FOREST BIODIVERSITY CONSERVATION: A PANACEA FOR CLIMATE CHANGE MITIGATION AND ADAPTATION

***Audu, M. A, Okumodi, B. O, Ogoliegbune, O. M and Showunmi, L. I**
Forestry Research Institute of Nigeria, P.M.B. 5054, Jericho, Ibadan, Oyo State, Nigeria
****E-mail**: monsurahabiola9@gmail.com*

Abstract
Biodiversity conservation and climate change have been interlocked. One of the universal responses to tackling global climate change is the conservation of the forests and its biodiversity. Developing countries of the world will suffer most from the impacts of climate change despite contributing lower impacts. This paper reviewed and highlighted the importance of forest as mitigation for climate change through absorption of greenhouse gases such as carbon dioxide. It also stated the roles of government in ensuring a conserved forest as well as presented a model for climate change. Changing climate is considered an environmental phenomenon with the potential of making worse existing disaster risks and cause extensive loss to human and environment. Recommendation was suggested.

***Keywords:** forest, adaptive forest management, climate change adaptation, sustainable development.*

Introduction

Climate is defined as the average weather, or as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. These quantities are most often surface variables such as temperature, precipitation, and wind. The classical period of time is 30 years, as defined by the World Meteorological Organization (WMO) (Parry et al. 2007). Climate change is also defined as any change in climate over time usually thirty years, which may result from natural variability or human activity. The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods' (Parry et al., 2007). Climate change is used to describe a systemic change in the key dimensions of climate including average temperature, wind and rainfall patterns over a long period of time (IPCC, 2007). It was reported by IPCC in 2001 that Africa was predicted to suffer the most from impacts of climate change. According to Morgan et al. (2001), increase in temperature, amount of atmospheric carbon dioxide and changes in precipitation have notable impact on the world's forests and the forest sector. However, climate change may increase and worsen the threats to forest, forest products such as severe floods, drought, increased frequency of forest fires, landslides, increased temperature, rain variability, increase in carbon dioxide, rising sea levels, insects and disease outbreaks. Therefore, identification of cases of vulnerability of people living in and around forest reserves becomes necessary so as to suggest mitigations.

Forest and Climate Change

Forests help society to adapt through protection against the impacts of climate change. Climate change will increase the frequency and intensity of natural hazards while forests on the other hand offer protection against their impacts. Forest helps prevent landslide, mudflow, rock slide and avalanches, reduce the risk of flooding and have positive effects on water regimes and on water supply. Forests preserve biodiversity, landscape and soil fertility through reduction of erosion and corrosion not only within forests but also to the benefit of downstream agriculture. The local micro-climate is positively influenced, especially temperatures in urban areas. The maintenance and the adaptation of forests will help preserve genetic variety and improve the resilience of habitats. Forests offer employment, help generate incomes, raw materials for industry and renewable energy which supports low carbon economy. Societies can make use of forests to reduce impacts of natural hazards, erosions and changes in microclimate by land use planning. Forestry measures have to take into consideration the regionally varying impact of climate change and have to adjust to specific local situation. Forests offer an option to meet low carbon economy targets needed for adaptation. Forests play a very important role in carbon balance (Liverman, 2009). According to Hamilton et al. (2018), a large percentage of terrestrial organic carbon is stored in forest biomass and soil. With this, any change in the coarse CO_2 balance of forest ecosystems, whether as a result of changes in use or due to changes in management, has a strong impact on the atmospheric CO_2 concentration (Bradshaw et al. 2015). Forest biomass production captures CO_2 from the environment, thus, the range of influence of this capture varies greatly depending on the state and composition of the forest. There are even exceptional situations in which the amount of CO_2 released from the system exceeds that which is captured. Owing to these, Boegelsack et al. (2018) posited the science of forest, known as forestry, to remain a key instrument for regulating the carbon storage level of managed natural forests.

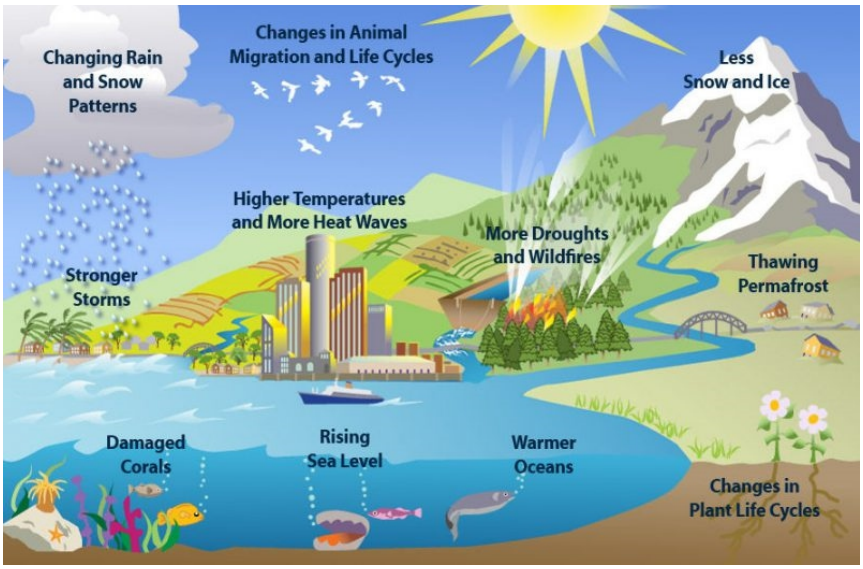

Fig. 1: Effect of Climate change. Source :www.skisoutheast.com

Figure 1 shows the effects of climate change on the ecosystem. The greenhouse gases released into the atmosphere due to continuous loss of forest causing climate change results into changes in animal migration and life cycles, changing rain and snow patterns, more droughts and wildfires as well as stronger storms. It also leads to changes in plant life cycles, higher temperatures and more heat waves, melting of snow and ice leading to rise in ocean level.

Forest Management and Climate Change

Sustainable forest management is the management that maintains and enhances the long-term health of forest ecosystems for the benefit of all living things while providing environmental, economic, social, and cultural opportunities for present and future generations (CCFM, 2008). Biodiversity, ecosystem condition and productivity, soil and water, role of the forests in global ecological cycles, economic and social benefits, and society's responsibility are the major criteria for defining and monitoring sustainable forest management (CCFM, 2006). Forests and contribute to climate change mitigation by preserving and expanding carbon stocks in the forests including above and below-ground biomass, deadwood, litter, and soil, by producing renewable materials in order to substitute fossil fuel and materials for which production cost much fossil energy, and by storing carbon in harvested wood products. As climate change is probably the biggest challenge humanity is facing today, whose major cause is the emission of greenhouse gas, and there is an urgent need to find solutions that can lead to the mitigation of the already intense effects.

Adaptive forest management does not only aim at preserving and developing forest composition and structures but also at fostering a system to deal with the functionality of forests under conditions of climate change as a prerequisite for fulfilling the future needs of forest ecosystem services (Wagner, 2004). Adaptive management is defined as a large variety of different measures that support and assist forest ecosystems' stress resistance, resilience, and dynamic response, representing a set of target responses to climate change impacts. Ecosystem resistance to perturbations and its resilience are explained to be the ability to recover speedily after perturbations, are complementary components of ecosystem stability (Loreau and Behera, 1999). Ecosystem stability maintains the community structures and allows predictions about the response of the system to disturbances. In contrast, dynamic response may lead to ecosystem variability, including structural variation and community change.

Forest adaptation to future environmental or social conditions that results from climate change may significantly alter how and why forestry is practiced in many parts of the globe. With the climate, and as a result the environment, undergoing perceptible changes within the life span of trees, achieving sustainable forest management will increasingly resemble aiming at a moving target. The Intergovernmental Panel on Climate Change (IPCC, 2007) has concluded that warming of the climate system is unequivocal and most likely due to the observed increase in anthropogenic greenhouse gas concentrations in the atmosphere. In addition to the rise in average global temperatures, discernable changes have been observed in day, night and seasonal temperatures, in the frequency, duration and intensities of heat waves, droughts and floods, wind and storm patterns, frost, snow and ice cover, and in global sea levels. Anthropogenic warming has already caused many changes in forests. As large, extensively managed, long-lived ecosystems, often on marginal sites, forests respond sensitively to climatic changes, together with the people, societies and economic activities that depend

on them. IPCC rated boreal, mountain, Mediterranean, mangrove and tropical moist forests as the forest ecosystems most likely affected by climate change.

Importance of Forest to Climate Change

The importance of forest to man's survival cannot be overemphasized due to the various environmental, social and economic benefits it provides. Forest is a habitat for various species of trees and animals. More importantly, forest assists in the global cycling of water, oxygen, carbon and nitrogen, provides stability to hydrological system, regular supply of fresh water, prevents flood, soil erosion and situations of river bed downstream (Oregon Forest Resources Institute, 2018; Adebayo, 2009). United State Department of Agriculture (2011) states that forests play a critical role in maintaining the climate, freshwater systems, soils and biodiversity, all of which are critical to food security and other key aspects of human well-being. Forest helps in combating climate change through absorption and reduction of greenhouse gas such as carbon dioxide in the atmosphere. Various kinds of wood and non–wood items are derived from the forest. Forest supplies many products in form of wood which serves as basic material for construction, furniture, paper; and non–wood items which include extractions such as bark, dye, fibre, gum, incense, latexes, oil resins, waxes, shellac and tanning compounds, food, bush meats, flowers, fruits, honey/nuts, leaves, seeds, spices as well as decorative, ceremonial and medicinal items (Adebayo, 2009). Forest contributes to poverty reduction and agricultural stability by protecting the soil as majority of the rural communities depend heavily on forest products for their livelihoods (MNRT, 2009).

Modeling Scenarios of Climate and Biodiversity to Sustainable Development

Models and scenarios are useful tools for informing policy discussions on both biodiversity and climate change. They have played a key role in assessments of climate change under the IPCC and are increasingly used in the Global Biodiversity Outlook series and assessments under the CBD, and now also in the context of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). There is need however to develop models and scenarios that allow for climate and biodiversity objectives to be pursued together, in a broader context of sustainable development. Although there have been models developed as reported in the fifth assessment report of the IPCC. The models were aligned with four "Representative Concentration Pathways" for greenhouse gas emissions that lead to a range end-of century temperatures. Although, some of the models developed did not provide a positive outlook for biodiversity.

Recent models developed as reported in the Global Biodiversity Outlook however, demonstrate, that it is possible to reduce and eventually halt global biodiversity loss consistent with the 2050 Vision of the Strategic Plan, while also making progress towards climate change and other societal objectives. Pathways towards this longer term goal require a combination of actions including investment in agricultural productivity, reduced food waste and moderation of meat consumption, and strategic development of interconnected protected areas, other efforts to reduce greenhouse gas emissions from other sectors (fig. 2). Such transformational changes require behavioral changes by governments, private companies and individuals, including by millions of farmers and billions of consumers.

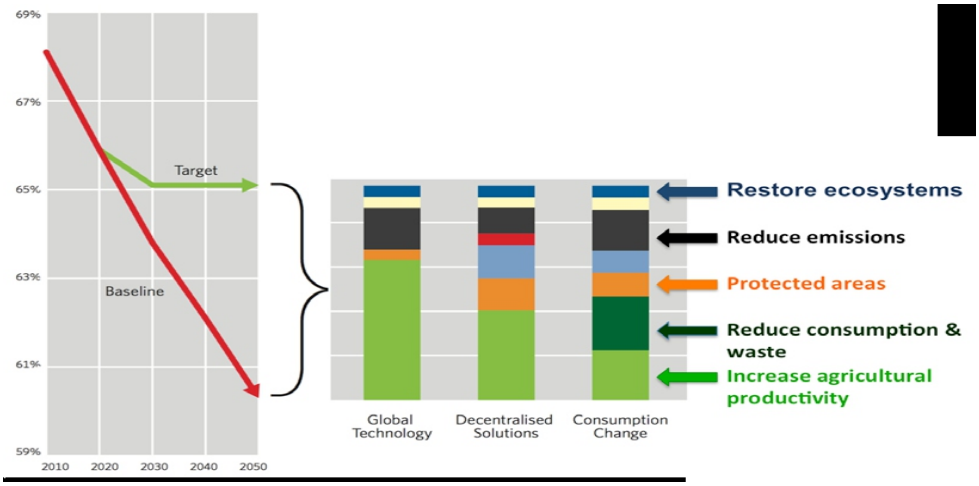

Figure 2: Scenarios and pathways towards the 2050 Vision if the Strategic Plan for Biodiversity 2011-2020. (Source: CBD, 2017).

Climate change Adaptation Strategy in the Face of Biodiversity Loss

Adaptation, as defined by the IPCC (2007), is an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities". Accordingly, a key aspect of integrating adaptation into conservation planning is to ascertain what the future will look like and accepting the uncertainties around this, and then integrate this knowledge into all activities that are currently in place. There has been several publications of what distinguishes some of the very familiar conservation approaches and actions (e.g., protecting corridors) touted as adaptation strategies as truly addressing the new or enhanced challenges faced by species in the context of rapidly changing climate conditions and their impacts. To date, all conservation planning activities that have been labeled in some form as climate change adaptation" can be placed into three broad strategies, they include:

Strategy 1: Continuing best practice: Given the limited extent of natural or semi natural habitats remaining outside conservation networks in many parts of the world and the continued loss and fragmentation of unprotected sites, the development of conservation networks, and especially protected areas, will remain a cornerstone of future conservation strategies.

Strategy 2: Extending on best practice principles: A goal of simply trying to achieve an adequate and representative system of reserves based on current species and ecosystem distributions and conditions is now regularly being rejected by most planners that are interested in incorporating future climate change into their plans (Mackey et al., 2008). It has been replaced by the identification of a series of extensions of these principles, all of which are based on the fact that climate change is a natural phenomenon and that species have overcome past climate change events (Heller and Zavaleta, 2009; Mackey et al., 2009; Watson et al., 2009; 2011a).

Strategy 3: Integrating assessments on species vulnerability to climate change into a conservation planning framework. To overcome the limitations of relying on a series of best practice principles, there are a set of methodologies being developed that aim to understand how vulnerable species are to climate change and integrate this knowledge into planning frameworks.

Conclusion

There is an increasing general consensus that climate change will continue, and accelerate, in the years ahead, with significant impacts. To increase the resilience to climate change mitigation efforts need to be complemented with adaptation measures. Since, 20% 0f the annual greenhouse gas (GHGs) emissions that cause climate change are accounted for by deforestation and forest degradation, effort should be geared towards reforestation to replace the lost biodiversity. Also, Nigeria has already lost almost all of its forests, though there are efforts to start reforesting by the Forestry Research Institute of Nigeria. It is therefore imperative to educate the society on the importance of conserving our forests. Also, there is a need for intensive campaign on forest conservation, and climate changing effects such as greenhouse effects, global warming and weather related issues. More so, strict ban on commercial logging, primate hunting and other destructive practices in the forests should be placed and monitored effectively. Moreover, the government should also provide support, training, education programmes and patrols to ensure compliance.

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