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## Maximizing the Role of African Forest for Climate Change Mitigation and Socioeconomic Development

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### ABSTRACT

Forestry has a significant role to play in green economy transformation process of African Continent. It is important to provide strong rationale that will link the forest to economic development. This paper therefore provides useful information on the potential of forest resources for socio-economic improvement with emphasize on the status of African forest. The paper reviewed the role of forest in climate change mitigation and achievement of Sustainable Development Goals as well as the role of forest in attaining industrialization. It was revealed that Central Africa has highest forest area with North Africa having lowest forest area. However, in terms of planted forest North Africa has highest area while Central Africa has lowest area. More so through sustainable management of forest some SDGs can be achieved. Forest is found to be useful approach in climate change mitigation through carbon sequestration. The strategies that can be adopted to improve the status of African forest include sustainable management of forest resources, afforestation and improved agroforestry practices. The paper recommends policy strategy that will re-position forestry subsector in order to achieve its primary roles in the climate change mitigation, economy and promote agroforestry to increase forest cover.

**Keywords:** Forest, climate change, mitigation, Socio-economic, development, Africa

### 1. INTRODUCTION

Forest resources have a significant role to play in achieving sustainable economic development and climate change mitigation. The benefits of forest include provision of livelihood activities for the poor, reducing their vulnerability to poverty, economic and

environmental shocks. Despite the huge potential of forest resources in ensuring socio-economic improvement, this sub sector has been under estimated considering its contribution to livelihood and poverty alleviation as it is yet to be made as option in development strategies of most countries (Bele, 2011). Forests are managed to achieve a balance across multiple goals including habitat, sustainable harvesting, employment, and others (Hoberg *et al.* 2016). Forests provide timber, and food, they conserve biodiversity, regulate water resources, and provide recreational opportunities (Schaphoff *et al.*, 2016). It also provide life supporting mechanism for planet earth, covering 4 billion hectares, almost one-third of the earth's surface, hosting 80% of global biodiversity and providing a source of revenue for more than one billion people. Forest is an unrivalled resource for the planet.

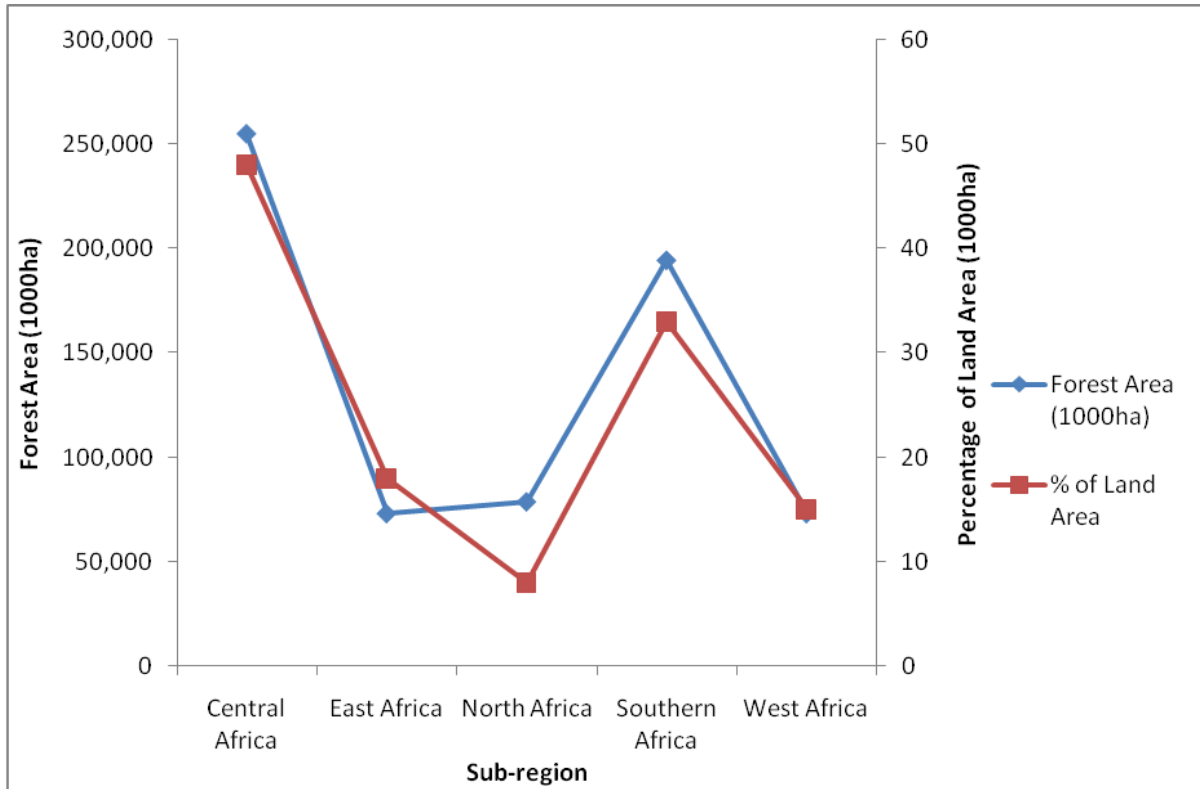
In most African countries forest products processing and utilization are integral part of rural economics. Aside from offering homes and livelihoods to many communities who rely on them for their food and medicine, forest also plays a pivotal role in providing water resources due to their influence on volume and distribution of rainfall, dynamics of water in soil and the quantities of water discharged into the atmosphere in the form of vapour. Forest is a source of wood mainly used by mankind in various forms for constructional works, as basic raw materials, for pulp and paper production, as fuel in industries and homes and a host of other products. Aside economic functions forest has been helpful in environmental sustainability in terms of erosion control, reduction of pollution, provision of food and habitat for wildlife. African Forestry is riding the global wave of climate change, to the point of masking its economic importance. Among the services derived from forest is climate regulation through carbon sequestration process (Daba 2018; Huston and Marland, 2003, Pan *et al.*, 2011).

Africa as a continent has an amazing natural diversity. The environment is one of the richest endemic floras in the world. Africa's extensive savannas host the largest remaining mammalian mega fauna on the planet. Africa has a considerable share in the world forests. However, only about 1.5 per cent of forests in Africa have been planted. The type of forests existing in African environment includes dry tropical forests and woodlands, moist tropical forests in Western and Central Africa and mangroves in the coastal zones. Deciduous woodlands cover about one quarter of the continent. African forests and trees are renowned for their habitats for wildlife, bee keeping, unique natural ecosystems and genetic resources. If properly harnessed, African forest resources have potential of lifting the economic towards the part of sustainability and reduce vulnerability to economic shock as well as instability.

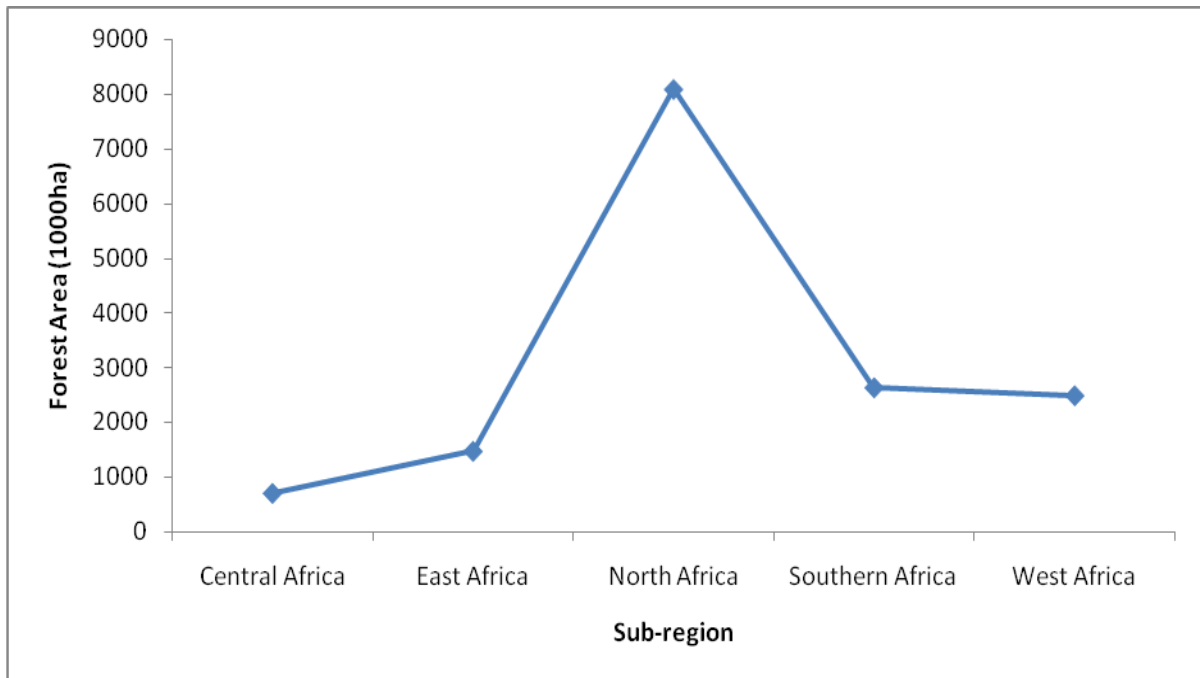
## **2. AFRICAN FOREST AREA**

Africa as a can be classified into nine categories including tropical rain forests, tropical moist forests, tropical dry forests, tropical shrubs, tropical mountain forest, sub-tropical humid forests, sub-tropical dry forests, sub-tropical mountain forests and plantations. The distribution of these forests varies from one sub-region to another, with the southern extremes of the Sahara desert, having the least forest cover while Central Africa has the densest cover. The distribution by sub-region is shown in Figure 1.

The five countries with the largest forest area are Democratic Republic of Congo, Sudan, Angola, Zambia and Mozambique and together they account for about 55% of the continent's forests. Planted forests account for a total of 15.4 million ha with the bulk being in North Africa (Figure 2).



**Figure 1.** Forest Area by Region in Africa.



**Figure 2.** Planted Forest Area in Africa as at 2010.

Seventeen African countries are “mega-biodiversity” countries and two of its forested areas, the Upper Guinea forest of West Africa and Eastern Arc mountain forests in East Africa are recognized as biodiversity hotspots. The Congo Basin, the second largest contiguous expanse of tropical rainforest in the world, accounts for 65% of Sub-Saharan Africa’s biodiversity. Central African forests store 25 - 30 billion tones of carbon and can sequester up to 630 kg of carbon per ha per year thereby providing a critical buffer against global climate change.

### **3. INTERLINKS BETWEEN FOREST RESOURCES AND SUSTAINABLE DEVELOPMENT GOALS (SDGs)**

Forest resource has a role to play in achieving sustainable development goals. Forest contributes to rural household economics and poverty reduction. Over 90% of people living in extreme poverty depend on the forest for all or part of their livelihood. Forest account for the income of about 23% of households in developing countries and most rural people depend on the forest resources for their survival. Goal 1 and 8 of SDG are central on Livelihoods, employment and poverty alleviation (SDG goals 1 and 8).

Forestry also contributes in many other ways such as through the direct production of food, provision of rural employment and income. In the whole of West Africa particularly, forest products often harvested by households, these products are in different forms such as leaves, fruits, seeds, nuts, roots, tubers, sap, bark, mushroom, honey, game, snails and insects. Trees are often the only reliable source of food for the family when crops fail or during the lean periods between harvests.

Food from the forests are often used to help meet dietary shortfalls during particular seasons of the year, bridging “hunger periods” when stored food supplies are dwindling and the next harvest is not yet available (Aju, 2014). Ending hunger achieves food security, Ensure healthy lives and promotes well being (SDG goals 2 and 3). Forest provides food security for farmers during seasonal gaps, especially during drought, flooding and other emergencies. SDGs 4 focused on quality education and lifelong learning opportunities, the contribution of forestry in achieving this goal include provision of learning materials, environmental education. Income obtain from economic activities related to forest are often used by rural household to pay school fees. Forests play a vital role in the global water cycle and the protection of water resources. During the wet season, forests act as giant sponges, soaking up rainfall and storing water. During the dry season, this water is slowly released into rivers and streams, and into underground aquifers (SDG 6).

Aside the primary function of forest, Forests are important in greenhouse gas emission reduction into the atmosphere and adapting to climate change. Forests represent the largest store of terrestrial carbon in the world: 77% of carbon stored in vegetation exists within forests, and 39% of carbon stored in soil occurs underneath the forest cover (SDG 13). Forests provide essential products for infrastructure, housing development and sustainable cities. 18% of the world’s population use forests to form a significant part of their shelter, including walls and roofs. Forests contribute to “green infrastructure” – the use of natural vegetation to support water management, climate adaptation, air quality, and sustainable food, energy and water production (SDG 9).

#### **4. ENVIRONMENTAL BENEFITS OF FOREST ECOSYSTEM**

##### **4. 1. Role of forest in climate change mitigation and adaptation**

Climate change issue is a global phenomenon constituting threats to food production and human health. It is a factor responsible for variability and put growing pressure on the socioeconomic standard, health, food production capabilities, and other aspects of lives of the rural poor (Siwar *et al.*, 2013). The adverse impacts of climate change have already been observed on natural resources, food security, human health, the environment, economic activity and physical infrastructures (Deschenes and Greenstone, 2007). The most vulnerable continents among the continents of the world are Africa and Asia, with sub-Saharan Africa having the highest levels of chronic poverty in the world, and South Asia containing the majority of the world's chronically poor people (Chronic Poverty Research Centre, 2008). According to Knox *et al.* (2012), by 2020 between 75 and 250 million people are likely to be exposed to increased water stress and that rain fed agricultural yields could be reduced by up to 50% in Africa if production practices remain unchanged. To alleviate the impact of climate change on the environment and livelihood sustainability in particular strategic approach must be adopted. One of the approaches to climate change mitigation is sustainable management of forest ecosystem.

The relationship between forests and climate change is that forest can mitigate climate change by absorbing carbon. Climate is the weather condition prevailing in an area in general or over a long period. The change in climate is the statistical distribution of weather patterns when that change lasts for an extended period of time. Our climate produces the temperatures and rainfall that makes plant, animal, and human life possible. Without the right temperature and rainfall, plants and trees could not grow, animals would not have food to eat and people would not survive. A working forest ecosystem is a virtual clean machine. It cleans the air removing particulate matter, it cools the air and adds moisture, the forest absorbs existing air separating the element, freeing and releasing the oxygen, disposing of the minor elements and using the carbon dioxide for food to grow. Forests releases water vapour which rises from the clouds and forest trees begin emitting oxygen soon after planting. In essence, the restoration of the working forest ecosystem will substantially correct and modulate the climate. Furthermore, forests play a crucial role in climate change adaptation strategies (Xu, 2018) and provide erosion control and protection of coastal ecosystems against storm surges and hurricanes.

##### **4. 1. 1. Role of forest in biodiversity conservation**

A well functioning ecosystem with diversity of biological resources can offer natural solutions that build resilience and thereby help society adapt to the adverse impacts of climate change. It can also improve food security and support poverty alleviation by providing safer and more secure livelihoods, especially for the poor and vulnerable. Biodiversity provides the direct and indirect benefits to humans such as food and material goods (Vedeld *et al.*, 2007). Forests provide preservation service and increase the variety of the different plants and animal species (biodiversity) which in turn improves the overall health of the community ecosystem. The forest is the key component of biodiversity both in them and as a habitat for other species. The forest contains a greater range of biological resources than any ecosystems on earth. A single massive tree can be home for thousands of species. The wide variety of trees and plants in the forest comprises of intensive biodiversity where interdependent species have evolved over millions of years to interact and flourish. Forest also improves biodiversity in the conservation and enhancement of rare species.

#### **4. 1. 2. Reduced Global Temperature**

The role of forest in climate regulation cannot be overemphasized. It helps to counteract the greenhouse emission and global climate change by taking carbon out of the atmosphere and storing it in the form of wood. The global temperature will decrease steadily as temperature decrease due to positive changes of increased rainfall patterns. This will cause positive changes at the earth's poles where the climate is very cold with ice covering the earth's surface and some covering parts of the sea as well. Decrease in temperature will maintain these glaciers and decrease global warming.

Also, glaciers found on very high mountains will cease melting because of improved temperature which will limit the rise in sea level. Meaningful benefits to the climate require consistent measures to protect, restore, and sustainably manage forests for the carbon and other environmental values on land. Forests provide shade and the cooling effect of evapotranspiration particularly in cities. It reduces discomfort, energy loss, and slow movements with windbreaks.

#### **4. 1. 3. Watershed Maintenance**

It improves water quality by slowing the rate at which rainfall runoff flows to rivers and streams and trapping, using or breaking down some of the pollutants and nutrients that are harmful to water quality. It also improves water quality by lowering water temperature with shade over streams. It improves groundwater quality by increasing the amount of rainfall runoff that percolates into the soil and replenishes a major source of drinking water and by breaking down or capturing toxins. Forests also act as water filters, collecting and storing water and recharging underground aquifers. Forests also increase the atmosphere humidity by transpiration which affects temperature and rainfall.

#### **4. 1. 4. Role of forest in wildlife Conservation**

Forests provide home for wildlife. Restoring forest also improves habitat quality, especially for wide ranging forest birds and mammals. Allowing trees to grow before harvesting generally increases a forest's structural diversity and provides habitat for a broader range of forest species. Healthy forests that retain structure generally have greater stability and resilience to withstand disturbances associated with climate change. Forest covers increases crop and livestock productivity and soil sustainability by sheltering fields with windbreaks. It links natural areas together with plantings to provide travel ways for wildlife

#### **4. 1. 5. Role of forest in tourism development**

Ecotourism is one of the essential sectors often opted for among public and private stakeholders of developing countries in responding to sustainability of ecosystems, livelihoods, cultural preservation and biodiversity preservation (Habibah *et al.*, 2012). The forest provides leisure in game viewing, waterfalls, botanical ramblings and other amenities provided by the forest.

Generally, forest increases the beauty of the environment in our community. It encourages healthy open-air activities, filters out harmful Ultraviolet (UV) rays and provides living laboratories and outdoor classrooms to researchers.

#### **4. 1. 6. Socio-economic Benefits of Forests**

Forests are widely known as the world's largest repository of terrestrial biodiversity. Forests provide a wide range of economic and social benefits. The production and consumption of wood products, non-wood forest products satisfied human need in terms of food, energy, shelter and health needs, as well as generating income. Forests contribute significantly to food security in many ways. Millions of people depend on food from forests, and from trees located outside forests, to increase the nutritional quality and diversity of their diets. This is particularly relevant during periods of seasonal food shortages, extreme climatic events and conflict. They also contribute to rural livelihoods and poverty alleviation through income generated by employment in the production of forest goods and services. Benefits also include the hosting and protection of sites and landscapes of high cultural, spiritual, or recreational value. Economic benefits can usually be valued in monetary terms but the social functions of forests are more difficult to measure and can vary considerably among people, depending on their traditions and level of development.

Forest plays a vital role in achieving food security. Forest leaves and fruit are often good sources of Vitamin A; e.g. leaves of *Pterocarpus* spp., *Moringa oleifera*, *Adansonia digitata*, the gum of *Sterculia* spp., oil palm of *Elaes guineensis*, bee larvae and other animal food; in addition fats and oils are needed for the synthesis of Vitamin A. Wild animals including insects such as tree ants, mushrooms (often consumed as meat substitutes), as well as forest leaves such as *Leptadenia hastata*, *Adansoniadigitata*. Forest fruits and leaves rich in niacin such as *Adansonia digitata*, fruit of *Boscia senegalensis* and *Momordi cabalsamina*, seeds of *Parkia* spp., *Irvingia gabonensis* and *Acacia albida*. Forest leaves are especially high in riboflavin, notably *Anacardium* spp., *Sesbania grandiflora*, and *Cassia obtusifolia*, as well as wild animals, especially insects. Forest fruit and leaves often supply the bulk of Vitamin C consumed, especially good sources include fruit of *Ziziphus mauritiana*, *Adansonia digitata* and *Sclerocarya caffra*, leaves such as *Cassia obtusifolia*

Forest is a source of energy for larger percentage of households in rural communities. Rural communities adjacent to forest plantations harvest wood for cooking. Fuel wood for instance accounts to about 80% of household energy requirements in rural areas and thus accounts for close to 10% of net national energy consumption. Wood is both a raw and structural material for industries. In the building industry, in particular its relevance at both local, national and international is well known. The forests is a reservoir of material for medicine used directly as unrefined in terms of plant extract such as leaves, stem, root, bark, fruit and other conceivable useful part of the tree and also in the most refined form by the pharmaceutical industry. Income from forestry and forest-related activities includes the wages, profits and timber revenue earned in the formal sector, plus the income earned in informal activities, such as production of wood fuel and non-wood forest products (NWFPs). The level of employment in the forestry sector is an indicator of both the social and economic value of the sector to the society.

#### **4. 2. Role of forest in achieving Industrialization**

Industrialization is crucial in the process of economic development. The process involves transformation of extraction based economy to manufacturing sector. The idea behind this transition is linked to integration and linkages with various sector of the economy. The strategy of industrialization includes the development of primary sector. The primary sector is responsible for the provision of raw materials that can be transformed into finished goods for

domestic use and export. Development of agro and forest based resources are the most viable option by which most economies in Africa can successfully meander from their present status to industrialized economy.

The fact that most African economies are richly blessed with abundant human and agro-forest resources is one point that has always been emphasized. For example, more than three-quarter of Nigeria land mass is considered good enough for agro-forest farming activities. However, these resources have not been properly harness competitively to foster economic diversification and transforming the economy misfortune to betterment of socio-economic life of the people. The relatively diverse variety of climatic conditions in most African countries supports the cultivation of a wide range of crops and forest tree species. The climate varies from the desert like and savannah climate as well as thick rain forests.

The aim of most African countries is to diversify their productive base and transit from natural based economy to an industrialized and innovation driven economy. In this quest and yearning for industrialization, development of forest and other ecological resources remain the most viable and sustainable way forward. If proper investments are made in the forestry sub-sector, the current contributions to the economy can be more than doubled, depend on the commitment and investment level. This is because African countries, particularly Nigeria have both human and natural resources to achieve this potential.

Provision of agro-forest based raw materials to cater for the fledgling manufacturing and production industry is one of the primary functions of forestry sub-sector. Industrialization cannot be achieved without reliable source of raw materials. Abundance of raw materials supply from extractive sector, such as forestry will boost the output of the existing industries and also attract foreign investor to the economy. Another benefit derivable from the development of forest and ecological resources is the creation of demand for goods produced by the industries. The purchasing power of the most rural communities is derived from the extraction and selling of marketable surplus of forest resources. These rural dwellers therefore provide their investible surplus inform of savings to be invested in manufacturing industries. All these processes are connected to industrialization.

It is a fact that the process of industrialization is to be initiated and self sustaining. This must begin with sustainable use of forest product. The economic history of many developed countries shows that agriculture and forestry contributed immensely and has transformed them to industrialized countries. The role of forest and ecological resources in economic transformation cannot be overemphasized therefore it is essential to use these resources efficiently to achieve sustainability. Proper management of forest resources will ensure their continued availability.

## **5. STRATEGIES FOR MAXIMIZING THE ROLE OF AFRICAN FOREST**

### **5. 1. Afforestation, Reforestation and Agroforestry practices**

In order to restore the status of African afforest, there is need to embrace and encourage afforestation programme. This involves the establishment of a forest or stand of trees in an area where there was no previous tree cover. Reforestation is the reestablishment of forest cover, either naturally (by natural seeding, coppice, or root suckers) or artificially (by direct seeding or planting). Agroforestry is a sustainable land-use practice involving the deliberate combination of trees, agricultural crops and/or animals on the same land management unit. It is



an alternative form of agricultural practice that can conserve and maintain forest trees along side with production of food and industrial raw materials. Planting of trees will improve resilience to climate variability and extreme conditions, enhances diversity in terms of plant biodiversity and farm enterprise diversity. Agroforestry is a sustainable form of agricultural system against the common traditional system most widely practiced in Nigeria that is associated with large scale deforestation and consequent loss of soil nutrients, biodiversity and soil impoverishment. The major cause of devegetation is increasing demand for land. Most traditional form of farming are characterised by clearance of forest cover exposing the land to degradation, low productivity, disruption of soil ecology, reduced soil nutrients and increased soil erosion. Pressure is put on forest resource extraction in an unsustainable manner.

## **5. 2. Sustainable management of forest resources and ecosystem services**

Sustainable management of forests involves growing and sustaining forest trees according to the principles of sustainable development. This will help to keep the balance between ecological, economic and social-cultural components of sustainable development. Natural resource management deals with managing the way in which people interact with natural environment with appropriate land use planning, water management, biodiversity conservation, and the future sustainability of major economic sectors such as agriculture, mining, tourism, fisheries and forestry. It indicates that people and their livelihoods rely on productive environment with recognition of the important role play by land in maintain sustainability.

### **5. 2. 1. Problem solving oriented scientific Research**

Effort should be directed towards expanding interdisciplinary research that explores ways to increase diversity of ecosystems without sacrificing potential yield of natural environment. Research and efforts with respect to causes and effect of environmental problems, sustainable use of natural endowments, ecosystem conservation etc will increase awareness of the importance of ecosystems, the services they provide, and the ways in which we are dependent on them.

### **5. 2. 2. Awareness creation and forest education**

Lack of awareness of or access to proper information has contributed to unsustainable human relation with forest ecosystem reflecting inform of deforestation. The current rate of deforestation is becoming alarming. Negative interactions of human activities inform of overexploitation and unsustainable exploitation of forest resources has engendered alterations in the ecosystem with accelerated and irreversible changes with significant consequences for human well-being. The forest reserves intended to be land under forest are been clear felled for agricultural purposes as a result of the availability of fertile land under forest cover. Informing people about the implication of their negative interaction with nature is a step towards a sustainable society.

Also, campaign on nature will raise awareness about the benefits of ecosystem and what is required of individual to ensure the sustainability of our natural environment. Efforts must be directed and intensified towards making available to people the need to have positive attitude and change of orientation that natural ecosystem services are free gift and it is common property that can be used unsustainably.

## 6. CONCLUSIONS

With the emerging roles of forestry in the economic sustainability and climate change mitigation, there is need for innovative approach to reposition African forest resources to ensure continuous supply and conservation. It is essential to promote agroforestry practices in Africa to ensure safe climatic condition, food security and sustainable environmental and proper land use. Efforts aimed at mitigating and adapting to climate change must include afforestation, reforestation, enhancement of carbon stocks and sequestration capacity through effective management practices. Policy strategy must be re-directed towards improving forestry sub-sector of African economy.

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