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Climate Smart Agricultural Technology in Developing Countries: A Review

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Abstract:- The key route to economic transformation and development is provided by agricultural modernization. the devastating effects of climate change, which is already seen in developing countries through prolonged droughts, floods, unsteady rainfall patterns and weather variations pose a great change to food production and rendering many households vulnerable to food insecurity and nutritional deficient.

Climate smart agricultural technologies are aimed at reducing the impacts on this global menace on farmer's thereby boosting productivity to enhance income and increase accessibility and availability of quality food for all. CSATs also enhance resilience through adaptation strategies to minimize the impacts of climate change.

However, the adoption of CSATs are hampered by limited access to information available, education level, social life, experience and cultural differences. To increase and surmount this menace, more awareness and enlightenment campaigns, local engagement of community leaders, more women participation and financial incentives should also be promoted and provided to encourage adoption of CSATs

I. INTRODUCTION

A key route to economic transformation, economic development and increase in material welfare is provided by agricultural modernization. The devastating effects of climate change, which is already seen in many developing countries through prolonged droughts, floods, unsteady rainfall patterns, pose a challenge to the revolutionalisation of agriculture. This has a negative impact on the farming industry, change in farming trends and patterns and surge in emigration from nations in developing countries in search of better soil for crop production and fodder for their animals by at least 50% between the years of 2010-2017(Connor, p.2018).

More so, farming household's nutritional and food security has been compromised, leaving 39% and 49% of them in state of food insecurity and varying degree of nutrient insufficiency. (Fraval,S., et al 2019). this suggests that the United Nations (UN) Sustainable Development Goals (SDGs) one and two (no poverty and zero hunger) may not be actualized in developing countries despite the at different tiers to end poverty and boost food and nutritional security especially in developing countries.

Climate smart agriculture can boost in resilience building to assist farmers increase productivity. Developing nations can increase their economic diversification by implementing use of climate smart technology advancement across agricultural value chain taking advantage of this global menace into an opportunity.

About 80% of farmers in Sub Saharan Africa are smallholders (Yamba, S., et al. 2019). they are largely vulnerable to the fluctuations of the changing climate. They are poorly resourced and lack adequate knowledge of the phenomenon, hence there is a need to develop their capacity to appreciate and make-do the available adaptation and mitigation technologies. Since the emergence of climate change, measures have been put in place by the governments and organizations to check the progression of climate change and reorient the agricultural systems to effectively support agricultural development and ensure food security (FAO,2015).

In addition to climate change, other global forces, or megatrends, are currently underway, with the potential to exacerbate the challenges that African countries are facing in transforming their economies. These megatrends include demographic changes, especially the upsurge in the population of the youth, growth in the middle class, increased urbanization, rapid technological changes, and the associated increase in anti-social behaviors.The supply of products from natural resources, such as food, water, energy, and ecosystems services, continues to receive pressure as demographic trends are projected to yield an increase in Africa's population by the year 2050. (Kombat, R.,2021). Concepts such as climate-smart agriculture could be used to help smallholder farmers adapt to climate change and, at the same time, mitigate greenhouse gas (GHG) emissions.

According to the Food and Agriculture Organization of the United Nations (FAO),climate change is a global phenomenon that presents one of the greatest risks humanity has ever faced. It causes floods and droughts and negatively impacts farmers' livelihoods by affecting ecosystems, water supplies, food security, settlements, and human health (FAO, 2016).

Because there is a significant relationship between climate and agriculture in all universal processes, changes in the climate have an impact on agricultural activities. Enhancing carbon dioxide (CO2) accumulations will likely have a large number of potential consequences on plants and may also pose a large number of indirect hazards to herbivores and all other members of the food chain. Agricultural activities are greatly impacted by hazardous climate conditions such as powerful rainstorms, strong wind pressures, and high temperatures (Amin et al., 2015).

Changes in the climate have an effect on agricultural activities since there is a strong correlation between climate and agriculture in all universal processes. In addition to potentially harming plants, increasing carbon dioxide (CO2) accumulations may also offer a range of indirect risks to herbivores and other members of the food chain. Hazardous climate conditions such intense rainstorms, high winds, and high temperatures have a significant impact on agricultural activity (Amin et al., 2015).

Furthermore, according to IPCC, Climate change frequently has a detrimental impact on agricultural productivity in some parts of the world, and developing and poor nations are particularly vulnerable to further negative effects. There are two ways to reduce these negative effects: mitigation and adaptation.

Mitigation is a process of reducing greenhouse gas emission, and it mostly falls under the purview of developing nations (Adger et al., 2005).

According to Adger et al. (2005) and The Energy and Resources Institute (2006), adaptation is the modification of social, ecological, and economic systems in response to observed or anticipated climate variability. It involves changing processes, practices, or structures in order to reduce negative effects and increase positive ones. It also the process by which strategies to moderate, cope with and take advantage of the consequences of climatic events are enhanced, developed, implemented and utilized.

By incorporating this strategy, CSA hopes to address the overlapping issues of food security and climate change (Lipper et al., 2014). No country is immune to the effects of climate change, and poorer nations, which were less responsible for the issue's emergence, are the most vulnerable and least able to adapt to its repercussions (Yesuf et al., 2008). According to Adger et al. (2005), socioeconomic and environmental factors affect susceptibility to various degrees.

Climate, soil quality, topographic exposure, and the availability of natural resources are examples of environmental factors, whereas socioeconomic factors include infrastructure, income, political environment, institutional strength, credit availability, and access to global markets (Adger et al., 2003; Sarun et al., 2018).

The way in which CSA activities are received by communities and organizations must be considered in research and development. In view of the emerging realities of climate change, survival needs a transformational and reorienting approach for agricultural development (Lipper et al., 2014). Therefore, if we are to close gaps and increase collective action on CSA, we need a proactive platform for government agencies, non-governmental organizations (NGOs), donors, the private sector, and civil society organizations.

The concept of 'climate –smart agriculture''(CSA) expresses a desire to better integrate agricultural development and climate responsiveness.in light of a changing environment and rising food demand, it seeks to meet both food security and more general development goals. production, adaptation and mitigation are pillars of CSA efforts that sustainably raise production, improve resilience and reduce or eliminate greenhouse gases (GHGs). This requires planning to handle tradeoffs and synergies between these three pillars (FAO,2010). To create more efficient, effective and equitable food systems that address issues in the environmental, social and economic dimensions across productive natural environment, different countries and stakeholder's interests are taken into consideration. many of the strategies that make up CSA already exist globally and are utilized by farmers to manage a variety of production risks despite the fact that the concept is new and continually evolving (FAO,2013).

Climate- smart agriculture (CSA) is an integrated approach aimed at managing the environment including crops, animals, forests, and aquaculture. CSA is aimed to address interconnected problems of food insecurity, sustaining food supplies and boosting productivity, CSA technologies seeks to accomplish three goals at once:

- To enhance and boost productivity: increased production and better food to enhance income and improve the availability of quality food for all, especially for the 75% of the world poor who reside mainly in developing nations that agriculture is the source of their livelihood.
- Enhance resilience: thereby lowering vulnerability to pests, diseases, droughts and other climate related hazards and shocks; and also increase the capacity to adapt to long term pressures such as shorten seasons and unpredictable weather patterns.
- Lastly it looks at techniques to absorb carbon from the environment as well as lower emissions per kilogram of food produced.

II. ADOPTION OF CLIMATE SMART AGRICULTURAL TECHNOLOGIES

In the past, farmers in Nigeria unintentionally employ CSA as a part of their regular food production system (Fanen and Olalekan 2014). In similar vein, it was discovered in the study of (Naswem et al. 2016) that planting drought resistant varieties, mixed cropping and recycling of waste products. In Nigeria the five most utilized climate smart agricultural technologies were conservation agriculture, the use organic manure, crop diversification, use of wetland (FADAMA), the planting of drought resistant varieties and OO9agroforestry.

More so, similar findings were reported by Tiamiyu et al. (2018). In their study the found out that farmers adopted climate smart technologies such as planting drought tolerant and early maturing varieties, applying organic compost, mulching, zero tillage intercropping, crop rotation, building terraces on hilly farmlands and agroforestry. All these indicated that farmers had kept up and continued to develop more CSA technologies to lessen the impact of climate change while boosting productivity and increasing their income.

III. CHALLENGES OF CLIMATE SMART AGRICULTURAL TECHNOLOGIES

Adoption of CSATs is hampered by a wide range of issues due to a variety of socioeconomic and institutional issues. Fawole, B., E & Aderinoye-Abdulwahab, S.A (2020).the inability of the farmers to incur cost in adoption CSATs, limited access to technical information and inability to put newly acquired knowledge into practice are some of the challenges associated with the adoption of CSATs.

Furthermore, some technologies that are also linked to sustainable soil management may also not be compatible with the farmer's customs. Fawole, B.E & Aderinoye-Abdulwahab,(2020). More so, a farmer's level of adoption may be influenced by his education level and his social life. (World bank 2018).

Other factors that influence adoption of CSATs as asserted by Williams et al (2015). Include lack of practical knowledge and understanding of the approach by the relevant stakeholders especially the farmers. In sufficient investment in CSATs has found severally and there is urgent need to increase investment that will boost adaptation and resilience in agriculture which are insufficient. The Africa's Infrastructure and Diagnostic Report (Foster and Briceo-Garmendia 2010) also noted a lack of social infrastructures such as roads, electricity, water and communications which are crucial to adoption of CSATs. and at the farm level absence or lack of productive resources such as land, water and good transportation system was little.

Lastly insufficient women empowerment despite women making a considerable contribution in food production in developing countries, women are mostly denied access to and control over productive resources especially land, crop and animal inputs and capital.

IV. RECOMMENDATION AND CONCLUSION

Adoption climate smart agricultural techniques is essential for the raising of agricultural productivity and resource use efficiency since it improves climate change adaptation, food security thereby ensuring food for all at meet the sustainable development goal while decreasing greenhouse gas emissions.

According to the report, obstacles limiting the adoption of CSATs include inadequate funding, lack of personal grasps of the strategy, limited access to CSATs materials and socioeconomic limitations at the farm level.

Therefore, in order to boost farmers' productivity and output, there urgent need for an active awareness and enlightenment for the adoption of CSATs as a response to the effects of climate change. In order to facilitate the adoption of CSATs government and stakeholders such as NGOs, community leaders should make sure that productive resources such as land, planting technologies, education and other social infrastructures are made available, accessible and attainable to farmers generally, but more particularly women.

Lastly incorporating financial incentives in form subsidies to adopters of CSATs will scale up level of adoption.

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