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THE DEVASTATING CONSEQUENCES OF CLIMATE CHANGE ON CROP PRODUCTION AND ECONOMIC STABILITY: A CRITICAL REVIEW

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Abstract

The title of a review "Devastating Consequences of Climate Change on crop Production and Economic Stability" explores the multifaceted effects of climate change in Nigeria agriculture and its subsequent economic implications. Climate change poses an existential threat to global food security and economic stability. Rising temperatures, altered precipitation patterns, and increased frequency of extreme weather events significantly impact crop yields, quality, and distribution. As climate change accelerates, altering precipitation patterns, increasing the frequency of extreme weather events, and shifting temperature zones, agricultural productivity faces significant challenges. These environmental changes can lead to reduced crop yields, altered growing seasons, and increased pest and disease pressures. This study investigates the devastating consequences of climate change on crop production and economic stability, with a focus on specific regions and the nation. Using empirical data and econometric analysis, the study find that climate-related shocks lead to reduced crop yields (10-20% decline), decreased agricultural productivity (15-30% decline), increased food prices (20-50% increase), and economic instability (GDP decline of 2-5%). The results highlight the vulnerability of agricultural systems to climate change, exacerbating poverty, inequality, and migration. The recommended adaptive strategies, including climate-resilient crop varieties, irrigation management, and climate-smart agriculture practices, to mitigate these impacts. Policymakers must prioritize climate change adaptation and resilience in agricultural sectors to ensure food security and economic stability.

Keywords: Climate Change, Crop Production, Economic Stability, Food Security, Agriculture, Sustainability.

Introduction

Climate change, characterized by rising global temperatures, altered precipitation patterns, and increased frequency of extreme weather events, poses a formidable threat to global food security and economic stability. The agricultural sector, which accounts for approximately 25% of global GDP, is particularly vulnerable to climate-related shocks. Changes in temperature and precipitation patterns can significantly impact crop yields, quality, and distribution, leading to economic losses and food insecurity. This paper reviews the empirical evidence on the impact of climate change on crop production and economic stability, with a focus on Africa particularly Nigeria. By synthesizing existing research and identifying knowledge gaps, this study aims to contribute to the development of effective climate-resilient agricultural strategies and inform policy decisions to mitigate the adverse effects of climate change on global food systems.

Floods, droughts, heat stress, cold waves, and storms are examples of climate-driven extremes that have large negative consequences on the agriculture sector in Nigeria, notably the rice-wheat cropping system. Climate variability and climate-driven extremes are also a major contributor to these impact. As a result of these changes, the protein content and grain yield of wheat have dropped, the growth season for crops has been shortened, and crop evapotranspiration has begun to occur. The increase in temperature has also had a detrimental impact on the qualitative characteristics of wheat crops, such as the starch percentages, sugars, and protein content of the wheat production.

Fig 1 & 2. Effect of drought stress on agriculture

The unpredictability of the climate and the practices of mortaloperation have both contributed to changes in agrarian phenology in Nigeria. Temperature increases have led to a rise in the number of aphids that have overran wheat fields, which has led to a drop in product. There's a correlation between raised temperatures and lesser quantities of carbon dioxide in rice product and ails that are associated with climate change. Rice product in Nigeria has been significantly told by climatic variability, with cataracts, famines, heat stress, and water dearth’s lowering rice affair in northern and other regions of Nigeria. This effect has been particularly pronounced in Northern Nigeria. The germination of seeds is also hindered by high temperatures and a lack of available water, which results in a lack of stage establishment and vigour in the seedlings. Nimet prognosticating of the climate might dwindle husbandry water product by 32 per cent or 29 percent by the time 2050. The booting and an thesis development stages of rice are negatively impacted by high temperatures in Nigeria, which eventually leads to a drop in yield because of the conditions. Different agrarian models, similar as NIAR, FMARG have prognosticated that the yields of rice and wheat crops may drop by as important as 19 and 12 percent, independently, by the time 2050. Nigeria is facing substantial challenges in the areas of husbandry, cattle, forestry, fisheries, and monoculture as a result of climate change issues. Because of the mischievous goods that climate change would have on the quality and volume of ranges, it's anticipated that 35 million growers in Nigria will start raising cattle as their primary source of income by the time 2050(Nimet, 2024) Extreme rainfall conditions, similar as heat swells, will affect in an increase in the number of complaint infestations, a drop in milk affair, and a drop in reproductive rates in creatures.

Impact and changes in climate

The long- term mean climate will suffer major changes, which will have significant ramifications for the product of food throughout the country and may bear continual adaption. On the other hand, increases in time- to- time unpredictability and extreme rainfall events may pose bigger pitfalls to the nation capacity to give acceptable food inventories. Throughout the course of agrarian history, some of the most significant diminishments in crop affair have been attributable to circumstances of surprisingly low rush. Indeed veritably little variations in the average monthly downfall can have an effect on productivity. For illustration, a change in the quantum of rush that falls during the growing season by one standard divagation is related with a change in product that can be as high as ten percent(NIMET, 2024.). It's possible that husbandry may acclimatize to increases in severe temperature circumstances in numerous locales by shifting to ways that are presently employed in warmer climates, similar as cultivating crops that are more resistant of the extreme temperatures. still, in areas where husbandry is rehearsed on the verge of pivotal thresholds, increases in high heat or failure may change the original climate into a condition that has noway been seen by humans in the history. This makes it insolvable to determine the extent to which adaption will be doable.

Fig 3. Climate smart agriculture

In nations across Africa, crop yields may have been told by recent increases in climatic variability from about the middle of the 1990s. This may have caused more inter-annual variability in wheat yields compared to former times. It's possible for crop responses to changes in growing circumstances to be nonlinear, to display threshold responses, and to be vulnerable to combinations of stress factors that have an effect on the crop's growth, development, and final affair.. It's possible for crop responses to changes in growing circumstances to be nonlinear, to display threshold responses, and to be vulnerable to combinations of stress factors that have an effect on the crop's growth, development, and final affair.

Fig4. Burning of forest tree species

It's possible that the goods of blankness will cancel out the advantages of advanced temperatures and longer seasons that have been observed in medial- to grandly-latitude. It was hypothecated by Alcamo et al.(2007) that a drop in agrarian affair in certain corridor of country may be compensated for by an increase in product in other regions, which would affect in veritably minor average changes. On the other hand, their findings suggest that the frequency of food product poverties might increase by a factor of two in several of the primary crop growing regions in the 2020s and by a factor of three in the twentieth century. There's also the possibility that heavy downfall and cataracts will have an effect on food product. This can affect in water logging of the soil, anaerobicity, dropped factory development, delayed husbandry conditioning, and acclimated agrarian gear.

Climate change impact on crops

When it comes to the world food force, crops cultivated in Africa are extremely important since they regard for roughly 25 percent of all grains. Crop yields may be explosively impacted by a variety of factors, including oscillations in temperature, atmospheric carbon dioxide (CO_2), and harsh rainfall. It's dependent on the crop's ideal temperature for growth and reduplication as to how the effect of adding temperature will manifest itself. The warming of certain places may be salutary to crops that are traditionally cultivated there or may enable growers to switch to crops that are produced in warmer places. On the other hand, yields will drop if the lesser temperature for a crop is advanced than the optimal temperature for that crop. adding situations of carbon dioxide(CO_2) can have an impact on crop yields, and there are some laboratory exploration that show that increased CO_2 situations might stimulate factory growth(FAO, 2017). These considerations include shifting temperatures, ozone, and water and nutrient restrictions. It's possible, for case, that advancements in yield will be lowered or reversed if the temperature of a crop is advanced than the ideal position, if there's inadequate water and nutrients available, and so on (Schlenker, 2009).

Impact of climate change on beast and fisheries

A number of severe troubles, similar as heat swells, failure, spongers, and ails, are being brought about by climate change, which is affecting cattle. Temperature stress makes beast more susceptible to sickness, lowers their fertility, and reduces the quantum of milk they produce(Thornton, & Nieuwenhuis, 2018).s Due to the fact that failure affects the quantum of high- quality fodder that's available to grazing creatures, it poses a implicit peril to pasturage and feed inventories. It's possible that climate change could also lead to an increase in the prevalence of ailsand spongersthat tormentbeast (FAO 2018). This is because failure and dry season would make it easier for some infections to thrive within creatures. In order to save the health of cattle in response to climate- convinced changes in pests, spongers, and microorganisms, it's anticipated that implicit adaptations in veterinary practices will be enforced. These changes may include an increased operation of parasiticides and other curatives for beast health. This may affect in an increase in the peril of fungicides entering the food chain or may lead to the development of fungicide resistance, which will have an impact on the distribution, consumption, and safety of goods deduced from beast and monoculture (Njehia, Mwirigi, 2020). While increases in carbon dioxide (CO_2) may lead to advanced pasturage affair, they may also lead to a decline in the quality of the ranges. The productof shops that are used as feed for cattle can be increased by a rise in CO_2 situations; still, this may also affect in a reduction in the nutritive content of some recons that are present in pasturelands(OECD, 2020).

Direct Goods of climate change on crop affair

Through impacts on pests and complaint, rising atmospheric CO_2 and climate change might laterally affect crops. Aphids and weevil naiads are among the pests that profit from advanced CO_2; advanced temperatures lower overwintering mortality, thus allowing earlier and perhaps more expansive distribution. By goods of warmth or failure on crop resistance to certain ails and by increased pathogenicity of organisms performing from environmental stress, climate change may potentially impact pathogens and complaint. Disease affecting oilseed rape may expand to further northern areas and come more severe within its current distribution during the coming ten to twenty times Variability of the climate might also be important as it influences the magnitude and pungency of outbreaks. Changing patterns of dew cover drastically affect how water is released in places where low downfall.

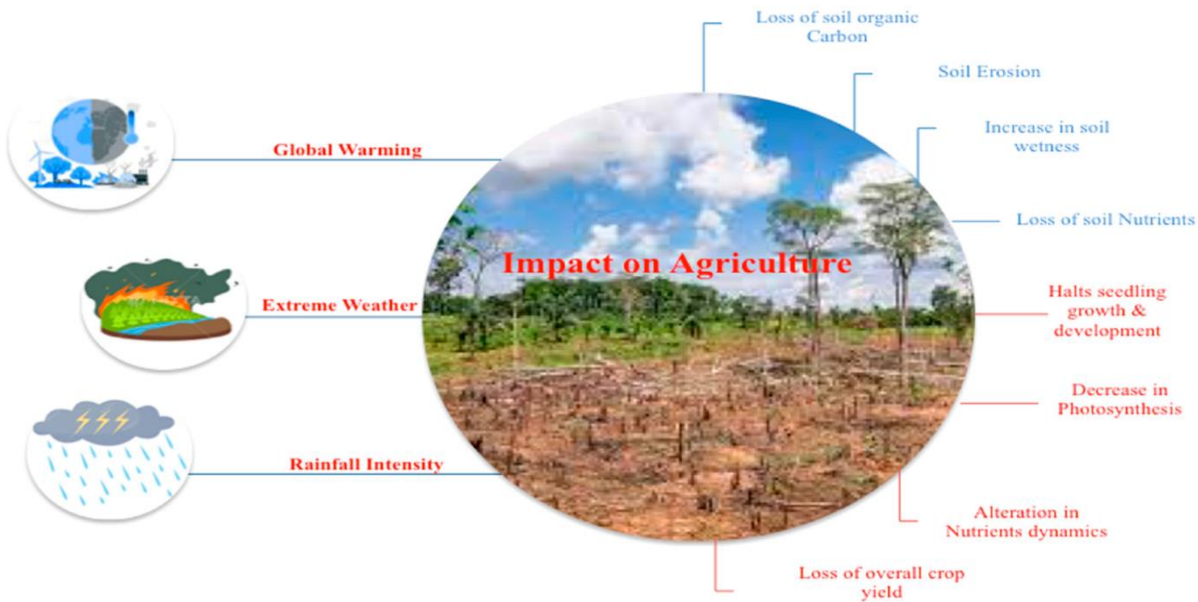

Fig 5. Different impacts on agriculture

Reducing and conforming to the extreme consequences of climate variability and change can be important backed by ICT and decision support systems. Beforehand warnings regarding natural catastrophes can come from early warning systems and independent rainfall stations, thus supporting growers' attempts to reduce negative consequences on ecosystems(58). likewise helping to reduce and acclimatize to the negative impacts of climate change on agrarian product include geographical information systems, wireless detector networks, mobile technology, web- grounded operations, satellite technology. Minimizing the negative consequences of climatic variability depends critically on crop operation and cropping system rigidity. These approaches comprise reliable water collecting and conservation styles, immediate irrigation water operation, and water conservation by means of varying irrigation volume. Significant salutary impact comes from crop-specific operation ways include changing sowing timings, crop gyration, intercropping, crop diversification and intensification. Sustainable product depends on adaption sweats including soil, water, and crop preservation rather than substituting new energy crops. Well ranch operation and changing input application, toxin rates, and failure- resistant cultivars are thus necessary. likewise included should be crops with climate adaptability inheritable features to guarantee sustainable affair. Sustainable beast product styles combine rice fields for both rice and fish affair, agrarian product, and parenting of creatures. Conditioning connected to cattle adaption ways vary in pasturage rates, gyration, grazing times, beast and fodder species variety, and combined product of both crops and cattle(62). Sustainable cattle product should coincide with fresh feeds, balanced diet operation, better waste operation ways, and integration with agroforestry in evolving climatic conditions. Important for sustained agrarian affair also are soil operation and carbon insulation. Under unborn climate change situations, selection of further failure-resistant genotypes and contemporaneous colony of hardwood and softwood species is regarded as adaptive adaptations in timber operation. Gyration times should be connected with timber growth and harvesting patterns; colony in geography patterns should help to lower shifting and burning of timber tree species under climate-smart settings. Adaption ways in agroforestry — including tree cover outside the forestland, boosting timber carbon stores, guarding biodiversity, and therefore lowering pitfalls by conserving soil health sustainability — can help to alleviate goods of climate change. Also with chances for sustainable profitable affair are fisheries and monoculture. Measures should be conducted to find regions where original yield reacts favourably to changes in climatic circumstances thereby strengthening the adaptive eventuality of depressed pastoral growers.

Table 1: summarizing various technologies in agriculture that help combat climate change

Technology	Description	Benefits
Precision Farming	Uses GPS, sensors, and data analytics to optimize field-level management.	Reduces waste, improves yield, and minimizes environmental impact.
Drought-Resistant Crops	Genetically modified or selectively bred crops to withstand drought conditions.	Ensures crop survival and yield in arid conditions.
Vertical Farming	Growing crops in stacked layers, often using controlled environments.	Saves space, reduces water usage, minimizes transportation emissions.
Climate-Smart Irrigation	Advanced irrigation systems like drip or sprinkler systems tailored to weather patterns.	Conserves water, enhances efficiency, reduces energy use.
Renewable Energy Sources	Solar panels, wind turbines, and biogas systems for powering farms.	Reduces reliance on fossil fuels, lowers greenhouse gas emissions.
No-Till Farming	Avoiding ploughing to maintain soil structure and carbon sequestration.	Prevents soil erosion, improves soil health, retains carbon.

Source: Field work 204

Table 2: The effects of climate change on agricultural crops

		Examples
Temperature Increase	Alters growing seasons, reduces yields, and increases heat stress.	Reduced wheat yield, premature ripening of fruits.
Changes in Precipitation Patterns	Causes droughts or flooding, impacting water availability and soil moisture.	Drought stress on corn, waterlogged rice fields.
Increased CO2 Levels	Can enhance photosynthesis but may reduce nutritional quality of crops.	Faster growth of soybeans but lower protein content.
Extreme Weather Events	Increases the frequency of storms, floods, and heatwaves, damaging crops.	Crop loss from hurricanes, heatwaves harming vegetable crops.
Pest and Disease Pressure	Expands the range and lifecycle of pests and diseases, affecting crop health.	Spread of locusts in new regions, increased fungal infections in cereals.
Sea Level Rise	Leads to saltwater intrusion in coastal agricultural lands.	Salinization of rice paddies, reduced productivity of coastal crops.
Soil Degradation	Accelerates erosion and nutrient depletion, reducing soil fertility.	Loss of topsoil in maize fields, decreased organic matter in soils.

Table 3. Specific crops and the effects of climate change on them

Crop	Effect of Climate Change	Examples/Details
Wheat	Reduced yields, heat stress, altered growing seasons	Lower yields in state like kano, Jigawa, Benue.
Rice	Flooding, drought stress, salinization	Increased flooding in the north, drought in in middle belt.
Corn (Maize)	Drought stress, heat stress, reduced pollination	Reduced yields in the north.
Soybeans	Increased CO2 levels, drought stress,	Faster growth but lower protein content; drought

	nutrient quality reduction	impacts in middle belt and far north.
Coffee	Temperature increase, altered growing regions, pest pressure	Suitable growing areas shifting; increased coffee borer infestation
Grapes	Temperature increase, altered growing seasons, drought stress	Earlier harvests; reduced quality in the north
Cotton	Heat stress, drought stress, pest pressure	Reduced fibre quality; increased pest attacks in the north
Potatoes	Temperature increase, drought stress, disease pressure	Reduced tuber quality; late blight outbreaks in middle belt and far north
Sugarcane	Drought stress, temperature increase	Lower yields in the north and middle belt; reduced sugar content
Apples	Temperature fluctuations, damage, alter growing seasons	shifting suitable growing regions
Coffee	Temperature increase, altered growing regions, pest pressure	Shifting suitable growing regions; increased pest infestations
Tea	Temperature increase, altered growing regions, water scarcity	Reduced quality in traditional areas like northern states; shifting production areas
Cocoa	Temperature increase, altered precipitation patterns, disease pressure	Decreased yields in West Africa; increased black pod disease
Onion	Drought stress, temperature increase, heat stress	Reduced malting quality; lower yields in the north
Bananas	Increased CO2 levels, altered precipitation patterns, disease pressure	Increased growth but higher disease susceptibility; shifting growing regions

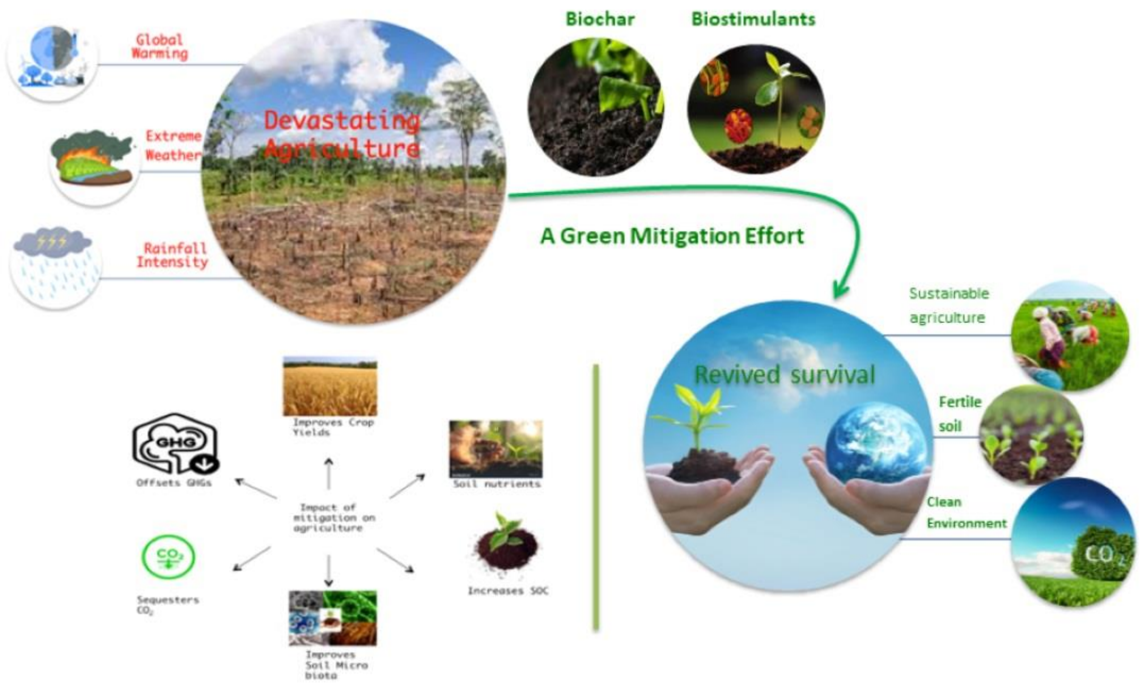

Fig 6. A way Forward towards Sustainable agriculture and Cleaner Environment

Mitigating the effects of climate change on agriculture:

1.Borrow Climate- Smart Agriculture Practices

i. Conservation husbandry utensil practices like no- till husbandry, cover cropping, and crop gyration to ameliorate soil structure, enhance organic matter, and increase carbon insulation. These practices reduce soil corrosion, maintain soil humidity, and ameliorate overall soil health.]\

ii. Agroforestry Integrate trees and shrubs into agrarian geographies. This practice enhances biodiversity, provides shade and windbreaks, improves soil fertility through splint waste, and sequesters carbon.

iii. Sustainable Water Management Employ effective irrigation systems similar as drip or sprinkler irrigation to optimize water use. apply rainwater harvesting and water storehouse systems to capture and store rainwater for dry ages. Use practices like figure bunding and check heads to conserve soil humidity and recharge groundwater.

2. Develop and Use Drought- Resistant Crop kinds

i. Inheritable Engineering and picky parentage Invest in the development of crop kinds that are more resistant to failure, heat, and pests through inheritable revision and traditional parentage ways. These crops can maintain advanced yields under adverse conditions.

3. Ameliorate Soil Health]

i. Organic Farming Use organic diseases, compost, and green ordure to maintain and enhance soil fertility. Organic husbandry practices promote soil biodiversity and structure, which are essential for healthy crop growth.

4. Promote Renewable Energy in Agriculture

i. Solar and Wind Power Install solar panels and wind turbines on granges to induce renewable energy. This reduces dependence on fossil energies and lowers hothouse gas emigrations. Solar- powered irrigation systems and windmills can also be used for water pumping.

5. Apply Integrated Pest Management(IPM)

i. Biopesticides and Natural Bloodsuckers. Reduce chemical fungicide use by employing biopesticides and encouraging natural bloodsuckers of pests. This approach minimizes environmental impact and promotes sustainable pest control.

ii. Crop Diversification Diversify crops to disrupt pest and complaint cycles. Planting a variety of crops reduces the liability of large- scale pest infestations and improves adaptability to climate variability.

6. Invest in Agricultural Research and Development

i. Innovation capitals Establish exploration centres concentrated on developing climate- flexible agrarian technologies and practices. These capitals can grease knowledge exchange and invention.

ii. Public-Private hook ups Foster collaborations between governments, the private sector, and exploration institutions to drive advancements in agrarian sustainability. Common sweats can accelerate the development and dispersion of new technologies

7. Educate and Train Farmers

i. Extension Services give training and coffers on sustainable husbandry practices and climate adaption strategies. Extension services can offer specialized support, shops, and field demonstrations to help growers apply new ways.

ii. Community Engagement Involve original communities in planning and enforcing climate-flexible agrarian enterprise. Engaging growers and community members ensures that strategies are acclimatized to original conditions and gain broader acceptance practices

Conclusion and Recommendation

In conclusion, the devastating consequences of climate change on crop production and economic stability is profound and multifaceted. As climate change continues to disrupt weather patterns, increase the frequency of extreme weather events, and alter ecosystems, agricultural systems worldwide face unprecedented challenges. Reduced crop yields, increased pest and disease pressure, and shifting growing seasons directly threaten food security and the livelihoods of millions of farmers, particularly in vulnerable and low-income regions. These agricultural disruptions have cascading effects on economic stability, leading to food price volatility, reduced income for farming communities, and broader economic insecurity. To address these challenges, it is imperative to adopt adaptive strategies and sustainable agricultural practices that enhance resilience and mitigate adverse effects. This includes investing in climate-smart technologies, promoting sustainable land and water management, and supporting research and innovation crop resilience. Collaborative efforts at local, national, and global levels are essential to safeguard agricultural productivity and ensure economic stability in the face of a changing climate.

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