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Climate-Smart Agriculture (CSA) - A Way towards Resilience, Food and Nutritional Security

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SUMMARY

To enhance nation's food and nutritional security that builds climate resilience, India's challenge is to combat poverty through a development pathway. The greenhouse-gas emissions from agricultural sector are poised to grow dramatically in the next several years. Climate-Smart Agriculture (CSA) is an approach to address the interlinked challenges of food security and climate change, with three objectives: (1) sustainably increasing agricultural productivity, to support equitable increases in farm incomes, food security and development; (2) adapting and building resilience of agricultural and food security systems to climate change at multiple levels; and (3) reducing greenhouse gas emissions from agriculture (including crops, livestock and fisheries). This paper studies causes and effects along with the objectives of CSA, while also assessing other cobenefits, economic impact to counter balance the deleterious impact of climate change on agricultural sustainability.

INTRODUCTION

Climate change is already a threat to the ever-increasing population around the world which has exacerbated droughts, heat waves, floods and other extreme-weather events, as well as created an influx of new pests and diseases. As there is an increase in the greenhouse-gas emissions in the atmosphere, greenhouse effecthas led to the rising in temperature. The average global temperature is predicted to rise by 2˚C until 2100, which would cause significant economic losses universally. The concentration of CO_2 is increasing at an alarming rate and has led to higher growth and plant productivity due to increased photosynthesis, but increase in temperature counteractsthis effect as there is increase in crop respiration rate, evapo-transpiration, higher insect-pest infestation, a shift in weed flora along with reduced crop duration. Climate-smart agriculture (CSA) is an approach to transform and reorientagricultural systems to aid food security under the new realities of climate change. Climate change impedes food markets, posing population-wide risks to food supply. Threats can be reduced by increasing the adaptive capacity of farmers as well as increasing resilience and resource use efficiency in agricultural production systems. The primary focus of this study is to find the issue of climate change and its possible causes along with its impact on the agricultural sector to work towards resilience and food security.

Causes of Climate Change

Rising temperatures and extreme weather events has reduced the crop yield in many countries of Asia. Ozone depletion in the atmosphere is mainly caused by the anthropogenic activities which emit greenhouse gases such as CO_2, methane, and nitrous oxide as well as other substances.The agricultural sector alone contributes 15% of the total emissions, predominantly methane and nitrous oxide. The use of chemical fertilizers especially nitrogen containingalso leads to greenhouse-gas emissions. N fertilizer use can be lowered by 38% with improved crop management practices.Better crop management also leads to consumption of 11% less input energy with 33% increased yields, which leads to reduction in greenhouse-gas emissions by 20%.

Impacts of Climate Change on Indian Agriculture

The changes in climatic events such as temperature and rainfall significantly affect the yield of crops. Agriculture being the most vulnerable sector to climate change thereby causing huge economic impacts. The effect of precipitation, rising temperatures and CO_2variationchanges according to the location, crop and magnitude of change in the parameters. The net revenue of farmers significantly decreases with a decrease in precipitation or increase in temperature. This lead to low demand for agricultural exports, which causes fluctuations in national income. Crop yields can be increased by expanding irrigated areas, as climate change varies according to the area and irrigation application, thereby having a detrimental effect on the environment. Rising temperature reduces the duration of crops which reduces the yield of many crops. The overall production of rice, wheat and maize is expected to decline if both the temperate and tropical regions experience anincrease of temperature of 2°C. In general, climate change impacts more on tropical regions, as crops in this region remain closer to their high-temperature optima which experiences high-temperature stress during elevated levels of temperature. Insect, pests and diseases are also more widespread in humid and warmer regions.

Economic Impact of Climate-Smart Agriculture

Agricultural markets will be severely affected by the climate change, causing a reduction of 0.26% in global GDP. If the climate predicted for the 2080s occurred today, there would be a projected annual loss of 0.2–1% in household welfare. It is expected to cost 1.2% of GDP with a 1°C increase in mean global temperature for both market and non-market damages which will increase in quadratic progression. If the adaptation of strategies used in the past are also being used for future mitigation strategies, global income is likely to decrease by 23% within the year 2100 and a wider gap in income inequality. It has been estimated that global economic growth will be reduced by 0.28% per year.

The economic benefits of various climate-smart agriculture technologies can be seen in Table below.

Table 1. Economic benefits of various climate-smart agriculture technologies

Crop	Climate-Smart Technology	Enhanced Efficiency	References
Rice	Site-specific nutrient management	Partial factor productivity of nitrogenincreased	Pampolino et al. (2007)
Rice	Direct-seeded rice	Reduced preparation and irrigation costs	Mishra (2016)
Wheat	Zero tillage	Reduced cultivation cost, reduced GHGs emissions, and increased yield	Aryal et al. (2015)
Wheat	Site-specific nutrient management	Increased yield by 29% over farmers fertilizer practices (FFP)	Singh et al. (2015)
Rice-wheat cropping system	Improved crop varieties	Increased net returns	Khatri et al. (2016)
DSR–Wheat	Direct-seeded rice	Saving of irrigation, lesser labor requirement	Bhullar et al. (2018)
Groundnut	Drought-tolerant varieties	Increase in yield by 23%, lower variability in yield, increased share of risk benefits in total benefits	Birthal et al. (2012)

Direct Seeded Rice

SSNM

Zero Tillage Wheat

Fig.1.CSA Technologies

CONCLUSIONS

Ever increasing population has put a lot of pressure on agriculture to ascertain the food and nutritional security of the world, which further exacerbateswith climate change. Climate change will decrease agricultural productivity in the nearing future, even though there are unreliability regarding the future climate scenario and its possible impacts. Although there are certain mitigation and adaptation strategies which were being developed to counterbalance the deleterious impact of climate change on agricultural sustainability. These technologies include carbon-smart activities (crop residue management, zero tillage, growing legumes), water-smart practices (laser land levelling, crop diversification, raised-bed planting, DSR,rainwater harvesting and micro-irrigation), weathersmart activities (ICTbased agrometeorological services,stress-tolerant varieties),climate-smart nutrient management(leaf colour charts,precision nutrient application like SPAD, SSNM, green seeker, crop residue management, etc.), and knowledge-smart activities (agricultural extensions to enhance capacity-building). Inclusion of these technologies can appreciably reduce the consequence of climate change on cropsmaking them more suitable to the climate by curtailingthe unfavourable impacts. Thereby, it is necessary that the farmers are being educated regarding various climate-smart technologies and adaptation strategies though various training programmes to simplify those technologies at the field level.

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