciences*, 84(5).
- 7) Darrall, N.M. 1989. The effect of air pollutants on physiological processes in plants. *Plant Cell and Environment* 12, 1–30.
- 8) Jaeger, H.J., Unsworth, M.H., De Temmerman, L., and Mathy, P. (Eds.) 1993. Effects of air pollution on agricultural crops in Europe. *Air Pollution Research Report 46*. Commission of the European Communities, Brussels, Belgium.
- 9) Jackson, M.L. 1973. *Soil Chemical Analysis*, Prentice Hall of India Pvt. Ltd., New Delhi.
- 10) Jacob, M. B., and Hochheiser, S. 1958. Continuous sampling and ultra-microdetermination of nitrogen dioxide in air. *Analytical Chemistry*, 30, 426.
- 11) Kumar, S., Prasad, S., Malav, M. K., and Gupta, N. 2016. Characterization and pretreatment of wheat straw using microwave assisted dilute acid to produce fermentable sugars for hydrogen production. *Green Farming* 7 (1), 95-98.
- 12) Lehnherr, B., Grandjean, A., Machler, F., and Fuhrer, J. 1988. The regulation of photosynthesis in leaves of field grown spring wheat (*Triticum aestivum* L. cv. Albis) at different levels of ozone in ambient air. *Plant Physiology* 88, 1115–1119.
- 13) Marshall, F.M., and TeLintelo, D.T.H. 2001. Pollution Effects: Social and economic implications of urban and peri-urban agriculture in India. *Urban Agriculture Magazine*. NO 5 December 2001.
- 14) Leusden, the Netherlands. Meijstrik, V., 1980. The influence of low SO₂ concentrations on growth reduction of *Nicotiana tabacum* L. cv. Samsun and *Cucumis sativus* L. cv. Unikat. *Environmental Pollution Series A, Ecological and Biological*, 21(1), 73-76.
- 15) Pandey, J., Agrawal, M., Khanam, N., Narayan, D., and Rao, D. N. 1992. Air pollutant concentrations in Raipur district of Chhattisgarh, Rajasthan, India. *Atmospheric Environment. Part B. Urban Atmosphere*, 26(1), 91-98.
- 16) Pask, A. J. D., Pietragalla, J., Mullan, D. M., and Reynolds, M. P. 2012. *Physiological breeding II: a field guide to wheat phenotyping*. CIMMYT.
- 17) Prajapati, S. K., 2012. Ecological effect of airborne particulate matter on plants. *Environmental Skeptics and Critics*, 1(1), 12.
- 18) Prusty, B. A. K., Mishra, P. C., and Azeez, P. A. 2005. Dust accumulation and leaf pigment content in vegetation near the national highway at Raipur district of Chhattisgarh, Rajasthan, India. *Ecotoxicology and Environmental Safety*, 60(2), 228-235.



- 19) Raja, R., Nayak, A. K., Rao, K. S., Puree, C., Shahid, M., Panda, B. B., and Lal, B. 2014. Effect of fly ash deposition on photosynthesis, growth, and yield of rice. *Bulletin of environmental contamination and toxicology*, 93(1), 106-112.
- 20) Ram, L. C., Srivastava, N. K., Jha, S. K., Sinha, A. K., Masto, R. E., and Selvi, V. A. 2007. Management of lignite fly ash for improving soil fertility and crop productivity. *Environmental management*, 40(3), 438-452.
- 21) Saha, D. C., and Padhy, P. K. 2011. Effects of stone crushing industry on *Shorea robusta* and *Madhuca indica* foliage in Lalpahari forest. *Atmospheric Pollution Research*, 2(4), 463-476.
- 22) Sharma, R., Pervez, Y., and Pervez, S. 2005. Seasonal evaluation and spatial variability of suspended particulate matter in the vicinity of a large coal-fired power station in India—a case study. *Environmental Monitoring and Assessment*, 102(1-3), 1-13.
- 23) Stone, R., 1992. NRC faults science behind ozone regs. *Science*, 255, 26. Subbiah, B.V., and Asija, G.L. 1956. A rapid procedure for determination of available nitrogen in soil. *Curr. Sci.* 25, 259-260.
- 24) TeLintelo, D. J. H., Marshall, F., and Bhupal, D. 2002. Urban food: the role of urban and peri-urban agriculture in India: a case study of Raipur district of Chhattisgarh, Rajasthan. *Food, Nutrition and Agriculture*, FAO Bulletin.
- 25) Walkley, A., and Black, I.A. 1934. An examination of a Degtjareff method for determining soil organic matter, and proposed modification of the chromic acid titration method. *Soil Sci.* 37, 29- 38.
- 26) West, P. W., and Gaeke, G. C. 1956. Fixation of Sulphur Dioxide as Sufitomercurate III and Subsequent Colorimetric Determination. *Analytical Chemistry*, 28, 1816.
- 27) Xie, R., Seip, H. M., Wibetoe, G., Nori, S., and McLeod, C. W. 2006. Heavy coal combustion as the dominant source of particulate pollution in Raipur district of Chhattisgarh, Rajasthan corroborated by high concentrations of arsenic and selenium in PM 10. *Science of the total environment*, 370(2), 409-415.



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