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AGRICULTURE AND CLIMATE CHANGE: MITIGATION PRACTICES

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ABSTRACT

In the last decade, an overwhelming consensus has emerged among scientists that the world has entered an era of rapid global climate change, much of which is attributable to Green House Gas (GHG) emissions from human activity and agricultural production processes. Even though the overall consequences of Green House Gas emissions remain uncertain, many scientists believe the risks of negative impacts felt through global warming are substantial, and suggest that society turn its attention to emission reduction.

Agriculture is not just affected by climate change, agricultural and agricultural production systems also have the potential to mitigate or exacerbate climate change trends. Agriculture is now recognized as both contributing to and suffering from the negative effects of climate change which makes it imperative to look into the effects of agriculture on the climate.

This paper looks at agriculture both as a significant emitter of Green House Gas (GHG) and as a potential sink for GHG.

KEY WORDS: *Climate Change, Agriculture, Green House Gas, Sustainable Agriculture.*

INTRODUCTION

Climate change is widely considered to be one of the greatest challenges to modern agriculture that has profound socioeconomic and environmental impacts. Climate change can result from a variety of natural causes such as solar output, sunspot activity, Milankovitch episodes and Vulcanicity or from human activities such as deforestation, overgrazing and increased atmospheric Carbon-dioxide through burning of fossil fuels, or from both the natural and human activities (Nkemdirim, 2003).

Third World countries, particularly Africa are threatened by the predicted effects of climate change because of their economic dependence on climate for development whose backbone is agriculture. Farming accounts for as much as 32% of greenhouse gas emissions, if deforestation is included. On the other hand, climate-driven water scarcity and increases in the severity of droughts and floods will affect food production, especially in subsistence sectors.

According to Chomitz et al. (2006), climate change is one of the greatest environmental, social and economic threats facing our world today. The warming of the climate system is believed to be unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level (Nicholson et al., 2000; Dessai and Hulme, 2001).

Agricultural production has increased dramatically worldwide in the past 50 years as modern agricultural practices evolved. But this success has been costly due to water pollution, soil depletion, and a host of human (and non-human) health and safety problems that have emerged as important side effects associated with modern agricultural practices.

According to the Intergovernmental Panel on Climate Change (IPCC) 2007, agriculture, as practiced today, accounts for nearly 14% of greenhouse gas emissions annually and that the agricultural sector is impacted by climate change Research indicates that current agricultural activities are a significant source of greenhouse gases that aggravate climate disruption. The Panel on Climate Change (IPCC) concluded that worldwide, agriculture exacerbates climate change trends by contributing about 13.5 percent of global GHG emissions and that Industrial agriculture is a major contributor to climate change. It also reported that a significant portion of the greenhouse gas emissions created by industrial agriculture are generated by agricultural pesticides and chemicals, deforestation and the burning of biomass.

The variability of the climate has been a topical issue in a sustainable environment as the crop yield and production is very important to the economy and livelihood of the peoples of the world at large. The sub-humid climatic zone of Africa permits the cultivation of a variety of crops in a pattern that emerged in earlier centuries in response to local conditions (Ziervogel et al., 2008; Onyekwelu et al., 2006), it follows therefore that any change in climate may impact the agricultural sector in particular and other socio-economic activities in general. Climate change could have both positive and negative impacts and these could be measured in terms of effects on crop growth, availability of soil water, soil fertility and erosion, incidents of pests and diseases, and sea level rise (Onyekwelu et al., 2006; Ziervogel et al., 2008; Semenov, 2009; Butterworth et al., 2009).

It is however essential that a portfolio of strategies be developed, that includes adaptation, mitigation, technological development and research (climate science, impacts, adaptation and mitigation) to combat climate change. It is also imperative on countries to take a proactive role in planning national and regional programmes on adaptation to climate variability and climate change through the Integration of mitigation and adaptation frameworks into sustainable development planning.

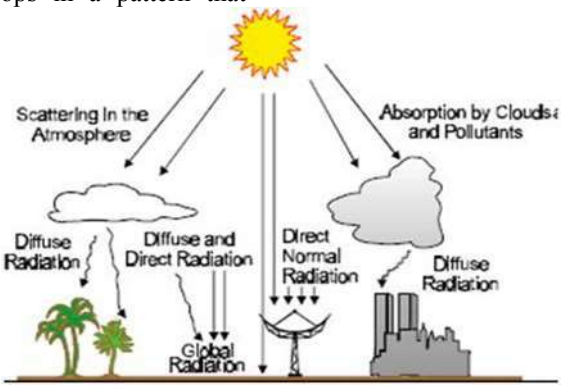

Figure: 1 – Climate change due to nature, diffuse and global radiation.

AGRICULTURE AND CLIMATE CHANGE

Climate change and agriculture are interrelated processes, both of which take place on a global scale. Agriculture has been shown to produce significant effects on climate change, primarily through the production and release of greenhouse gases such as carbon dioxide, methane, and nitrous oxide, but also by altering the Earth's land cover, which can change its ability to absorb or reflect heat and light, thus contributing to radiative forcing.

The agricultural sector is a driving force in the gas emissions and land use effects thought to cause climate change, however agricultural land can serve as a sink for GHG emissions, especially through soil carbon sequestration, which could help moderate climate change. According to the Intergovernmental Panel on Climate Change, the three main causes of the increase in greenhouse gases observed over the past 250 years have been fossil fuels, land use, and agriculture.

The Intergovernmental Panel on Climate Change (IPCC) 2007, reported that agriculture, as practiced today, accounts for nearly 14% of greenhouse gas emissions annually.

Agriculture contributes to greenhouse gas increases through land use in four main ways:

- CO_2 releases linked to deforestation
- Methane releases from rice cultivation
- Methane releases from enteric fermentation in cattle
- Nitrous oxide releases from fertilizer application

Together, these agricultural processes comprise 54% of methane emissions, roughly 80% of nitrous oxide emissions, and virtually all carbon dioxide emissions tied to land use.

Industrial agriculture is a major contributor to climate change, and a significant portion of the greenhouse gas emissions created by industrial agriculture are generated by agricultural pesticides and chemicals, deforestation and the burning of biomass.

IMPACT ON AGRICULTURE

The agricultural industry has a history of adaptation and innovation; that is why agricultural sustainability, survival and prosperity in the face of climate change depend upon adequate adaptation measures (AAFRD, 2005). All facets of agriculture are highly dependent on climate, which is why the threat of climate change must be taken seriously particularly in Africa because over 60% of Africans remain directly dependent on agriculture and natural resources for their well-being (FAO, 2003; Boko, et al., 2007).

Africa's geography makes it particularly vulnerable to climate change, where seventy per cent of the population relies on rain-fed agriculture for their livelihoods. With high confidence, IPCC (2007) concluded that climate variability and change would severely compromise agricultural production and access to food, also that in the drier areas of the world and would lead Stalinization, desertification of agricultural land, reduction in river run off and aquifer recharge in the semi-arid areas.

With the virtually certain likelihood of warmer and more frequent hot days and nights, there are projected to be increased insect outbreaks impacting agriculture, forestry and ecosystems. Agricultural sector will be under increasing pressures to ensure continued productivity, while safeguarding environmental quality. This depends on our ability to maintain the natural resource base that supports and sustains agriculture, especially in the developing world.

CLIMATE CHANGE MITIGATION

IPCC (2007) defines Mitigation as the technological change and substitution that reduce resource inputs and emissions per unit of output. Although several social, economic and technological policies would produce an emission reduction, with respect to climate change, mitigation means implementing policies to reduce Green House Gas (GHG) emissions and enhance sinks Improved crop and grazing land management to increase soil carbon storage; some mitigating agricultural practices include;

- Restoration of cultivated peaty soils and degraded lands;
- Improved cultivation techniques, livestock and manure management to reduce CH4 emissions;
- Improved nitrogen fertilizer application techniques to reduce N_2O emissions;
- Dedicated energy crops to replace fossil fuel use;
- Improved energy efficiency.

A large proportion of the mitigation potential of agriculture (excluding bio-energy) arises from soil carbon sequestration, which has strong synergies with sustainable agriculture and generally reduces vulnerability to climate change. Considerable mitigation potential is also available from reductions in methane and nitrous oxide emissions in some agricultural systems. Biomass from agricultural residues and dedicated energy crops can be an important bio-energy feedstock, but current concerns with food prices make this a questionable alternative.

About 65% of the total mitigation potential is located in the tropics and about 50% of the total could be achieved by reducing emissions from deforestation. Forest related mitigation options can be designed and implemented to be compatible with adaptation, and can have substantial co-benefits in terms of employment, income generation, biodiversity and watershed conservation, renewable energy supply and poverty alleviation

At the beginning of the 21st century, environmental changes on an unprecedented, global scale have begun to impinge upon agricultural practices simultaneously and often interactively. This spectrum of "global environmental" hazards include:

- Global climate change due to the accumulation of greenhouse gases in the lower atmosphere;
- Stratospheric ozone depletion (a process that will probably increase for several decades, after which a slow recovery is expected).
- Loss of biodiversity - this is occurring at a rapid rate, and entails both the disappearance of useful species and genes and the weakening of various ecosystems thereby reducing the flow of nature's life-supporting "goods and services";
- Desertification, depletion of fertile soil, groundwater and natural fisheries; this is undermining the productivity of food-producing ecosystems, thereby offsetting expected gains from genetically modified organisms, precision farming and aquaculture; and
- Various chemical pollutants, familiar as part of industrialization's legacy of local pollution, are now being recognized as persistent and globally pervasive.

CLIMATIC RISKS

As much as 80% of the variability in agricultural production is due to the variability in weather conditions. In many developing countries where rain fed agriculture is the norm, a good rainy season means good crop production, enhanced food security and a healthy economy. Failure of rains and occurrence of natural disasters such as floods and droughts could lead to crop failures, food insecurity, famine, loss of property and life, mass migration, and negative national economic growth.

Severe weather events that are responsible for natural disasters impact the socioeconomic development of many nations. By 2025, population in water-scarce countries could rise to 2.8 billion, representing roughly 30 per cent of the projected global population. Over the next two decades, the world will need 17 per cent more water for agriculture and the total water use will increase by 40 per cent. In many developing countries, 70 per cent of the available fresh water is used for irrigation.

CLIMATE CHANGE MITIGATION

There is several mitigating measures that the agricultural sector can undertake to cope with future climate change and reduce GHG emission. These include:

- Changing planting dates;
- Use of Low-carbon alternatives to fossil fuels include wind (to generate electricity or power pumps) and solar (to generate electricity and heat water or buildings)
- Planting different varieties or crop species;
- Development and promotion of alternative crops;
- Developing new drought and heat-resistant varieties;
- More use of intercropping;
- Using sustainable fertilizer and tillage practices (improving soil drainage, no-till, etc)
- Improved crop residue and weed management;
- More use of water harvesting techniques,
- Better pest and disease control for crops;
- Implementing new or improving existing irrigation systems (Reducing water leakage, soil moisture conservation - mulching);
- Improved livestock management (Providing housing and shade, change to heat-tolerant breeds,
- change in stocking rate,
- altered grazing and rotation of pasture);
- More use of agro forestry practices;
- Improved forest fire management (altered stand layout;
- landscape planning; dead timber salvaging; clearing undergrowth;
- insect control through prescribed burning);
- Development of early-warning systems and protection measures for natural disasters (droughts, floods, tropical cyclones, etc.);

CONCLUSION

Addressing climate change can be considered an integral element of sustainable development policies. Climate change and other sustainable development policies are often, but not always, synergistic. There is growing evidence that policy decisions eg., about macro-economic policy, agricultural policy etc., which are often treated as being apart from climate policy, can significantly reduce emissions. Reducing both loss of natural habitat and deforestation can have significant biodiversity, soil and water conservation benefits, and can be implemented in a socially and economically sustainable manner.

Making development more sustainable can enhance both mitigative and adaptive capacity, and reduce emissions and vulnerability to climate change. Synergies between mitigation and adaptation can exist, for example land management. In other situations, there may be trade-offs.

Climate change is widely considered to be one of the greatest challenges to modern human civilization that has profound socioeconomic and environmental impacts. It is essential to develop a portfolio of strategies that includes adaptation, mitigation, technological development and research (climate science, impacts, adaptation and mitigation) to combat climate change.

It is imperative on countries to take a proactive role in planning national and regional programmes on adaptation to climate variability and climate change. Integration of mitigation and adaptation frameworks into sustainable development planning is an urgent need, especially in the developing countries.

REFERENCES

1. *Antle JM. (2010) Adaptation of Agriculture and the food security to climate change: policy issues. Issue Brief 10-03. February, 2010. http://www.rff.org/rff/documents/RFF-IB- 10-03.pdf (accessed May 29, 2010).*
2. *Butterworth MH, Semenov MA, Barnes A, Moran D, West JS, Fitt BDL (2009). North –South divide: contrasting impacts of climate change on crop yields in Scotland and England J. R. Soc. Interfacedoi:10.1098/rsif.2009. 0111. Published online*
3. *Chomitz KM, Buys P, DeLuca G, Thomas TS, Wertz-Kanounnikoff S (2006). At Loggerheads? Agricultural expansion, poverty reduction, and the environment in the tropics. The World Bank, Washington, D.C., p. 284.*
4. *Danbaba AM (2007) Introduction to crop science. Adeoye publishers, Lagos, pp 78-88.*
5. *Dessai S, Hulme M (2001). Climatic implications of revised IPCC emission scenarios, the Kyoto Protocol and quantification of uncertainties. Integr. Assess. 2(3): 159-170.*
6. *Nicholson SE, Some B, Kone B (2000). An Analysis of recent rainfall conditions in West Africa, including the rainy seasons of the 1997 El Nino and the 1998 La Nina years. J. Climate, 13: 2628-2640.*
7. *Nkemdirim LC (2003). Climates in Transition: Commission on Climatology, Washington DC. Minateman Press.*

8. *Onyekwelu JC, Reinhard M, Bernd S (2006). Productivity, Site Evaluation and State of Nutrition of Gmelina arborea Plantations in Oluwa and Omo Forest Reserves, Nigeria. For. Ecol. Manage. 229: 214-227.*
9. *Semenov MA (2009). Impacts of climate change on wheat in England and Wales. J. R. Soc. Interface 6: 343– 350. (doi:10.1098/rsif.2008.0285)*
10. *Ziervogel G, Cartwright A, Tas A, Adejuwon J, Zermoglio F, Shale M, Snith B. (2008). Climate change and adaptation in African agriculture. Prepared for Rockefeller Foundation by Stockholm Environment Institute.*
11. *Food and Agriculture Organization of the UN retrieved 25 June 2007*
12. *Intergovernmental Panel on Climate Change (IPCC) 2007 Climate Change 2007: Synthesis Report. United Nations Environment Programme, 2007:Ch5, 8, and 10*
13. *Alberta Agriculture, food and Rural Development (AAFRD) (2005) Agriculture adaptation to climate change in Alberta: Focus group result. Ednonton. Alberta. pp 1-55.*
14. *Boko MI, Niang A, Nyang C, Vogel A, Medany B, Osman-Elasha R, Yanda A (2007) Africa in climate change 2007: Impact and vulnerability. Contribution of Working Group II to the Fourth Panel on Climate Change. Cambridge University Press. Cambridge.*
15. *Food and Agricultural Organization (FAO) (2003) Responding to agricultural and food insecurity challenges: Mobilizing Africa to implement NEPAD programmes. Conference of Ministers of Agriculture of the African Union. Moputo, Mozambique 1-2 July 2003.*