



Assessment of the Impact of Climate Change on Soil Health Status and Influence on Food Security

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According to the IPCC, the global temperature is expected to increase between 1.8°C to 4°C during the 21st century and precipitation patterns altered. Soils are intricately linked to the atmospheric/climate system through the carbon, nitrogen, and hydrologic cycles. Because of this, altered climate will have an effect on soil processes and properties. A healthy soil acts as a dynamic living system that delivers multiple ecosystem services, such as sustaining water quality and plant productivity, controlling soil nutrient recycling decomposition, and removing greenhouse gases from the atmosphere. Climate change has a lot of implications on food security in Nigeria. It also constitutes threats to global food security. Food security encompasses food availability, accessibility and utilization. Agriculture is a major land use, using approximately 38% of the global land area. Climate change may affect food systems in several ways ranging from direct effects on crop production, changes in rainfall leading to drought or flooding, warmer or cooler temperature which leads to change in the length of seasons. Therefore, further study of soil health status and climate change interaction is critical in addressing future food security concerns.

Introduction

Soil health is the ability of the soil to function as a vital living system, within ecosystem and land-use boundaries to sustain biological productivity, maintain the quality of air and water, environment, and promote plant, animal and human health (Doran and Zeiss, 2000). For a soil to function at optimal level, it requires more than just focusing on crop productivity but rather on proper management and good land-use decisions which encompasses a balance between soil functions for productivity, plant and animal health and environmental quality (Doran, 2002).

Climate change and agriculture are interrelated processes and global warming is projected to have significant impacts on agriculture by influencing through direct and indirect effects on crops, soils, livestock and pests. With this change in climate there will be effects on the environment, including the soil (Brevik, 2012) Soils are important to food security, and climate change has the potential to threaten food security through its effect on soil properties and processes (Lal, 2010)

According to the projection of the International Panel on Climate Change (IPCC) the increase in global temperature will probably rise from 1.1°C to 4°C by the end of the 21st century (IPCC, 2007). Nigeria has been identified as a climatic hot zone likely to see major changes in weather patterns ranging from rainfall, temperature, and sea levels throughout the 21st century (Akpodiogaga, et al 2009). The effects of the change in climate will be on the environment, including the soil and this has the potential to threaten food security through its effects on soil properties and processes (Brevik, 2013).

The rapid projected increase in world population to 8.9 billion people by 2050 will lead to higher demands for agricultural products (Lichtfouse et al, 2009). Food demand will increase by 60-70% in the next 40 years, in an environment where droughts and precipitation will have a negative impact on food production (Valin et al, 2014). As a result of the increase in the effect of climate change, crop yield has decreased tremendously in many areas, and producers are intensifying efforts to increase cultivated areas and this has led to a rise in cost of production. Meeting the projected



demand for healthy and sustainable food production is a crucial challenge. In fact, increasing crop productivity by mitigating climate change and preserving agroecosystems is one of the significant goals of sustainable agriculture (Timsina, 2018) However, meeting agricultural demand by intensive use of synthetic fertilizer and pesticides has led to land degradation and environmental pollution in several agroecosystems which has had an adverse effect on humans, animals and aquatic ecosystems (Devarinti, 2016)

The potential impact of climate change is visible in the agricultural sector. Climate change will not only affect the production of crops but will also negatively impact their quality. Lack of nutrients and protein will be found in the grains, due to which the health of humans will be affected even after taking a balanced diet. Due to the increase in temperature in the maximum regions, production of most crops will decrease.

Influence of Climate change on Soil Health Status

The potential impact of climate change on soil health is majorly through soil organic matter. The major components of soil organic matter are Carbon and Nitrogen (Brady et al, 2008). Soil organic matter is one of the most complex and heterogeneous components of soils which vary in their properties, functions and turnover rates (Weil and Magdoff, 2004). Soils with huge amount of organic matter have high water retention capacity, cation exchange capacity and are more productive than soils with depleted organic matter (Brevik, 2013). Increased temperature is likely to have a negative effect on C allocation to the soil, leading to reductions in soil organic C and creating a positive-feedback in the global C cycle (increased temperatures lead to increased CO₂ release from soils to the atmosphere, which leads to more increases in temperature) as global temperatures rise (Wan et al, 2013). A decrease in soil organic matter can lead to a decrease in fertility and biodiversity, as well as a loss of soil structure, resulting in reduced water holding capacity, increased risk of erosion and increased bulk density and hence soil compaction. Through climate change our soils are expected to become more susceptible to erosion by wind and water thereby losing their fertility (Sivakumar, 2011). Land use and management practices that leads to build up of soil organic matter will help in absorbing CO₂ from the atmosphere, thus mitigating global warming. By increasing its water storage, soil organic matter can play an important role in the prevention of flooding after extreme rainfall, while storing water in the event of droughts thus increasing soil resilience.

Effects of Climate Change on Food Security

Food security (is) a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (FAO, 2003). Climate change is expected to result in long term shortages of water, diseases and pest outbreaks on crops and livestock, soil degradation and other resources. Thus to be food secured, a household must have access to sufficient food that meets its nutritional requirements either by purchasing food or directly producing (Essien, 2013). As the world’s population increases geometrically, there are more people who need food, livestock and energy. In order to meet the increasing food needs as a result of the geometric increase in population, man now rapidly depletes the fertile soils, biodiversity, fossil groundwater, and numerous other non-renewable resources to meet his needs (Abrahamson, 1989) Rough estimates suggests that for the next 50 years or so, climate change may likely have a serious threat to meeting global food needs than other constraints on agricultural systems (IPCC, 2007). Agricultural production in Nigeria like in other developing countries is highly vulnerable to variations in climatic parameters which may have direct effect on performance of food crops. More productive and resilient agriculture requires transformations in the management of natural resources (e.g. land, water, soil nutrients, and genetic resources) and higher efficiency in the use of these resources and inputs for production (Onuoha, 2014). Long-lasting climate pressures, such as prolonged drought, will also increase the vulnerability



of migratory groups to climate change which could be disastrous. Short-term migrants could be forced into becoming more permanent migrants by limiting the scope of areas to move to, resulting in dire consequences such as pressures on land and resources (Desanker, 2002). Low soil fertility is currently a food security problem in many developing countries, particularly in Africa and South Asia (Sanchez, 2005). Proper soil management has the potential to effectively reduce food security.

Recommendation

- Government should integrate issues of climate change as well as adaptation strategies into the national development plan since the climate change risks is not only a challenge to food security but to the country's general development
- Sensitizations and trainings should be organized for farmers in other to improve their knowledge on climate change
- Localized mitigation strategies should be provided in other to improve and sustain food security for agricultural productivity which will ultimately improve land management

Conclusion

There is an emerging consensus that changes in temperature and precipitation can have detrimental effect on the food security of the most vulnerable people, in the absence of adaptation. However, the overall impact of climate change on food security is not fully understood. Climate change poses a serious threat in Nigeria especially in the areas of Agriculture. Agriculture is likely to suffer losses due to the change in weather condition such as heat, and change in rainfall pattern. Mitigation strategies can help to minimize the negative effect of climate change. Agriculture is not only affected by climate change, but contributes through emitting greenhouse gases. Therefore, climate change mitigation can be achieved through the reduction of greenhouse emissions from agriculture by encouraging environmental friendly agricultural practices. As a nation, we have to employ better adaptation techniques and technology in order to successfully mitigate the rising effect of climate change.

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