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ECONOMICS OF CLIMATE CHANGE ON AGRICULTURAL PRODUCTION ININDIA

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Introduction

India is aware about the impact of climate change on agriculture and farmers' lives. Extensive field and simulation studies were carried out in agriculture by the network centres located in different parts of the country. The climate change impact assessment was carried out using the crop simulation models by incorporating the projected climates of 2050 & 2080. In absence of adoption of adaptation measures, rainfed rice yields in India are projected to reduce by 20% in 2050 and 47% in 2080 scenarios while, irrigated rice yields are projected to reduce by 3.5% in 2050 and 5% in 2080 scenarios. Climate change is projected to reduce wheat yield by 19.3% in 2050 and 40% in 2080 scenarios towards the end of the century withsignificant spatial and temporal variations. Climate change is projected to reducethe kharif maize yields by 18 and 23% in 2050 and 2080 scenarios, respectively. Climate change reduces crop yields and lower nutrition quality of produce. Extreme events like droughts affect the food and nutrient consumption, and its impact on farmers.

Government of India has formulated schemes/plans to make agriculture more resilient to climate change. The National Mission for Sustainable Agriculture (NMSA) is one of the Missions within the National Action Plan on Climate Change (NAPCC). The mission aims at evolving and implementing strategies to make Indian agriculture more resilient to the changing climate.

Objectives of the study

1. To study the current scenario of agricultural situation COVID-19 pandemic in India.
2. To analyse the growth of agricultural production in India.
3. To evaluate the rainfall status of India.
4. To give policy suggestion on climate change in agricultural sector in India.

Data sources and methodology

The data used for the analysis were secondary in nature and collected for a period of 21 years i.e., from 2001- 02 to 2021-22. The data have been collected from various published records from Department of Economics and Statistics, Ministry of Agriculture, Government of India (rbi.gov. in). Collected data have been analyzed through various statistical and econometrics tools such as index number, annual growth rate, linear growth rate, trend and compound growth rate.

Current scenario of Agricultural Situation

In this scenario, both consumers' purchasing limits have been lowered due to a drop-in salaries and employment, while retailers have stocked more nourishment, thus influencing food accessibility and food cost. Due to transportation constraints, the harvest was not delivered to the final destination, resulting in produce shortages and price increases. In the chain of production, automation has gained more importance when it comes to harvesting, and manufacturing products. Following the onset of the COVID-19 pandemic, several initiatives were launched in the Agriculture sector in India. Various agricultural policies were implemented by the government to assist the needy. The following list includes only a few examples: The state-run procurement activities made certain that farmers purchased the most expensive seeds and pulses at the lowest price designated by the government (OCED, 2018). From April 2021, the industries and agriculturists will be able to resume operations as long as they are outside of the virus hotspots.

As per the Pradhan Mantri Garib Kalyan Yojana/Package, the government declared that 1 kg of pulses and 5 kg of rice and wheat will be provided to 800 million underprivileged people every month between April and June, while another 80 million people will be able to cook for free during this time so that they can keep themselves alive (GOI, 2020). Fertilizer production and sales make the world's top fertilizer supplier. Manures and fertilizers are highly tradeable globally because of Lockdown. Additionally, spring season crops such as barley,

sunflower, maize, and open field foods/vegetables have been severely impacted by this pandemic too. Labour migration has resulted in a rise in transmission rate, which in turn has led to acute scarcities in the agricultural sector, which are the major determinants for the crop harvest. Due to the high transmission rate of COVID-19, the agricultural sector has been affected by difficulties in finding healthy workers and labour shortages (Aday & Aday, 2020).

In 2020, the Farmers' Produce Trade and Commerce (Promotion and Facilitation) Act will come into effect in the United States. According to the government, farm bills will help to increase farmers' incomes. In such a country, farmers are not well-educated and are thus unaware of the laws. Consequently, they can not market their yield without a pan card. Farmer fear of the Crop MSP is met by centralization and hands-on control of large corporations. The presumption is that these bills will weaken agriculture. The farmers believe that all larger corporations may declare the price of their crops and gain additional profit from it, bringing about the decline off farmers. In the event of a pandemic, travel restrictions could lead to a significant reduction in food arrivals. The state government has confirmed that Bills are being developed in order to provide a framework for all farmers to buy and sell their harvests outside Market.

On the contrary, the farmers are worried about their business and concerned that they will lose a significant amount of money if they operate outside of the market under the minimum support price scheme. Farmers are also fearful of the trade fee. If empowered authorities fail to make judicious decisions, farms will be vulnerable to big corporations, without anyone offering them a chance to be heard. In the farmers' opinion, having the land transferred to large corporate and trader interests will lead to even greater problems (Kaur et al., 2021). During COVID-19, a fear of the spread of corona virus was created and resulted in a large number of fatalities for the farmers' protests. a sizable percentage of protesting farmers belong to the elderly age demographic, who can be more easily affected by the virus.

Table 1.

Year	**Rice** (Lakh Tonnes)	**Wheat** (Lakh Tonnes)	**Coarse cereals** (Lakh Tonnes)	**Pulses** (Lakh Tonnes)	**Total food grains** (Lakh Tonnes)	**Rainfall** (in millimetres)	**Population** (in million)
2011-12	1053.0	948.8	420.1	170.9	2593.0	1054.3	1220
2012-13	1052.4	935.1	400.4	183.4	2571.0	1242.6	1236
2013-14	1066.5	958.5	432.9	192.5	2650.0	1044.7	1252
2014-15	1054.8	865.3	428.6	171.5	2520.0	1085.0	1268
2015-16	1044.1	922.9	385.2	163.2	2515.0	1083.1	1284
2016-17	1097.0	985.1	437.7	231.3	2751.0	1127.2	1299
2017-18	1127.6	998.7	469.7	254.2	2850.0	1020.8	1314
2018-19	1164.8	1036.0	430.6	220.8	2852.0	1288.8	1328
2019-20	1188.7	1078.6	477.5	230.3	2975.0	1289.6	1343
2020-21	1243.7	1095.9	513.2	254.6	3107.0	1236.4	1357
2021-22	1294.7	1077.4	511.0	273.0	3156.2	1257.0	1370
2022-23	1355.4	1127.4	547.5	275.0	3305.4	1259.0	1383

Source: Key indicators of Database, Asian Development Bank report, 2023.

TABLE.2

SHARE OF CEREALS AND PULSES TO TOTAL FOOD GRAINS PRODUCTION IN INDIA DURING 2011-12 TO 2022-23

Year	Rice (Lakh Tonnes)	Wheat (Lakh Tonnes)	Coarse cereals (Lakh Tonnes)	Pulses (Lakh Tonnes)	Total food grains (Lakh Tonnes)
2011-12	40.61	36.59	16.2	6.59	100
2012-13	40.93	36.37	15.57	7.13	100
2013-14	40.25	36.17	16.34	7.26	100
2014-15	41.86	34.34	17.01	6.81	100
2015-16	41.51	36.7	15.32	6.49	100
2016-17	39.88	35.81	15.91	8.41	100
2017-18	39.56	35.04	16.48	8.92	100
2018-19	40.84	36.33	15.1	7.74	100
2019-20	39.96	36.26	16.05	7.74	100
2020-21	40.03	35.27	16.52	8.19	100
2021-22	41.02	34.14	16.19	8.65	100
2022-23	41.01	34.11	16.56	8.32	100

Source: calculated value

Table.3

Growth of Rainfall in India during 2011-12 to 2022-23

(In millimetre)

Year	Rainfall (in millimetres)	Index Number	Growth Rate over previous year
2011-12	1054.3	100	-
2012-13	1242.6	117.860	17.860
2013-14	1044.7	99.089	-15.926
2014-15	1085	102.911	3.857
2015-16	1083.1	102.731	-0.175
2016-17	1127.2	106.914	4.071
2017-18	1020.8	96.822	-9.439
2018-19	1288.8	122.242	26.253
2019-20	1289.6	122.318	0.062
2020-21	1236.4	117.272	-4.125
2021-22	1257	119.226	1.666
2022-23	1259	119.4157	0.159

Diagram.1

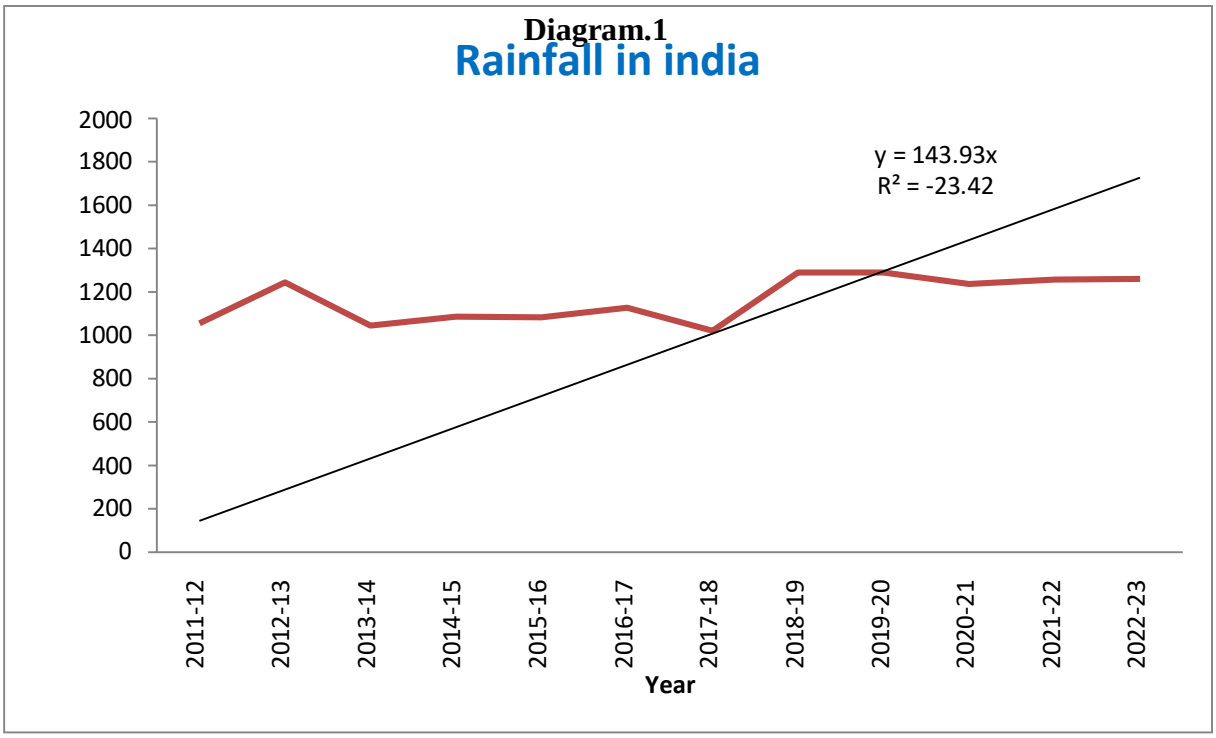

Table.4

TOTAL PRODUCTION OF FOOD GRAINS TO TOTAL POPULATION IN INDIA DURING 2011-12 to 2022-23

Year	**Total food grains** (Lakh Tonnes)	**Population** (in million)	**Per capita food grains production**
2011-12	2593.0	1220	2.125
2012-13	2571.0	1236	2.08
2013-14	2650.0	1252	2.117
2014-15	2520.0	1268	1.987
2015-16	2515.0	1284	1.959
2016-17	2751.0	1299	2.118
2017-18	2850.0	1314	2.169
2018-19	2852.0	1328	2.148
2019-20	2975.0	1343	2.215
2020-21	3107.0	1357	2.29
2021-22	3156.2	1370	2.304
2022-23	3305.4	1383	2.39

Source: ADB data, calculated value

Table. 5

NATURAL GROWTH RATE OF CLIMATE CHANGE AND FOOD GRAINS PRODUCTION IN INDIA DURING 2011-12 TO 2022-23

Year	Natural Growth Rate of Total food grains	Natural Growth Rate of Rainfall
2011-12	-	-
2012-13	-0.848	17.860
2013-14	3.0727	-15.926
2014-15	-4.906	3.857
2015-16	-0.198	-0.175
2016-17	9.3837	4.071
2017-18	3.5987	-9.439
2018-19	0.0702	26.253
2019-20	4.3128	0.062
2020-21	4.437	-4.125
2021-22	1.5835	1.666
2022-23	4.7272	0.159

Source: calculated value

Policy suggestions for agricultural sector

The major problems confronting Agricultural sector at the moment are a knowledge gap and an infrastructural gap, particularly in rural regions. Issues related to water, commerce, and transport networks add considerable expense to producers' livelihoods. An even worse problem is lack of procurement systems. There seem to be a lot of programmes targeted at developing agriculture. Non-efficient transport methods cannot lead to an increase production, decreased cost, or higher price collection at the ground level. Furthermore, ineffective state govt. support exacerbates these issues. Thus, corporate agriculture may be a solution to the Indian agricultural sector, but it requires a deep thought and innovative legislation so that neither the corporations nor the producers or farmer suffer. Food supply depends on agricultural output. Agricultural development in India necessitates the development of highly creative concepts for the improvement of this area. Furthermore, farming is a physically demanding and back-breaking occupation in the absence of automation. A direct consequence of this has been the abandonment of farming by the majority of farmer's children in favour of other careers.

Farmers get more income when they sell their property to developers, shopping complexes, and manufacturing plants. This has increased the strain on agriculture, necessitating the development of technology to improve productivity in order for India's dwindling farmland to continue to feed its billion-plus population in the years to come. India, while being one of the world's largest producers of agricultural commodities, has very poor farmers' income. Conventional farming has accelerated agricultural production, but at the cost of severe ecological damage. People regard organic production as being more sustainable because of its reduced use of external inputs and its smaller environmental impact. According to a new study published recently, smart agriculture has the potential to close the yield gap among both conventional and organic agriculture due to its inherently more diverse biological production systems.

Sources mostly employed experimental design, controlled experiment locations, paired farms, and organic system experiments placed within a conventional framework. Can large-scale advanced organic agriculture emulate plot-scale organic yields and environmental benefits? The claims made above are correct. So extensive conclusions should be made with care, and an impartial system comparison is needed.

Conclusion

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