

CROP DIVERSIFICATION: A KEY TO CLIMATE CHANGE AND MONO-CROPPING IN HARYANA, INDIA

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Abstract. Two major issues (climate change and rice wheat monocropping) in Haryana's agriculture sector are the focus area of this paper. The intensity of weather extremes (such as high temperatures, heavy and unpredictable rain, and flash flooding) has increased as a result of human-caused climate change. Agriculture is highly dependent on the weather, which makes it vulnerable. There is mounting evidence to suggest that extreme daytime and nighttime temperatures have a negative impact on crop growth as well as yield and quality (V Venkatramanan, 2009). Another major issue for the state's sustainable agriculture is the monocropping of rice and wheat. Rice and wheat cropping pattern have replaced the state's previous multiple cropping of pearl, millet, and gram during 1960-80. Due to the monocropping, various environmental and livelihood problems have arisen like declining and polluting groundwater, diseases, insect and pest attacks, a decline in health as well as altered dietary habits, etc (Singh, 2000). To mitigate the effects of climate change and monocropping, crop diversification could be an effective option for sustainable agriculture and food security.

Introduction. Haryana is the second-largest contributor to India's central food grain pool and is self-sufficient in food production. The state is fourth largest in wheat production and tenth largest in rice production (PHD RESEARCH BUREAU, 2019). As a means of ensuring national food security, it also poses numerous challenges to the state's long-term agricultural sustainability. Rice and wheat accounted for nearly half of the state's farm output in 2018-2019. Pesticides, fertilisers, and water are all needed in greater quantities for these crops. As a result of excess utilisation, these chemicals polluting the soil and groundwater. Food grain production and nutrient-dense food products are in high demand, which necessitates a restructuring of the agricultural system. However, as a result of human-induced climate change, agriculture is more vulnerable and the livelihoods of farmers are threatened. While agricultural technology has advanced, climate parameters (primarily temperature and rainfall) still play a significant role in determining crop yields and thus the livelihoods of rural residents and the security of their food supply. Crop production is expected to fall by 17% as a result of 1.2°C temperature rise, according to current projections (Nelson et al., 2014). Haryana is particularly vulnerable to climate change and the occurrence of extreme weather events because of its geographical location. Temperature rise and fluctuating rainfall patterns have been documented in the state. Climate change is altering annual and seasonal rainfall variability, primarily because it increases evapotranspiration. Climate change can have a significant impact on the state's agricultural economy. There are numerous benefits of multi-cropping, including the preservation of biodiversity, reducing crop failure risk, decreasing pollution, and reducing the risk of diseases and pests such as weed invasion. Therefore, the current research is being carried out to evaluate the prospects and challenges of climate change and monocropping in the context of agricultural crop diversification.

Objectives of the Study.

- To understand the impacts of climate change on agriculture.
- To analyze the consequences of monocropping in the study area.
- To understand the crop diversification program as the key to climate change resilience.

Climate Change. Farmers' livelihoods are threatened by anthropogenic climate change, which makes agriculture more vulnerable. Agriculture and food security in rural areas are influenced by climatological factors, such as temperature and rainfall. Climate change and extreme weather events pose a serious threat to the state of Haryana. It's alarming for Rabi crops that February witnesses the largest increase in temperature (1.4°C), followed by March (1.2°C). Wheat crops have been reported to be affected by such temperature increases (P. Kumar & Singh, 2013). Temperature rise and fluctuating rainfall patterns have been documented in the state. Climate change is altering annual and seasonal rainfall variability, primarily because it increases evapotranspiration. Climate changes can have a significant impact on the state's agricultural economy. Farm productivity, cropping patterns, profitability, supply and trade are just a few of the economic effects of climate change on agriculture. The country's large peasantry and small farmers face a major challenge from climate change. A country's agricultural productivity is highly vulnerable to local climate change, and as climate affects so many aspects of plant and animal biology, the impacts of climate elements and their extremes must be evaluated. It's possible that disrupting the "Ecosystemic balance" will have a negative impact on many societies, especially in developing countries like India, where agriculture used to contribute less than a quarter of the country's GDP. Research on climate change impacts on crop farming in Haryana, which is an agricultural state, is lacking.

Climate Change's Effect on Agriculture. Climate change's impact on agriculture could lead to food security issues and jeopardise the livelihoods of a large portion of the population. According to the research conducted in Asian countries, If nothing else changes, a rise in the global average temperature of 1.5 degrees Celsius is expected to result in a 13 percent drop in annual net revenue across the entire sample of countries studied (Mendelsohn, 2014). Crop yield and the types of crops that can be grown in certain areas can be affected by climate change by affecting agricultural inputs like water for irrigation, the amount of solar radiation that affects plant growth, and pest prevalence. As the temperature and rainfall fluctuate, the quantity and quality of crops produced is decreased. Productivity may also suffer if the length of crop growth cycles is affected by temperature. Soil erosion and soil degradation are more likely to occur as a result of climate change because of warmer air temperatures and extreme weather events. Drought, sparse rainfall, and seasonal water scarcity are major threats to agriculture in a warming world. Floods, thunderstorms, heatwaves and extreme rainfall, as well as hail storms and other water-related events, can have devastating effects on cropped areas. As a result of climate change, food distribution patterns will change, as well as the quality and accessibility of the food. Additionally, it raises humanitarian concerns because food security is closely linked to public health and will create a vicious cycle of hunger, disease and criminal activity. According to the Food and

Agriculture Organization of the United Nations (FAO), the number of people who are undernourished in the world has risen steadily since 2014. (Arora, 2019). These studies showed that eradicating hunger by 2030, as outlined in the Sustainable Development Goals (SDGs), would be a difficult task.

Crop Specialisation. From 1966 to 1980, Haryana's food grain production grew at a compound annual rate of 5.33 percent, compared to the national average of 2.77 percent. There was a 12.47 percent increase in the production of rice and wheat during the same period as a 5.12 percent decrease in the production of pulses(V. Kumar, 2017). The state is dominated by the cultivation of wheat and paddy. During the 1950s and 1960s, India was reliant on foodgrain imports from the West. The Green Revolution, which was started in Haryana, Punjab, and Western Uttar Pradesh, helped India overcome its acute food deficit and achieve food self-sufficiency, particularly in rice and wheat. As a result of the minimum support price (MSP) guarantee attached to paddy and wheat, these crops become more specialised. As a result, adverse effects on the environment and human health have been observed. The rice and wheat monopoly has also reduced leguminous pulses and other traditional crops like maize, jowar, and bajra, which not only disrupted the dietary habits in rural areas but also raised economic constraints on poor and marginalised people by denying them the ability to obtain affordable sources of nutrition. The failure of crop diversification in these states has been attributed to the fact that the MSP and the market for paddy and wheat are both stable, while alternative crops are not being procured at a sufficient rate. There has been a lot of talk about how excessive use of chemical fertilisers and pesticides is contributing to groundwater depletion, pollution, harming human and environmental health as a result of the overuse of flat-rate subsidised electricity for water lifting and increasing MSP for paddy and wheat (Shah and Chowdhury 2017).

Adverse Impact of Rice and Wheat Mono-Cropping. Seeds of high yielding varieties, mechanisation, large-scale irrigation via canals/tube wells, widespread use of chemical fertilisers and pesticides were all introduced in India during the Green Revolution. The original green revolution states inadvertently adapted to paddy and wheat mono-cropping in the race for surplus production. Consequently, the infrastructure and market mechanisms for rice and wheat have become more specialised. The environmental, agricultural, and economic consequences of mono-cropping are discussed in the following paragraphs.

Ground Water Depletion. Since the green revolution, the state has run out of water. From 1974 to 2018, the state average decline in the water table was more than 10 meters. according to the Central Ground Water Board, Government of India. The value indicates an excessive use of water compared to the natural replenishment rate of groundwater. Over-exploitation accounts for 55 of 108 blocks, while critical blocks account for 11, and semi-critical blocks account for 5. (Government of India report).

Pollution of Ground Water, Soil & Environment.'About 65 percent of Haryana's ground water is of poor quality,' according to the Haryana Kisan Ayog, and the state's second-generation green revolution problems have caused a steep decline in resource base, soil degradation (soil compaction, soil salinity, sodicity, water logging and

pesticide residues) and a reduction in soil organic carbon content, hydrological imbalance that has increased the overall cost of cultivation. The report shows a rise in soil, water, and environmental pollution (Haryana Kisan Ayog Report 2014: 2).

Air Pollution due to Paddy Stubble Burning. A significant increase in air pollution in Haryana due to the burning of paddy stubble is critical. A major health hazard, crop residue burning (CRB) contributes between 12 and 60 percent of the regional environment's Particulate Matter (PM) concentration. Nitrogen, sulphur, phosphorus and potassium are all stolen from the soil's top layer by paddy straw burning. To get rid of paddy straw quickly, farmers often choose a low-cost and simple option like hay bales or hay bale compost. As a second issue, removing the paddy straw is a time-consuming and labor-intensive process that necessitates specialised farm equipment. Despite government subsidies, labour availability in the state has decreased significantly.

Social Inequity. There has been a significant shift away from agriculture to other occupations as a result of social inequity in access to infrastructure (such as suitable land, irrigation facilities, and high-yield seed varieties), class and caste economic boundaries, and gaps in policy implementation. Agricultural input costs have risen as a result of a shortage of field labourers. Farm productivity and output have declined in Haryana over time. We are on the verge of a crisis in rice production because of stagnant productivity levels. Rice's total factor productivity (TFP) growth in Punjab has been declining at a rate of 0.07 percent per year over the past few years. Resource degradation, high input and labour costs, natural calamities, and gaps in technology are lowering total factor productivity (TFP)," says the Haryana Kisan Ayog. Agriculture's long-term viability is being jeopardised by depletion of natural resources and overuse of inputs (Haryana Kisan Ayog 2013: 18).

Crop Diversification. Combating climate change and monoculture can be accomplished in part by implementing agricultural crop diversification. To be more precise, diversification is a shift in product and input use decisions based on market forces and profit maximisation principles in an organisation. It's important to consider the different returns from value-added crops with complementary marketing opportunities when considering how to increase agricultural production on a particular farm through crop diversification. It's a vital tool for boosting the economy. The need for community awareness and farmers' education on Climate Change and its possible hazards, as well as how different farming communities may be able to adapt to the changing conditions and prepare themselves, is also essential. Government and district administrations had to take an active role in helping agricultural communities deal with the risks associated with their primary occupations and livelihoods system, no doubt. In addition to reducing climate and market risks, the use of diversified cropping systems has resulted in a wider range of nutrient-dense foods for the average household. In order to achieve a congruence of increased productivity, profitability and sustainability, governments need to explore fully the potential and prospects of crop diversification. Crop diversification recommendations are as follows:-

- To ensure that farmers receive a fair price for their crops, procurement of alternative crops should be made on time and with a low rate of crop rejection.
- The reported cartelization of pulses in the media must be checked on an urgent basis to instill confidence among farmers to grow pulses.
- To avoid market volatility, the 'price rationalisation' system may be opted for. Farmer compensation should cover the difference between the market selling price and MSP if state agencies do not purchase the crop.
- All crops intended to compete with rice should be included in the Minimum Support Price (MSP) programme, and the list of MSPs should be updated regularly.
- Agriculture programmes should be delivered and implemented through a "single window" to avoid duplication of efforts with the same or complementary objectives.
- A "long-term lease/rent act" could be passed to protect farmers' interests. Farmers will have confidence that even if he lends their land for long-term contract farming or cooperative farming, their land will remain safe.
- Farmers must be provided with adequate information about the importance of the contract and cooperative farming during the state, district, and block-level Kisan Mela and Kisan Ghoshti events.
- An Area Specific Agriculture Plan should be developed to help the state's farmers and processors overcome procurement and MSP challenges. This necessitates the creation of agriculture zones dedicated to specific crops. Farmers/Producers Organizations, co-operatives, or a conglomeration of these can help farmers in their fight against the big players in the market.

Conclusion. It is clear from the preceding discussion that social scientists, agricultural experts, and policy planners of the state were concerned about the growing trend toward risk of climate change and monocropping pattern. Excessive use of toxic pesticides and chemical fertilisers has left the soil infertile and degraded, according to research. The dominance of rice and wheat over maize, barley, pulses, and oilseeds in the food supply and demand chain has created an imbalance. Climate change is putting even more strain on agriculture, which is already under a lot of pressure due to an ever-growing population. Many studies have predicted a decrease in agricultural productivity due to climate change, despite the fact that there are many unknowns about the future climate and its possible effects. Pest infestation, soil fertility, irrigation resources, physiology, and metabolic activities of plants were all hampered by climate factors such as temperature, precipitation, and greenhouse gases. Climate change's negative impact on agricultural sustainability has been offset by a variety of mitigation and adaptation strategies.

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