

THE POTENTIAL OF BIODIVERSITY UTILIZATION AND SUSTAINABLE DEVELOPMENT IN GHANA

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ABSTRACT

The search for sustainable economic growth and development in Ghana commenced in 1957 when the country gained independence. After the first president, Kwame Nkrumah was overthrown in 1966, the nation witnessed a significant setback in terms of development which affected all aspects of the society including utilization of biodiversity and its sustainable development. Sustainable development is a kind of development that helps to meet the present's needs without preventing the ability of future generations to meet their needs. The biodiversity in Ghana is very rich. It plays a significant role in ecosystem services and functions by providing food materials, medicine and industrial raw materials. This paper seeks to review the potential utilization of Ghana's biodiversity and its sustainable development. In this paper, a broad literature search was conducted to identify relevant articles that correspond to the main topic. The results indicate that Ghana has rich biodiversity and it is the potential heritage and valuable asset for the country's ecological integrity and economic reformation, if only it is managed properly. The country's biodiversity also underpins ecosystem resilience which plays a critical role by reducing disaster risks and peace-building strategies. It was found that the forests, wetlands and mangroves which form part of the biodiversity help to reduce the impact of floods, drought and tsunamis. For successful sustainable development of Ghana's biodiversity, the Environmental Protection Agency (EPA) should collaborate with main stakeholder agencies that are more concerned about biodiversity. In other to achieve sustainable utilization, resourcing research institutions and universities to join the regional tray of biotechnology studies should be of great interest to the government and policymakers.

Keywords: Biodiversity, Ecosystem, Sustainable development, Resources, Living organisms and Disaster

INTRODUCTION

Biodiversity is the variety of different forms of life on earth, including the different plants, animals, micro-organisms, the genes they contain and the ecosystem they form. It refers to genetic variation, ecosystem variation, species variation (number of species) within an area, biome or planet (Singh et al., 2006). All over the world, there has been collective interest in issues of the environment, especially the current declining state of the global and local environment, which is as a result of undesirable human activities. Biodiversity loss is of immediate concern, because of its negative implications for human survival on earth the loss of each species comes with the loss of potential economic benefits. Hence, loss of natural products that increase world food supply and the medicines humans depend on, as well as a loss of ecosystem balance. Biodiversity plays an important role in the way ecosystem function and the material well-being of the world. We obtained various productive materials from biodiversity. This includes agricultural or food materials, medicine and industrial raw materials. Not less than 60 wild species have been used to improve some of the world's major crops by providing genes for pest resistance, improved yield, and enhanced nutrition (IUCN, 2012). More than 12,000 years ago since agriculture began, roughly 7,000 plant species have been used for human consumption. While most people depend mainly on domesticated species for their dietary needs, some 200 million depend on wild species for at least part of their food (Rawat and Agarwal, 2015).

The search for sustainable economic growth and development in Ghana commenced in 1957 when the country gained independence (Aryeetey and Fosu, 2003). Under the leadership of the first president, Kwame Nkrumah, the nation witnessed unprecedented economic growth and development as a result of high investments in industrial development with the support of development partners (Smertin, 1987). After Nkrumah, was forcefully removed from office in 1966 by the Ghanaian Military, the nation witnessed a significant setback in terms of development which affected all aspects of the society including scientific research, inventions as well as proper management and utilization of biodiversity. Ghana falls within the Upper Guinea Forest Ecosystem which extends from Guinea to Sierra Leone and eastward to western Togo (Cincotta et al., 2000). This ecosystem is rich biologically because of its high degree of species endemism. It is considered as one of the world's prioritized biodiversity conservation areas (Conservation International, 1999). In Ghana there are over 3,600 plant species of which 2,900 species are indigenous, 250 are introduced species and 43 species are endemic (MES, 2002). The southwest forests florals have the highest diversity. Most of these forests are found on substrates rich in gold, bauxite, diamonds and crude oil. The faunal diversity of 225 mammal species (includes forest and savanna elephants, monkeys such as chimps, red, olive, black and white Colobus and Mona and several angulates), 74 bat species, 37 species of rodents, and 724 bird species, 221 species of Amphibia and reptiles, and 850 species of butterflies in the forest zone alone (MES, 2002). However, this rich biodiversity has the potential to be utilized in the development of Ghana in one way or the other. Even though Ghana has several institutions which have developed strategies such as, Ghana Shared Growth Development Agenda (GSGDA) (2010-2013) which has strategies for the promotion of science, technology, maintenance of the quality of the environment and integration of environmental concerns into developmental policies (Forest and Wildlife Policy (1994), Wildfire Policy (2002), National Bio-safety in biotechnology guidelines). And the Fisheries Act (2002) which is about the management of aquatic ecosystems; with policies which help develop small-scale fishing enterprise and ensures no importation of exotic species.

Yet, biodiversity in Ghana is under severe pressure in many ecosystems and this has made it difficult for proper utilization and development for the benefit of the country. Nonetheless, our biodiversity has the potential to be properly utilized and developed for the growth of our country Ghana. Some of these are discussed below.

POTENTIAL UTILIZATION IN ECOSYSTEM SERVICES AND FUNCTION

Ghana has a rich Biodiversity, which needs proper conservation. Biodiversity plays an important role in ecosystem services (natural systems that support human activity) and function. Biodiversity plays a major role in mitigating climate change by contributing to long-term sequestration of carbon in several biomes (Singh , 2006). It is through biodiversity that sequential stability of CO₂ and O₂ is maintained. Due to the build-up of CO₂ in the atmosphere and ozone layer depletion, the earth is becoming warmer and more prone to natural calamities. The total area of land occupied by mangroves along the Ghanaian coastline is about 10,000 ha (Saenger and Bellan, 1995). A square kilometer of the coastal ecosystem such as the mangroves forests (such as Amansuri and Iture) can store up to five times more carbon than the equivalent area of matured tropical forests. These areas are being destroyed three times faster than forests, releasing substantial amounts of carbon dioxide into the atmosphere and the ocean, and contributing to climate change (IUCN, 2012). Biological resources are important media in biochemical cycles (such as, Oxygen, Nitrogen, and hydrological cycles), without which the cycles are not complete. Absorption and breakdown of pollutants and waste materials through decomposition, for example in food webs and food chains where the flow of energy goes through production, consumption and decomposition without which breakdown and absorption of materials will not be complete (Rawat and Agarwal, 2015). In the ecosystem, there is no waste as decomposition will take place to purify our environment by transforming the waste into other forms of biodiversity. Determination and regulation of the natural world climate whether local, regional or micro-level through influencing temperature, precipitation and air turbulence. The country's biodiversity underpins ecosystem resilience and plays a critical role as part of disaster risk reduction and peace-building strategies. Forests, wetlands and mangroves play a critical role in development as it helps in reducing the impacts of extreme events such as droughts, floods and tsunamis. These events which often occur in Ghana through our human activities, leading to waste of socio-economic resources, could be properly managed by developing effective and constant monitoring and evaluation strategies. Again, coral reefs that are found in our aquatic ecosystem, but the most unutilized in our part of the world, have a valuable ecosystem contribution. Convention of Biodiversity (CBD) (2014) records that, the value of the ecosystem services provided by coral reefs ranges from more than US\$ 18 million per square kilometer per year for natural hazard management, up to US\$ 100 million for tourism, more than US\$ 5 million for genetic material and bio-prospecting and up to US\$ 331,800 for fisheries. Moreover, the protective services of biodiversity provide protection of human beings from harmful weather conditions by acting as windbreaks, flood barriers among others. Production of at least one-third of the world's food, including 87 of the 113 leading food crops, depends directly or indirectly on pollination carried out by insects (honey bee), bats and birds. It is recorded that, the worldwide economic value of the pollinating service provided by insects is worth over US\$ 190 billion per year (Potts et al., 2010). But the question is, does our country has a share in it?

POTENTIAL UTILIZATION IN AESTHETIC VALUES PROVISION

Our planet is beautiful because of biodiversity. Biological diversity adds to the quality of life and provides some of the most stunning aspects of our existence. Human beings derive great pleasure from natural surroundings. The structures, shapes and colors stimulate our senses and enrich our culture. Biodiversity is accountable for the beauty of a landscape. People go far off places to enjoy the natural surroundings and wildlife. This type of tourism is referred to as eco-tourism, which has now become a major source of income in many countries, and Ghana should not be left out. A lot of money is paid to conserve wildlife for their value in nature through so many organizations. Wild species enhance our appreciation and enjoyment of the environment through leisure activities e.g. bird watching and nature trailing; Sporting activities e.g. sport hunting, sport fishing, diving and mushroom picking; Hearing, touching or just seeing wildlife; Enjoyment as seen in art and culture e.g. dolls and teddy bears. Ghanaians must understand that human wealth and economic development are derived from the resources of the earth and that there is only one earth for our use. They must, therefore, acknowledge their inter-dependency on the resources on earth and recognize that in the long run depletion of water resources, reduction in biodiversity and disruption of ecosystems would have disastrous consequences for all. There are a lot of places in Ghana that needs to be developed and utilized properly for eco-tourism. This includes:

The Black Volta River, in the Upper West Region, can be properly sustained toward economic, social and environmental prosperity and progress of people in the region. The catchments area of the Black Volta River is home to rare animal and bird species, such as hippopotamus, antelopes, monkeys and crocodiles, as well as partridges and wild guinea fowls, which could be properly conserved for the development of eco-tourism. To enable successful development of the rich biodiversity of this area, the Environmental Protection Agency (EPA) should collaborate with the Zukpiri Integrated Wildlife Sanctuary and the 16 communities along the Black Volta River to prevent; bushfires, indiscriminate felling of trees, destruction of biodiversity, farming along river banks, and causing siltation of water bodies. Again, the government should collaborate with NGO's to strengthen institutions and rural communities to enable them to reverse land degradation and desertification trends in the Upper West, and also to promote the adoption of sustainable water and land management systems that would improve food security and reduce poverty.

POTENTIAL UTILIZATION FOR MEDICINAL PURPOSE

Wild species of plants and animals have long been the source of vital pharmaceutical products. Natural products play a crucial role in traditional healthcare systems. The World Health Organization estimates that about 80% of people in developing countries obtain their primary health care in the form of traditional medicines (Farnsworth, 1988). The pharmaceuticals and Herbal centers in Ghana can make good use of properly conserved biodiversity for the production of quality drugs. Recently, Ghanaian herbalist's uses extract from the bark of trees to treat malaria and other diseases. Sales of herbal medicines can often be an important source of employment and income for local communities and businesses. Natural products were once the only source of pharmaceuticals, but by the 1960s synthetic chemistry had advanced to the point where the pharmaceutical industry's interest in natural products for drug development had declined. In many cases, wild populations of species serve as the blueprint for the synthesis of medicine. Several technological advances led to a revival of interest in research in natural products in the

1980s (Kingston, 2010). The development of modern techniques involving computers, robotics, and highly sensitive equipment for the extraction, fractionation, and chemical identification of natural products has dramatically increased the efficiency and decreased the cost of screening for natural products. As in the case of aspirin, one of the most valued and very used medicines, once the chemical structure had been identified from nature, it was found to be cheaper to synthesize than to grow. Other examples of medicines whose chemical structures were obtained from nature are morphine, modified from the poppy plant (opium), and Novocain, a synthetic form of cocaine derived from the coca plant. Even so, many chemists feel that recent synthetic chemistry is still not able to match the complexity of many of the natural compounds that have proved effective as drugs (Nicolaou et al., 1998). For example, Taxol, a compound from the Pacific yew tree (which is not considered economically important for timber or other commercial purposes), is being used to treat ovarian and breast cancer. The compound was discovered in the 1960s but could not be synthesized till the 1990s; and even now, the process is so time-consuming and expensive that natural precursors are used in the production of the drug. The government needs to join hands in maintaining our biodiversity because drugs developed from natural products often generate large profits for drug companies, but the real value of biodiversity as a "raw material" for drug development is much smaller as reported by Simpson et al. (1996). The government of Ghana, like those of many other African countries, should encourage the practice of traditional medicine alongside conventional medicine in law and promotes their coexistence to reach the largest number of citizens (Agbovie et al., 2002). The use of medicinal plants in Ghana is underwired by the existence of some governmental institutions involved in research in medicinal plants. One such research body is the Center for Scientific Research into Plant Medicine (CSRPM), which was established in 1773 and given legal backing two years later. The main aim of the center, located at Mampong–Akuapim in the eastern region of Ghana, is to screen and evaluate the efficiency of plant materials reported by some herbalists to have medicinal properties, as well as their preparation as distillates, extracts, and decoctions for treating certain diseases in humans. These institution needs to be resourced technologically to help promote plant medicine as well as conserving wild species of medical importance.

Table 1. Medicinal uses of some identified plant species in Ghana. (Agbovie et al., (2002), Addo-Fordjour et al., (2008), Abbiw, (1990))

Scientific Name	Diseases/Illness condition Treated	Parts Used
<i>Acacia gourmaensis</i>	Sight problems, stomach pains	Roots, bark, leaves
<i>Acacia hockii</i>	Headache, tooth ache, poor sight	Roots, leaves
<i>Acacia mellifera</i>	Piles, skin rashes, enhance sexual performance,	Fruit, roots, leaves
<i>Acacia Spp</i>	Cure for wildlife & animals	Leaves
<i>Adansonia digitata</i>	Sickling or malnourished child	Leaves, fruit
<i>Azelia africana</i>	Blood tonic, terminating of pregnancy (abortion), foetus implantation	Leaves
<i>Albizia adianthifolia</i>	Skin rashes, stop bleeding	Leaves

<i>Anacardium occidentale</i>	Snakes bites, sores, rashes, dysentery, cough, hypertension	Seeds, leaves, fruit, bark, Roots
<i>Aneilema aequinoitiale</i>	Fever	Roots, leaves
<i>Aneilema beniniense</i>	Erectile dysfunction	Roots, leaves
<i>Annogeissus leiocarpus</i>	Sores, de-wormer for humans & animals	Leaves
<i>Annona senegalensis</i>	Poison, detoxification	Leaves, roots
<i>Axonopus compresus</i>	General body pains, fever	Leaves
<i>Azadirachta indica</i>	Malaria, mosquito repellent, pesticides, stomach pains	Leaves, seeds
<i>Bauhia rufescens</i>	Piles	Roots, leaves
<i>Berlinia grandiflora</i>	Sight problems	Roots
<i>Blighia sapida</i>	Malaria, piles, convulsion	Leaves, roots
<i>Bombax costatum</i>	Snake bite, pillows, food	Leaves
<i>Borassus aethiopum</i>	General body pains	Fruit, leaves
<i>Ceiba pentandra</i>	Mental problems (anti-depressant)	Root, bark
<i>Chromolaena odorata</i>	General body pains, headache	Leaves
<i>Cleome rutidosperma</i>	Stimulant, antiscorbutic, skin rashes	Roots, seeds, leaves
<i>Combretum collinum</i>	Headache, stomach pains, convulsion, body weakness	Roots, leaves
<i>Cordyla pinnata</i>	Rheumatism, headache, body pains	Roots, bark
<i>Detarium microcarpum</i>	Fever, cure baldness	Leaves, roots, barks
<i>Detarium macrocarpum.</i>	Sores treatment	Leaves
<i>Diospyros mespiliformis</i>	Mental illness, epilepsy, convulsion, headache	Roots, leaves, bark
<i>Echinochloa spp.</i>	Body hydration	Fruits, leaves

POTENTIAL BIODIVERSITY UTILIZATION AND SUSTAINABLE DEVELOPMENT IN BIOTECHNOLOGY

Until recently, agricultural, pharmaceutical and industrial uses of biodiversity mostly relied on different methods of research and development. Currently, with the help of the new biotechnologies, individual samples of plants or microorganisms can be preserved in culture and screened for potential use in any of those industries. Companies are screening the traits of organisms to develop new anti-fouling compounds for ships, new glues, and to isolate genes and proteins for use in industry (Whittle, 2009). A thermophilic bacterium found in Yellowstone hot springs provided the heat-stable enzyme Taq polymerase, which makes it possible, in a process known as polymerase chain reaction (PCR), to amplify specific DNA target sequences derived from minute quantities of DNA (Bej et al., 1991). PCR has provided the basis of medical diagnoses, forensic analyses, and

basic research that were impossible just 10 years ago. Rabinow (1996) reported that the current world market for Taq polymerase is \$80–85 million per year. Biodiversity is the key "raw material" of the biotechnology industry, but the process of examining biodiversity for new applications in the biotechnology industry has only begun. Again, it has become clear in recent years that the ultimate role of microorganisms in global processes can be exploited in maintaining and restoring environmental productivity and quality (biodiversity conservation). Indeed, microorganisms are already playing roles in both environmental monitoring and environmental restoration (for example, through bioremediation of spilled oil) and the prevention of pollution (for example, through waste processing). Modern biotechnology is providing tools that will enhance the environmental roles of microorganisms, and this trend should accelerate as the appropriate basic and applied sciences mature (Zilinskas et al., 1995). Dooley (1994), also reported on the development of a variety of probes and diagnostics for monitoring food and environmental quality and there is much discussion of the development of genetically engineered organisms for speeding the clean-up of wastes, spills, and contaminated sediments. Furthermore, marine biotechnology is being pursued keenly and on a larger scale in Japan (Yamaguchi, 1997), where one major goal is to find ways to lower global atmospheric CO₂ concentrations. Without hesitation, the prediction of climate change will be much improved by a better understanding of global cycles, and the tools of marine biotechnology will be heavily involved in this endeavor. For sustainable utilization and development of biodiversity in Ghana, the government should have a keen interest in resourcing research institutions and universities to join the world's tray of biotechnological studies.

POTENTIAL METHODS OF DEVELOPING BIODIVERSITY IN GHANA

Protecting ecosystems against extremes of flood and drought, protect watersheds and maintaining water quality is possibly achievable in Ghana. Our communities are an integral part of the protection of water resources. Ghanaians must be encouraged to protect natural vegetative cover in watersheds from extreme events such as floods and drought. We should avoid unnecessary vegetation removal such as with deforestation leads to the siltation of reservoirs, which could cause a reduction in water yield and quality and the deterioration of aquatic habitats. On the macro level, it has been suggested that forests that are not disturbed maintain the rainfall in their direct environment by contributing to the hydrological cycle. Thus, it may create the specific microclimates that some organisms require for their existence. Even though one of the most important sectors in the Ghanaian economy is the forestry sector, in terms of job creation, incomes for local communities, foreign exchange earnings through timber products export and protection of the environment, also being the provider of multiple palpable and impalpable goods and services. This is classified as follows; timber and wood products, non-timber products (Table 2) and environmental services (such as biodiversity conservation, carbon sequestration and clean air, micro-climate regulation/modification, soil fertility improvement, soil conservation/soil erosion control, recreational (aesthetic) value and Job creation/ generation of employment). Hence, its maintenance and development for generational benefit should be of great interest to the government. Institutions such as the EPA and security services should work hand-in-hand, to check Small and Medium Forest Enterprises (SMFEs) and their practice of good afforestation and arrest unlicensed tree harvesters.

Biodiversity plays a significant role in the formation of soil and the maintenance of soil structure and the retention of moisture and nutrient levels, millipedes and worms, conditions soil, breaks down organic matter and gives nutrients to plants. Again,

avoiding rampant clearing of vegetation will help prevent salinization of soils, soil erosion and a decrease in soil productivity. Moreover, biodiversity conservation is the key, all conservation strategies instituted by the government should be properly enforced. Ecotourism sites such as the Kakum National Park, The Mole National Park and the Buabeng Fiema Monkey Sanctuary, should be properly monitored and maintained by the government. Again, we should maintain a good running ecotourism sector, which will ensure to generate more revenue as this is environmentally friendly and is attractive to many foreign tourists since not many countries around the world have such natural tourist sites. One very successful ecotourism story in Ghana is the Tafi Atome Monkey Sanctuary where the local community, because of their traditional believe, protect monkeys and runs monkey tours through the forest. This helps the community protect the monkeys and the forest as well as bring in good revenue which can be used to fund development projects in the community and beyond. Thus, involving traditional leaders in planning and strategizing is very important. Many small towns which would have taken a long time to develop and get access to modern amenities and facilities, but with proper development and utilization of our biodiversity could have facilities such as; hospitals, banks, schools, portable drinking water and electricity supply. Ecotourism is just profitable anyhow we look at it. Foreign companies and investors are naturally drawn to booming sectors and industries. A sector that is environmentally friendly but also contributes immensely to the economic development of the country needs more attention and support.

Table 2: Small and medium forest enterprises (SMFE) found in Ghana.

Wood forest products	Non-wood forest products	Forest services
Small scale carpentry	Shea butter	Ecotourism
Fuelwood production and trade	Cola	Plantation growers
Charcoal production and trade	Chewing stick and sponge	
Canoe/wood carving and trade	Gum Arabic/resins	
Lumber trade	Spices (black and white pepper, Prekese)	
	Edible and wrapping leaves	
	Essential oils	
	Edible seeds	
	Honey production	
	Dyes	
	Baskets/hats/mats	
	Bamboo and rattan products	
	Snails	
	Mushrooms	

Medicinal products

Bushmeat trade

Palm wine tapping

Source: Osei-Tutu, 2010.

CONCLUSION

The effort of the Ghanaian biodiversity into the economy in terms of job creation, incomes, exchange earnings, good forest products, export and protection of the environment has not received the requisite attention. Biodiversity is the country's heritage and valuable assets for ecological integrity and economic reformation. If biodiversity resources are managed intelligently and properly, they would catalyze national development and a conduit for poverty alleviation. Ghana's efforts in the past to ensure sustainable use of biodiversity for national development had been mediocre and often below expectations because much efforts had not been expanded in managing biodiversity for the public good. Therefore, there is the need to take into account in decision making across government sectors how to develop our biodiversity and realize its utilization to help national development and decision-making processes. Biodiversity is at the heart of ecosystem goods and services, which had significant economic value for livelihoods and poverty reduction.

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