Climate change effect on Indian farmers

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Abstract

Climate change is adversely affecting the agricultural sector in India, adaptation of farmers to rapidly changing climatic conditions, the results of the present study show that farmers' production and rising temperature, erratic and low rainfall in India are consistent with climate data. Indian farmers have often and systematically adopted extensive adaptation measures. Farmers generally adopt interpretive and utilitarian methods, resources and agricultural labor agriculture and cropping practices are affected by climate change rainfall or temperature in Indian land areas. However, as farmers' adaptation measures result from climate change in their production, the study points to the need for scaled-up investment in the Indian agricultural sector in overall and in building the production capacity of farmers. It is necessary to formulate an effective policy to the changing climatic conditions of the farmers and their results.

Keywords: Climate Change, Farmers, Effect and Productivity.

1. Introduction

Over the past three decades, climate change has seen an increase in the average temperature rise and frequency of extreme rainfall events across India. As a result, the yield of major crops varies from year to year. In India, rainfed rice yields are expected to decrease slightly (2.5 percent) in 2050 and 2080, however, irrigated rice yields are expected to increase by 7% in 2050 and 10% in 2080 scenarios. Wheat yields are expected to drop 6 to 25% by 2100, while maize yields will fall by 18 to 23%. Seaweed is expected to benefit from future weather because their production will increase (23-54 percent). The Indian Council of Agricultural Research (ICAR) launched the NICRA Network Project in 2011 to address the impact of climate change. The NICRA project is being chaired by the Secretary of the High-Level Monitoring Committee (HLMC), DARE & DG, ICAR and consists of invited members representing various ministries of the Government of India. The committee also recommends that NICRA take steps to make Indian agriculture more adaptable to climate change. Beyond that, a panel of experts regularly reviews the project and offers advice on many issues. The Indian Council of Agricultural Research then assesses the vulnerability of Indian agriculture to climate change (ICAR). This has been done to 573 rural districts in India (excluding the Union Territories of Andaman and Nicobar Islands, Lakshadweep). According to vulnerability research, 109 out of 573 rural districts (19% of total districts) are classified as "very high risk", while 201 districts are classified as "at-risk".[1]

India follows a climate system and farmers; wherein international agreements must be translated into domestic law in order to be enforceable in the country. that the absence of a time-bound requirement to enforce decisions, such as the 2015 Paris Agreement, has allowed the Indian government to dither in its commitment to mitigating climate change. India's only of facial recognition of climate change is the National Action Plan on Climate Change (NAPCC), 2008, but the authors argue that it lacks specifics on mitigation targets.[2]

The world is progressively transforming the agri-food market system over the rapid rise of farmers' retail chains. However, this transformation in India is slow in both the upstream and downstream of the supply chain. The size of the food retail market in India is estimated to be large, where the share of the agri-food retailer is growing rapidly. On the one hand, there are concerns about its effects on farmers, especially small tenants, on the other hand, if it is considered an effective way to connect farmers with markets.[3] The emission of greenhouse gases (GHGs), which is responsible for global warming, is a matter of concern. For its mitigation it is important to quantify the total emissions of GHGs from various sectors, including farmers, agriculture. Field experiments and validated Info crop model have been used to estimate emissions of methane (CH_4), nitrous oxide (N_2O), and carbon dioxide (CO_2) from rice systems in India. The global warming potential (GWP) of these GHGs was calculated. Annual emissions from farmers' 42.21 million hectares of paddy fields in India were 2.07, 0.19, and 72.90 Tg (1 Tg = 1012 g) of CH_4-C, N_2O-N, and CO_2-C, respectively. The global warming potential of rice paddies is equal to 316.6 and 13.7 Tg of CO2 and CO2, respectively. High emissions of CH4 have been observed in some districts of West Bengal due to relatively high soil organic carbon content, continuous sinking management and large area per district under rice. N2O-N emissions from Andhra Pradesh and northern states have increased due to large paddy area and relatively high N fertilizer use. The eastern and southern parts of the country showed higher GWP, mainly due to higher CH4 and CO2 emissions with larger rice areas per district. The GWP of paddy growing areas across the country equals <1 to 10 Tg CO2 per district. This regional inventory can help identify areas where excessive emissions of greenhouse gases are taking place and incorporate centralized management practices in these areas to reduce emissions.[4]

Under the FASAL scheme, forecasting of area, production and yield is generated based on remote sensing and econometric modelling. The agencies involved in the project are Space Application Centre (SAC), Ahmedabad, Institute of Economic Growth (IEG), New Delhi and India Meteorological Department (IMD). Under the scheme, multi-season forecasts of area and production of specific crops are envisaged at the national / state level. Inputs from remote sensing, weather, and field observations are used to validate forecasts and conclusions for desired range, accuracy, and timeliness. DAC & FW established Mahala Nobis National Crop Forecasting Center (MNCFC) on April 23, 2012, in collaboration with ISRO to implement remote sensing methodology on crop forecasting and drought assessments. These forecasts are used to validate official crop estimates based on the traditional system. Multiple forecasts of 11 major crops such as rice (kharif and rabi), corn (kharif and rabi), maize, bajra, hemp, millet, cotton, sugarcane, groundnut (kharif and rabi), rapeseed and mustard and wheat are at national / state / district level. However, based on technical feasibility and requirements, 11 crops have been converted into paddy (kharif and rabi), corn (rabi), maize (rabi), soybean, hemp, legumes (rabi), cotton, sugarcane and chickpea (rabi). Rapeseed & mustard and wheat. At present, clinical forecasts are being prepared for 8 crops of wheat, rice (kharif and rabi), hemp, sugarcane, cotton, rapeseed / mustard, rabi corn and rabi pulses.[5]

Agricultural development in India should focus on reducing greenhouse gas emissions through measures such as significant reduction in deforestation; Improving forest conservation and management; Effective control of wildfires; Promoting agroforestry for food or energy; Soil carbon sequestration; Restoring land through controlled grazing; Developing strategies to conserve soil and water resources by improving nutrition, improving their quality, availability and utilization efficiency for ruminant livestock. A National Network Project titled "Impact, adaptability and vulnerability to climate change in Indian agriculture" has been launched focusing on the impact of climate change on different sectors of agricultural production.[6] Determining how and where farmers can contribute to feeding the world in ways that organic, conventional or other systems address many sustainable goals moves us beyond both the organic or traditional debate. The identified multiple eco-logical and social benefits justify greater research investment in organic and environmental management systems.[7] Farmers are forced to leave their lands fallow, after harvesting a single crop during the rainy season. Able bodied men are traveling in search of work to the neighbouring districts of Tamil Nadu and to the nearby state of Kerala. Poverty has been forcing children to stop going to school and become child labourers to supplement the income of their families. The health and hygiene situation also has worsened due to the overall poverty and penury, and the villagers become easy prey to the usurers.[8] impact associated with changing climate has increased, particularly for gill disease and Vibrio contamination, but there remains a lot of uncertainty and contradictory impacts and the association with climate change cannot be confirmed.[9]

Interactions between land and atmosphere are complex and have great impact on the evolution of both components. In many studies, for a few decades now, soil moisture has been shown to have a determinant impact on these turbulent exchanges between land and atmosphere. But as experienced in many national centres, replacing the current operational land DA systems, often based on the assimilation of screen-level observations, with modern land DA ingesting spaceborne microwave passive measurements rarely leads to positive results in terms of numerical weather prediction.[10] Climate change will affect all sectors of the economy, and its impacts could jeopardise water, food and energy security. Hydrological responses to climate and land use changes are expected to cause a wide range of environmental impacts, and water is the primary medium through which we experience the effects of climate change. Available projections indicate high variability in such effects, mainly in the risk of shortages in environmental and public water supplies, in addition to negative effects on water quality through, amongst others, flooding and saline intrusion.

2. Objectives

To Effects of Rainfall and Temperature on Farmers' Productivity

3. Formation of Hypothesis in Research Design

Climate change has a significant impact on agricultural productivity.

4. Methodology

Developed a web-enabled Decision Support system (DSS) for real time crop growth monitoring at district level using multi-temporal satellite remote sensing data received at IARI satellite ground station. The DSS was hosted on public Satellite derived weekly Land Surface Temperature (LST), Normalized Difference Vegetation Index (NDVI) and Daily Rainfall products were generated for crop pixels and averaged in each district for a period of 2001-2013 (Fig. 5). A web-interface was created in PHP, WYSIWYG and HTML which allowed for selection of State from India map and then selection of district. The interface provided selection of parameter (rainfall, LST and NDVI), season (Kharif or Rabi) and year. This web-interface was linked to database of parameters which fetched the related data of current season and compared it with parameter of same season in previous year and with long-term average. The temporal profile of parameter of current year and its comparison with that of previous year and long-term average was visualized graphically as well as in tabular format. The anomaly in parameter for current period from long term average was also computed, then categorized into five classes and visualized as a map. A web-interface allows selection of maps for different weeks/fortnight. The parameter database was kept updated with new real time data as it became available. The system was used to monitor the wheat crop condition in response to terminal heat stress during Feb-March 2013 and crop condition across India during Kharif and Rabi seasons of 2013-14.[11]

5. Data analysis.

Table 1 shows sensitivity combinations and their temperature change yields.

Change in Temp(˚C)	Rainfall change (%)		CO2 Concentration (ppm)		Yield		Deviation from control (%)	
	Avg	Range	Avg	Range	Avg	Range	Avg	Rang
-1.0 to 0.0	10.5	-43 to 40	536	355-744	6542	6062-7143	12	4 to 23
0.1 to 2.0	7.2	-44 to 49	612	340-887	5845	4987-6583	0.4	-14 to 13
2.1 to 4.0	5.4	-48 to 48	638	366-875	5225	4675-5553	-10	-5 to -20
4.1 to 6.0	-8.4	-50 to 45	600	333-898	4821	3867-5605	-17	-4 to -34
6.1 to 7.9	-2.2	-37 to 44	656	380-883	4179	2700-5637	-28	-3 to -54

Source: Climate Change & Agriculture in India 2016.

Sensitivity analysis revealed the influence of a combination of temperature and precipitation changes on crops, both with and without CO_2 fertilisation. This would aid in the development of effective adaption techniques.

Table 2 shows sensitivity combinations and their yields as a function of rainfall change.

Rainfall change (%)		Change in Temperature (˚C)		CO2 Concentration (ppm)		Yield		Deviation from control (%)	
Avg	Range	Avg	Range	Avg	Range	Avg	Range	Avg	Range
-44	-50 to -40	3.2	-0.1 to 5.4	642	346 - 847	5445	4340 - 6721	-6.5	-25.4 to 15.5
-35	-38 to -32	5.9	3.9 to 7.6	649	333 - 883	4601	2700 - 5637	-21.0	-53.6 to -3.2
-25	-29 to -21	4.1	-0.3 to 7.3	619	340 - 871	4960	3446 - 6741	-14.8	-40.8 to 15.8
-15	-20 to -11	4.0	0.7 to 6.7	570	418 - 898	4859	3363 - 5537	-16.5	-42.2 to -4.9
-4	-9 to 0	4.7	0.5 to 7.9	618	399 - 836	4753	3163 - 5986	-18.4	-45.7 to 2.8
6	1 to 10	2.5	-0.5 to 7.5	682	563 - 815	5623	4128 - 6792	-3.4	-29.1 to 16.7
15	11 to 20	3.8	-0.8 to 7.2	565	355 - 852	5266	3873 - 6347	-9.5	-33.5 to 9
25	21 to 30	3.3	-1.0 to 7.8	579	440 - 887	5440	3317 - 7143	-6.5	-43 to 22.7
35	31 to 40	2.5	-0.9 to 6.9	529	366 - 866	5269	4009 - 6572	--9.5	-31.1 to 12.9
45	41 to 49	2.8	0.6 to 7.2	615	412 - 861	5165	3102 - 6476	-11.3	-46.7 to 11.3

Source: Climate Change & Agriculture in India 2016.

Table 3 displays the CO2 change concentration sensitivity combinations and their yield.

CO2 Concentration (ppm)		Change in Temperature (˚C)		Rainfall change (%)		Yield		Deviation from control (%)	
Avg	Range	Avg	Range	Avg	Range	Avg	Range	Avg	Range
367	333-399	2.9	-0.8 to 7.6	-8.2	-46 to 39	4691	2700 - 6313	-19.4	-53.6 to 8.5
449	403-500	3.8	-0.9 to 7.2	8.8	-35 to 45	4735	3102-6572	-18.6	-46.7 to 12.9
552	504-599	3.4	-0.4 to 7.9	0.3	-50 to 43	5056	3163 - 6468	-13.1	-45.7 to 11.1
651	604-691	2.9	-1.0 to 7.8	16.9	-35 to 49	5473	3317-7143	-6.0	-43 to 22.7
746	700-798	3.8	-0.1 to 7.5	- 11.3	-47 to 35	5472	4128-6721	-6.0	-29.1 to 15.5
850	802-898	4.4	0.6 to 7.3	-2.3	-45 to 47	5469	4428-6476	-6.0	-23.9 to 11.3

Source: Climate Change & Agriculture in India 2016.

6. Conclusion

Climate change is caused by large-scale changes in weather patterns due to cyclical changes in India's land climate, but it has a serious impact on farmers' ecosystems, India's rainwater system, etc. There is a require embracing and recognize innovation. and creativity for climate change mitigation. Farmers are an important factor in enabling sustainable development and improving crop yields, while reducing greenhouse gas emissions and reducing associated vulnerability.

7. Reference

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