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Overview of impact of climate change on crop production & its mitigation

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Abstract
Consequences of climate change on natural and human systems. Agriculture is one sector, which is immediately affected by climate change. Short or long-term fluctuations in weather patterns-climate variability and climate change can influence crop yields and can force farmers to adopt new agricultural practices. In most tropical and sub-tropical regions potential yields are projected to decrease for most projected increases in temperature. In mid-latitudes, crop models indicate that warming of less than a few °C and the associated increase in CO_2 concentrations will lead to generally positive responses and generally negative responses with greater warming. In tropical agricultural areas, similar assessments indicate that yields of some crops would decrease with even minimal increases in temperature because they are near their maximum temperature tolerance. Yields of both *kharif* and *rabi* crops decreased as temperature increased; a 2°C increase resulted in 15-17 per cent decrease in the grain yield of both crops, but beyond that the decrease was very high in wheat. Most of the simulation studies have shown a decrease in the duration and yield of crops as temperature increased in different parts of India.

Keywords: Crop production, climate change and mitigation

Introduction
Wheat, rice and maize are staple crops and feeding the growing human population depends on their continued success. Climate change poses a range of effects: the increased concentration of carbon dioxide can increase crop yields, while changes in temperature and rainfall will have a variety of effects, with very high temperatures and drought both adversely affecting yield. Taking all factors into account, AR5 concluded that a change of 2°C or more above late-20th-century levels will adversely affect yields and food production. The agricultural sector represents 35% of India's Gross National Product (GNP) and as such plays a crucial role in the country's development. Food grain production quadrupled during the post-independence era; this growth is projected to continue. The impact of climate change on agriculture could result in problems with food security and may threaten the livelihood activities upon which much of the population depends. Climate change can affect crop yields (both positively and negatively), as well as the types of crops that can be grown in certain areas, by impacting agricultural inputs such as water for irrigation, amounts of solar radiation that affect plant growth,as well as the prevalence of pests.

Impacts Overall
- Negative impact on rice, wheat and horticulture. Neutral or positive on some crops like soybean, groundnut, coconut, potato in some zones
- Impact on livestock and fisheries still to be better understood
- Short term impacts in 10-15 years (in the range of 4-6%) but long term impacts could be as high as 25% (with business as usual scenario)
- Short term impacts can be addressed through better deployment of existing technologies backed by few policy initiatives while long term impacts require strategic research on a long term and a major policy changes.
- Global climate change may raise production of potato in Punjab, Haryana and western and central UP by 3.46 to 7.11% in A1b 2030 scenario, but in rest of India particularly West Bengal and plateau region potato production may decline by 4 to 16%.
- Such climatic changes are likely to result in increased soybean yields by 8-13%. Effect of climate change on groundnut is likely to be variable with yields varying between -5 and +7% as compared to current yields.

- Possibly some improvement in yields of chickpea, rabi maize, sorghum and millets; and coconut in west coast.
- Less loss in potato, mustard and vegetables in north-western India due to reduced frost damage.
- A 1ºC increase in temperature may reduce yields of wheat, soybean, mustard, groundnut, and potato by 3-7%. Much higher losses at higher temperatures.
- Sorghum, being a C4 plant, does not show any significant response to increase in CO2 and hence the different scenarios do not affect its yield.
- The change in climate may bring about changes in population dynamics, growth and distribution of insects and pests. The predicted changes to agriculture vary greatly by region and crop. Findings for wheat and rice are reported here:

Wheat Production

- The study found that increases in temperature (by about 2ºC) reduced potential grain yields in most places. Regions with higher potential productivity (such as northern India) were relatively less impacted by climate change than areas with lower potential productivity (the reduction in yields was much smaller);
- Climate change is also predicted to lead to boundary changes in areas suitable for growing certain crops.
- Reductions in yields as a result of climate change are predicted to be more pronounced for rain fed crops (as opposed to irrigated crops) and under limited water supply situations because there are no coping mechanisms for rainfall variability.
- The difference in yield is influenced by baseline climate. In sub tropical environments the decrease in potential wheat yields ranged from 1.5 to 5.8%, while in tropical areas the decrease was relatively higher, suggesting that warmer regions can expect greater crop losses.

Rice Production

- Overall, temperature increases are predicted to reduce rice yields. An increase of 2-4ºC is predicted to result in a reduction in yields.
- Eastern regions are predicted to be most impacted by increased temperatures and decreased radiation, resulting in relatively fewer grains and shorter grain filling durations.
- By contrast, potential reductions in yields due to increased temperatures in Northern India are predicted to be offset by higher radiation, lessening the impacts of climate change.
- Although additional CO2 can benefit crops, this effect was nullified by an increase of temperature.

Strategies for Climate Change Adaptation

The Paris Agreement is an historic achievement that builds on more than two decades of progress in negotiations on climate change. It shows the firm commitment of countries to work together to limit global temperature rise, foster climate resilience, and align global financial flows towards low-emission, climate-resilient development. After a three-year effort since adoption of the Paris Agreement, Parties are expected, at COP 24 in December 2018, to adopt the outcomes of the Paris Agreement work programme, detailing the modalities, procedures and guidelines needed to give full effect to the Agreement. Parties are also committed to increasing the level of ambition described in their nationally determined contributions. This is crucial if we are to reach the Paris goal of limiting temperature rise to well below 2 °C and as close as possible to the safer 1.5 °C target. The concept of climate change adaptation has various definitions. According to IPCC, adaptation is defined as "adjustment in natural and human systems in response to actual or expected climatic stimuli and their effects." UNFCCC defines adaptation as "regulating process of ecological and socioeconomic systems to reduce possible damages from actual and expected climate change, that is, actions taken to help communities and ecosystems cope with changing climate conditions."

In reality, a wide variety of programs for the agricultural sector's adaptation to climate change are in effect depending on the national and/or regional conditions. For Canada, adaptation measures are classified into five programs: research and development (crop development, meteorological and climate information system, resource management innovation), government programs and insurance (agricultural subsidies, private insurance, resource management program), agricultural production techniques (agricultural production, land utilization, irrigation, cultivation time control), and financial management for farm households (crop insurance, crop future trading, income stabilization program, household income) [1]. Korea classifies adaptation measures for the Korean agricultural sector into five categories: technical measures (28 measures), legal and institutional measures, economical measures, public relations and education, assessment (monitoring and vulnerability assessment, 14), totaling 62 detailed measures [2].

The possible interventions to increase the adaptability of crop-livestock systems and mitigation measures to minimize the adverse impacts were studied across different agroecosystems of India. The output of the studies [3] so far indicated that a marginal 1^0C increase in atmospheric temperature along with increase in CO2 concentration would cause very minimal reduction in wheat production in India if simple adaptation strategies like adjustment of planting date and varieties are adopted uniformly.

But in absence of any adaptive mechanism, the yield loss in wheat may go up to 6 million tones. A further rise by 5 0C may cause loss of wheat production up to 27.5 million tones. Similarly, rice yields may decline by 6% for every one degree increase in temperature [4]. In addition to direct effects on crops, climate change is likely to impact natural resources like soil and water.

The impact of rising temperature and CO_2 are also likely to change insect pest dynamics. Dilution of critical nutrients in crop foliage may result in increased herbivory of insects. For example, Tobacco caterpillar (*Spodoptera litura*) consumed 39% more castor foliage under elevated CO2 conditions than controlled treatments [5]. The advancement of breeding season of major Indian carps as early as March has been reported from West Bengal which is extended from 110 to 120 days due to increase in environmental temperature, which stimulates the endocrine glands of fish and helps in the maturation of the gonads.

Managing Weather Risks in Agriculture

A comprehensive strategy of utilization of existing knowledge, strengthening R&D in key areas and evolving a policy frame work that builds on risk management and providing incentives to sustainable use of natural resources will be required for successful adaptation by farm sector to climate. The goal of this strategy is to minimize as risks

associated with farming and enable farms to cope with these risks [6]. Mainstreaming adaptations by considering impacts in all major development initiatives facilitate greater adoption of scientific and economic pricing policies, especially for water, land, energy and other natural resources. Consider financial incentives and package for improved land management and explore CDM benefits for mitigation strategies. Establish a "Green Research Fund" for strengthening research on adaption, mitigation and impact assessment [7].

Adaptations to climate change

- New varieties: drought/ heat resistant
- New farm management practices
- Change in land use
- Watershed management
- Agri-insurance

Adaptation of Indian Agriculture

- Use of bio technology to formulate suitable gene constructs to impart drought resistance and heat and cold tolerance
- Improved crop production techniques to enhance input use efficiency, use of resource conservation technologies, attain higher yields
- Special efforts for coastal, hilly and other critical and fragile areas
- The System of Rice Intensification, known as SRI - is an agro-ecological methodology for increasing the productivity of irrigated rice by changing the management of plants, soil, water and nutrients. SRI originated in Madagascar in the 1980s and is based on the cropping principles of significantly reducing plant population, improving soil conditions and irrigation methods for root and plant development, and improving plant establishment methods.
- The benefits of SRI have been demonstrated in over 45 countries. They include: 50%-100% or more increased yields, up to a 90% reduction in required seed, and up to 50% water savings SRI principles and practices have been adapted for rainfed rice as well as for other crops (such as wheat, sugarcane among others), with yield increases and associated economic benefits.
- Climate change impacts and adaptations to be considered in all planning activities
- Developing research infra-structure for integrated assessment of climate change
- Developing insurance and forecasting system
- Increasing climate literacy among stakeholders of agriculture
- Growing short duration drought tolerant millets and intercropping with pulses, etc.
- Seed treatment: priming.
- Transplanting of seedlings of millets.
- Thinning.
- Mulching.
- Re-sowing, if drought occurs within 15 days after sowing.
- Growing crops for fodder alone
- Insurance is a means of financially managing device for protection against probable hazard and its associated losses.
- Crop insurance is one of the special forms of nonlife insurance.
- There are mainly two forms of crop insurances *viz*. crop-yield insurance and crop revenue insurance. Crop insurance safeguards the farmers to protect the agricultural products from future losses due to the occurrences of disasters. Based on Clarkson *et al*. (2001), there are six requirements that must be met if farmers are to manage risks related to climate extremes, variability and change. These include:
- Awareness that weather and climate extremes, variability and change will impact on farm operations.
- Understanding of weather and climate processes, including the causes of climate variability and change
- Historical knowledge of weather extremes and climate variability for the location of the farm operations
- Analytical tools to describe the weather extremes and climate variability
- Forecasting tools or access to early warning and forecast conditions, to give advance notice of likely extreme events and seasonal anomalies
- Ability to apply the warnings and forecasts in decision making.

Improving Adaptive Capability of Agriculture

The following actions could be helpful in improving the adaptive capability of agriculture:

1. Improved training and general education of populations dependent on agriculture
2. Agricultural research to develop new crop varieties
3. Identification of the present vulnerabilities of agricultural systems
4. Food programs and other social security programs to provide insurance against supply changes
5. Transportation, distribution and market integration to provide the infrastructure to supply food during crop short falls.

Conclusion

It is estimated that India needs 320 MT of food grains by the year 2025. For a country like India, sustainable agricultural development is essential not only to meet the food demands, but also for poverty reduction through economic growth by creating employment opportunities in non-agricultural rural sectors. It is possible that climate change may force the pace of rural-urban migration (rurbanisation) over the next few decades. The ongoing agrarian crisis in rural India could be catalyzed by climate change into a migratory rout, driven by greater monsoon variability, endemic drought, flooding and resource conflict.

References

1. Smit B, Skinner MW. Adaptation options in agriculture to climate change: a typology. Mitigation and Adaptation Strategies for Global Change. 2002; 7:85-114.
2. Kim Chang-gil. Strategies for Implementing Green Growth in Agricultural Sector. In Proceedings in Green Korea 2009 - Green Growth and Cooperation. National Research Council for Economics, Humanities and Social Science, 2009.
3. Agarwal PK. Global Climate change and Indian agriculture; Case studies from ICAR, network project. Indian Council of Agricultural Research, 2009, 148.
4. Saseendran ASK, Singh KK, Rathore LS, Singh SV, Sinha SK. Effects of climate change on rice production in the tropical humid climate of Kerala, India. Climate Change. 2000; 44:495-514.
5. Srinivasa Rao, CH Ravindra Chary G, Venkateswarlu B,

Vittal KPR, Prasad JVNS, Sumanta Kundu *et al*. 2009.
6. Global Climate Change and Indian Agriculture: Future priorities. *In*: Global Climate Change and Indian Agriculture: Case studies from the ICAR Network Project (Ed. Aggarwal, P. K.), ICAR, New Delhi. 146-148
7. Venkateswarlu B, Arun K Shanker. Climate change and agriculture: Adaptation and mitigation strategies. Indian Journal of Agronomy. 2009; 54(2):226-230.