Climate field school as a panacea for climate change adaptation and mitigation for ecological sustainable and food production in agriculture. An overview

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Abstract: **The review is on the important of climate field school for climate change mitigation and adaptation on environmental sustainable and food production in agriculture. The review is qualitative and it used secondary data from various literatures. It emphasized that agriculture is sensitive sector been threaten by climate change variations affecting farmers' livelihood and creating extreme events of flood, wildfires, rainstorm, drought and heat waves on the land which is the only natural resources farmers depend on. The review further intensified the use of three approaches of food production sustainability, adaptation and mitigation of climate field school which stressed the need for, reduced related activities greenhouse gases emission and management processes for crops and livestock growth. The review categorized the various agricultural activities which emits greenhouse gases and the mitigations managing process which include reforestations, direct agricultural emission reductions, use of renewable energy sources as specific by climate field school for sustainable environment, adaptations and mitigations. The review identified limited information, knowledge, lack of local and indigenous indicators and dynamic variations of climate in various agro-ecological zones as some of the challenges in communication of climate change mitigations and adaptations in climate field school. The recommendations and conclusion include using participation approach for climate field school, encouragement partnerships of private, civil society organizations and International agencies, the use of good reforms institutional policies to support climate field school and consideration of social and gender considerations.**

I. INTRODUCTION

Agriculture is very sensitive to climate and Climate variation is the major challenge to development of agriculture in Africa and the worldwide. Climate change is not only challenging to development of agriculture but it is threatening food security and livelihood conditions of many population according to Technical Centre for Agriculture and Rural Co-operation (2009). (Kurukulsuriya and Mendelson 2007), reported that agriculture in African is very sensitive to climate variations such that farmers are experiencing net revenue loss due to unstable in precipitations, flood, wide fire and drought. In a similar study (Boko et al,. 2007), predicated that climate change on agricultural production have undesirable consequences on food security in African and this is expected to vary across and within countries of region spatially. Climate change is threatening agricultural system and it poses a serious danger of environmental disaster with high intense weather extreme events which is currently affecting livelihood of many low income countries in the world (Schild,2010).

In Nigeria agriculture is the main source of food and raw materials, contributing about 40% to the economy Gross Domestic Product (GDP) and provides 70- 80% employments for the population. According to (Ozor, 2009), the sector depends mostly on climate and weather conditions to stimulate the production of crops and livestock. Variability in climate change has negative impacts on farmers in developing countries because lack of technology and dependent on natural resources for farming and inability to manage the menace (Sthapit and Padulosi, 2011). The significant variations in temperatures, rainfall pattern, solar radiation and atmospheric gases have a serious impact on production of agricultural raw materials and it land use patterns (Ahmed, Al-Amin, Mohamad, & Chenayah,2016; Swiar, Idris,Yasar,Morshed,2014; Tawang,Ahmad,&Abdullahi, 2001; Vaghefi et al.,2016). In Nigeria just like any other developing country, the uncertainty of weather is affecting livestock and crop production where farmers' income is becoming very low leading to widespread poverty (Goyol and Pathiage,2018).

Problem statement

Since climate change is affecting farmers livelihood there is every need to gain wider knowledge on it for policy circle on adaptation and mitigation. There are many promising technology and innovations to combat climate change. Such innovations include climate field schools. According to (Smit and Wandel, 2006, Mano and Nhemachena, 2007), because adaptation are often field level specific many scholars have call for actors approach in order to gain analysis and better understanding of the fundamentals rules underlying adaptations processes for stakeholders. The introduction of climate field schools will help for adaptive and resilience capabilities of the rural farmers for enhancement and greater benefits. Climate field schools will call for innovations that are current with local knowledge and stakeholders' participation. According to Rijik et al (2000), people may be aware of existing information, but may not have the guidance to use it therefore climate field school will help farmers to make routine decisions about agricultural production in

farming system. Climate field schools will provide the calendar of activities in line with forecast weather to farmers taking cognizance of each agro-ecological zone. (Snapp et al, 2019), the farmers act as a subject of the research because it is always well known participatory research.

Therefore, transfer of appropriate technology on resilience using climate field school will be very important because total account of local capabilities to adopt including processes, materials adjustment and approaches will be address.

The approaches for climate field school

The need to embark on climate field school is very important for agricultural productivity improvement on resilience, sustainable ecology, adoption and the require efforts for joint investment by stakeholders and partners to support valve chain. According to World Meteorological Organization (WMO, 2015), climate field school started with the initiatives of Global Framework for climate change service with the aim and objectives of building a common knowledge on climatological processes for farmers' ability on anticipation of extreme events on planning, climate variables observations and use of farmers own experience .(Siregar and Crane 2011), denotes that climate field school is important as much as farmers field school in the sense that, there are similarity in farmers field school FFS and farmers field school CFS although different in implementation approaches. The CFS approach is assumes on small scale farmers to collect and interpret data or comprehend the analysis on agro- ecological within their environments, largely top-down approach and co-creation while FFS are based on understanding of good Agricultural practices, largely bottom up approach and observations. (Pulwarty et al., 2003) advocate, that information provided on climate field school should be clear in nature informing the learners about the limitations because of its variations in nature.

It is of important to know that development of communication on seasonal forecasts should be timely, clear and concise as it is very curial for change of users' behaviors who are farmers. In their research (Simelton and Le, 2020) opined that, for achievement of broad benefits from climate field school services, messages should be clear with the use of weather icons which may not be universal and may be interpreted differently based on gender, culture or education level. The most useful is the tailoring of information needs to users' specific need at temporal scales and appropriate time.

In their report, (Daniel et al.2020;Guido et al.2020), there should be a trend towards engaging the stakeholders to produce more reliable, relevant and information that are of use to participants involved. Climate field school is also a capacity building structure for climate service providers, it is also another benefit making for users who learn the innovations on climate data collection interpret and apply for positive decision making (Guido et al 2020).

According to Climate Resilient Agribusiness for Tomorrow (CRAFT, 2020) climate field schools arose on the need to address sustainability for income on agricultural production, enhanced adaptation and resilience and reduced greenhouse gases affecting agricultural production. (CRAFT, 2020), grouped the approaches into;

Food production: This is aim at reducing negative impact on the environment. It is the sustainability and intensification of production in agriculture. The climate researchers classified food production under Agriculture, Forestry and Land –use (AFOLU), according to (IPCC,2014) food production under forestry and land use accounts for about 24% percent of net gases emission. The sustainability of the environment should consider development of pathway for non-emission of greenhouse gases which include conversion of agricultural by-products and avoid burning. The avoidance of agricultural by-products and bush burning will contributing to mitigation consider a safe stay of 1.5-2 degree Celsius temperature goals (IPCC, 2018).

In a long run Food and Agriculture Organization (FAO) introduced the term Climate –Smart Agriculture (CSA) that includes aspect of climate field school which described the practices that can help the policymakers and extension agents on climate change mitigation and adaptation (FAO, 2010). The sustainability of food production is also an effective combinations of practices that reduces gases emission, enhance water and soil quality, improve food productivity and boosting resilience approach (Rathore and Srinivasulu,2018). In the use of climate field school, another aspect of the study for sustainability is integrated agricultural system which is environmentally friendly on land use base management. The use of greater zero tillage and minimum system have significantly improves soil aggregations, bulk densities, moisture conditions and organic matters.

*Adaptation***:** According to (CRAFT, 2020), Climate field schools on adaptation aim to reduce farmers' exposure to risks that are short term in nature, also considering their sensitivity by strengthening their resilience where their capacity are been built to adapt and prepare and prosper in the shock of long-term.

The adaptation on agricultural land use can be enhanced using climate field school on the following parameters of drought tolerant breeds, enhancement of moisture retention, soil fertility improvement, protection from wind and water erosion adoption to farmers for adaptation to climate change and protect the adverse effect .The attention of local knowledge can be enhance on practices of resilience which include perception of indigenous knowledge on weather and its extremity using local traditional to forecast weather. Cropping system analysis to identify the risk and adaptation practices using local indicators that are standardized and common to the community such as rainfall, temperature and rainfall measurement.

In a similar view (FAO, 2021) identified some types of adaptive options that should be considered using climate field school these are;

- Biodiversity genetics: this is the use of genetic characteristics of different varieties that reduce or do away with the exposure of species of living things that are considered important to man's survival in agricultural production. Such strategies include early plantation of maturity crops and plantation of crops that are tolerant to heat.
- Creating Environmental changes that are productive for agricultural use: This is the various ways of reducing or eliminating the impact of climate change risks, such practices include the use of mulch to reduce moisture content loss in the soil through evaporation, use of rain water harvesting system to capture more rainwater and channel it where land cultivation will take place in dry season, planting of grass on the top soil that will prevent topsoil run off and use of organic manure that will hold topsoil for erosion prevention.
- Decision making that will enhance agricultural productivity and reduce the risk of exposure: Growing crops in new locations to avoid sandy soils and drought prone places, Practice of mixed cropping so that will withstand harsh conditions and changing of how seed are planted to withstand the effect of dynamic weather conditions. (Segovia and Galang, 2002) advocated that climate change education should include overt links development that are sustainable which can create local impacts to farmers.

*Mitigation***:** This approach seeks the possible way to reduce Greenhouse Gases (GHGs) that are warming the planet. The approaches include renewable energy sources use of wind, solar energy and use of electric vehicle, use of biofuel and afforestation According to (CRAFT, 2020).

(FAOSTAT 2013) in their research listed sources of emission as follows;

- Enteric fermentation of ruminants including goats, sheep, cattle that emit methane directly as the byproduct contributing 43 percent of global warming.
- Synthetic fertilizer which emission of nitrogen dioxide from the soil to the atmosphere having 15 percent contribution of global warming
- Crop residues that remains on soil which contribute 3 percent of nitrogen dioxide in global warming
- Manure deposited on grazing lands contributes 16 percent of nitrogen dioxide emission leading to global warming
- Rice production result in emitting methane from anaerobic decomposition on flooded lands contributing 11 percent of the global warning
- Stored manure from livestock and urine caused methane emission contributing 7% percent of the global warming
- Manure deposited on croplands produces nitrogen which emits in the atmosphere by 2 percent contributing of global warming
- Cultivations of organic soil contribution are 2 percent from drained organic soils leading to global warning.

In their study (Brandon 1999, Brody and Ryu 2006) assert that through climate field schools, learners see or understands a direct effort of their action which is clear demonstration to obtain good results, therefore it is very important to include the gas emission sources and their percentages in the tools and calculations so that learners can track the changes they made overtime on mitigations.

Challenges of climate field schools communication

Several literatures have emphasized on problems of climate field school which include obstacles in information and knowledge constraints. Many have scores obstacles to be limited information in the area of weather condition (Mullins et al., 2018). (Eidit et al., 2012), reviewed that there is overlaying on scientific language while actors approach system is neglected.

Furthermore to CFS is that participants' knowledge gaps are too wide with the trainers which eventually make learners to lose attention because there is lack of practical tools for proper understanding. In another development some claims suggests that lack of technical know-how can prevent meeting the targets of climate field school (Gledhill et al,.2012). Most of researchers suggest that building of farmers capabilities on farmers' field school is completely undermine (Steenwerth,2014).

Researchers have observed that climate field school is been hampered by policies that are politically institutions which are short-term production in agriculture over long-term which intensified sustainability in climate change approach (Cavanagh,et al,.2017). Many authors are of the view that there should be improvement on institutional frameworks and more workable reforms that improves the climate change, agriculture and food policies system. (Cistulli, 2015 and FAO, 2018) reported that variations in agro ecological differences are the problems extension agents faced in climate field schools. In another observation researchers are of the view that effective and efficient communication of the information needed for possible adaptation is difficult because of the inability of the facilitators to translate the knowledge of climate change into the language of the farmers. Another great challenge facing extension workers in the field of climate change is the absence of developed of universal indicators of climate change parameters for measurement.

II. RECOMMENDATIONS AND CONCLUSION

- Farmers' field school should be field specific using actors approach by localizing agriculture and climate information within the reach of participants and consideration of their decision making based on what they learnt.
- There should be pluralistic approaches on climate field school that is involvement of many stakeholders on climate change advisory services delivered. Climate change been dynamic a holistic approach of many partners of international agencies, civil society organizations and private bodies should be involved.
- There should be collaborative efforts of curriculum development by education and agriculture ministries on climate change to schools.
- There should be wider sets of institutional reforms and policies that are align with national, state and local government that are viable and encourage participation of stakeholders in climate field school.
- The stakeholders on climate change advocacy should look into translation and interpretation of climate change indicators into simple and if possible indigenous knowledge because 70% of the farmers lived in rural area where indigenous language is mostly spoken.
- There should be policies formulation on climate field school that focused on social and gender consideration.

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