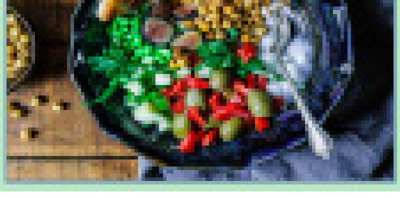
Volume 11 Number 3
Sommer 2023

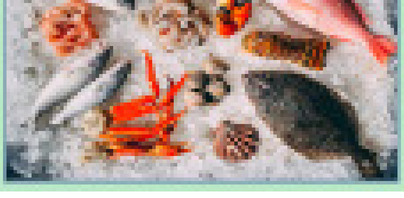
FOFJ

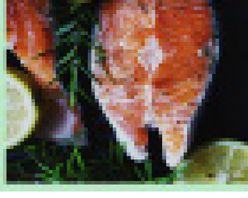
ISSN-Internet: 2197-411X
OCLC-Nr.:862804632

THE FUTURE OF FOOD JOURNAL

JOURNAL ON FOOD, AGRICULTURE & SOCIETY







Publisher

Sustainable Food Systems & Food Sovereignty

Future of Food: Journal on Food, Agriculture and Society

Volume 11, Nr. 3
September 2023

Published 30 September 2023

ISSN Internet	2197 411X
OCLC Number	862804632
ZDB ID	27354544

open access

Address
Future of Food: Journal on Food, Agriculture and Society
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Table of Contents

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ISSN-Internet 2197-411x OLCL 862804632

Editorial

Climate-Smart Agriculture: Adapting to a Changing Climate for Sustainable Food Production"

Muhammad Qasim Ali obtained his B.S. degree in Agri-Food Technology from the University of AJK Muzaffarabad, Pakistan. During the early of his career, he worked in a multinational food company as a Quality and safety officer. He was appointed Graduate Research Assistant (2022) at the University Malaysia Pahang for his Doctor of Science degree. During his PhD program, he worked at Seaweeds Bioprocessing, food quality and safety. Currently, he actively aspires to secure a Post Doc position. His research interests encompass Food (processing, Biotechnology, Halal food, safety, and preservation) and Food security and agriculture.

Fighting hunger ranks among the most difficult tasks of our period. This endeavour is further complicated by the impact of climate change, which is progressively influencing primary food production and broader food systems. Simultaneously, the agriculture and land use sectors significantly contribute to the overall greenhouse gas emissions on a global scale. The capacity of our natural resources to sustain future populations' food needs, particularly in the year 2050. It assesses global land use, water use, and fertilizer use for various dietary scenarios. The findings underscore the pressing need for substantial agricultural development to meet future food demands (Odegard & van der Voet, 2014).

Climate-smart agriculture represents a holistic and forward-thinking approach to addressing the challenges posed by climate change to agriculture and food security. By integrating adaptation, mitigation, resource efficiency, and policy support, CSA offers a promising pathway to not only safeguard our food supply but also contribute to global efforts to combat climate change. It underscores the necessity of adapting our agricultural systems to a changing climate while simultaneously working toward a more sustainable and resilient future for agriculture and food production.

Climate-smart agriculture offers a comprehensive strategy for addressing these interconnected challenges, with a focus on three core goals: enhancing productivity and income sustainability, bolstering resilience and adapting to climate change, and minimizing greenhouse gas emissions wherever feasible. The implementation process of CSA follows a structured framework comprising five key steps. It commences with building an evidence base and progresses through enhancing supporting policies, institutions, and financial mechanisms, ultimately culminating in on-the-ground implementation. Within the agricultural sector, encompassing crop and livestock production, fisheries, aquaculture, and forestry, as well as the management of land and water resources, and the various stages of food value chains, each faces distinctive challenges concerning the three CSA objectives while also exhibiting inter dependencies. To formulate successful strategies and production systems facilitating the shift towards climate-smart food systems, fostering resilient livelihoods for food producers, and advancing the global mission to eradicate hunger, it is imperative to possess a thorough comprehension of these challenges, recognize the interconnections within food systems, and foster coordination across various fields and sectors (Matteoli et al., 2020).

Climate-smart agriculture (CSA), A case study encompassing 24 initiatives across Africa, with a particular focus on the following core areas for in-depth examination, was conducted. These areas include: Climate-Smart Village Approach, Climate Information Services and Science-Policy Integration. The analysis of these case studies revealed that CSA can play a pivotal role in driving transformative changes within African food systems by: By adopting pertinent climate-smart technologies and practices, it is possible to redirect farming and rural livelihoods toward climate-resilient and low-emission pathways. The creation and application of WCIS can contribute to risk reduction in livelihoods, farms, and value chains in response to the growing unpredictability of weather and extreme events. Embracing climate-smart options that reduce waste in the production, processing, packaging, transportation, and marketing of food can mitigate the associated carbon footprint. It involves reshaping policies and financial mechanisms to facilitate action in these four core areas. This includes identifying innovative ways to mobilize sustainable finance and create effective financial channels (Zougmoré et al., 2021).

In this context, Climate-Smart Agriculture (CSA) plays a crucial role in bolstering crop production through a combination of adaptation and mitigation strategies. CSA actively contributes to the establishment of agricultural systems that are resilient to climate change. For example, it enhances soil quality, optimizes the efficient utilization of water and nutrients, and promotes stable crop yields while simultaneously curbing emissions associated with the Sustainable Development Goals. Despite the widespread recognition of the advantages of CSA, there exists a scarcity of comprehensive assessments regarding the full potential of CSA techniques for both adaptation and mitigation, and the existing evaluations remain scattered and incomplete (Abhilash et al., 2021).

Agriculture 4.0 incorporates an array of technologies, including Internet of Things (IoT) systems, deep learning techniques, and machine learning methods. These technologies are deployed to efficiently monitor and manage various agricultural processes. Smart agriculture is significantly improving the productivity and efficacy of the agricultural sector through various means. Nevertheless, there exist several challenges that must be addressed to make it economically viable for small and medium-scale farmers. The primary considerations include security and affordability. The anticipated growth in the adoption of IoT technology in agriculture can be attributed to increased competition within the sector and the implementation of favourable policies. The strategic use of advanced technology can play a substantial role in advancing food sustainability for both present and future generations by optimizing the utilization of available resources and assets (Raj et al., 2021).

Beyond its technical and economic aspects, climate-smart agriculture raises ethical questions about the equitable distribution of benefits and adaptation strategies.

1. Plant diverse crops to reduce vulnerability to changing climate conditions. Crop rotation and intercropping can enhance resilience and soil health. Develop and utilize crop varieties bred for climate resilience. These varieties can better withstand temperature extremes, pests, and diseases.

2. Implement efficient irrigation systems, rainwater harvesting, and drought-resistant crop varieties to conserve water resources. Adopt conservation tillage practices to reduce soil erosion and enhance soil fertility. Cover cropping and agroforestry can improve soil health.

3. Integrate natural ecosystems into agricultural landscapes to provide ecosystem services, such as pollination and pest control. Utilize climate data and forecasts to make informed decisions on planting and harvesting times, reducing climate-related risks.

4. Explore practices like agroforestry and cover cropping to sequester carbon in soils, mitigating climate change.

5. Minimize food waste through improved post-harvest handling and storage practices. Governments should create policies that incentivize CSA practices, such as providing subsidies for climate-resilient crop varieties and promoting sustainable land use.

ISSN-Internet 2197-411x OLCL 862804632

6. Invest in research to develop innovative CSA practices and educate farmers about their benefits. Establish financial mechanisms such as crop insurance and credit schemes to help farmers cope with climate-related losses.

7. Encourage community involvement in CSA initiatives, fostering knowledge sharing and collaborative efforts.

8. Promote the adoption of climate-smart technologies, including precision agriculture tools and weather-resistant infrastructure.

9. Implement sustainable livestock practices, including rotational grazing and improved feed efficiency, to reduce the environmental impact of animal agriculture.

10. Facilitate market access for small-scale farmers practising CSA, ensuring they receive fair prices for their products.

11. Encourage international cooperation to address climate change and food security challenges through initiatives like the Paris Agreement and the United Nations Sustainable Development Goals.

The african government has created many plans and strategies to combat climate change, but they are not properly carried out. In the long run, appropriate strategies and regulations for climate change should be created and properly executed because climate change significantly impacts agriculture production. Therefore, sustainable practices must be considered and put into action for the benefit of farmers, the environment, and food security.

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