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**THE ROLE OF BIOLOGY EDUCATION IN SMALL AND MEDIUM SCALE ENTERPRISES (SMES) FOR SUSTAINABLE DEVELOPMENT IN SUB-SAHARAN AFRICA.**

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**ABSTRACT**

*This paper focused on the roles Biology education play in Small and Medium Scale Enterprises (SMEs) for Sustainable Development in Sub-Saharan region of Africa. It discussed the role of Biology education in enterprises that directly or indirectly has to do with apiculture, aquaculture, fermented food, ecotourism and medicinal plants. The paper recommended that: Biology education curriculum in both secondary and tertiary institutions in the region should be restructured to include bio-entrepreneurship so that knowledge from the classroom can be easily translated into entrepreneurship. Countries in the Sub-Saharan region should encourage entrepreneurs and support research in the field of biology so as to exploit the vast animals and plant resources in order to combat poverty. Lastly, countries in the region should scale up and standardize their products to serve local and international demands.*

***Keywords:*** *Biology education, Sustainable Development, Small and Medium Scale*

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**Introduction**

Sub Saharan Africa and Africa as a whole is grappling with rapid growth in population and increasing unemployment with relatively slow economic growth. Resources abound in the region but they remain untapped due to lack of technical know-how, poor skills, corruption and government inability to make and implement policies that will bring about rapid growth that will improve the standard of living of their citizens.

Many countries in the region have large number of small and medium scale enterprises which are predominantly agro-allied in nature with over 70 percent

export in agricultural products and raw materials from the region. Yet, they are not able to produce the needed employment and improve the standard of living. Education has been a valuable tool for economic growth and sustainable development. Adamaechi and Romaine (2000) maintained that education for all cultural and political background for centuries have made the point about the relationship between a nation's education of its citizens and its social and economic development. Linking education to relevant bio-entrepreneurship can be a turning point for small and medium scale enterprises in the region. Ten (2012) posited that the human society has greatly explored biological knowledge overtime to make food, feed, beverage, fiber, advancement of modern technology and new biological knowledge has vastly expanded the application of biology.

### **Concept of Biology Education**

The term "Biology" is derived from two Greek words "bios" and "logos", which simply means Life and Study respectively. According to Oxford dictionary, biology is the study of living organisms, and these include structures (gross and morphological) functioning, origin and evolution, classification, interrelationship and distribution. Biology is the natural Science that studies life and living organisms, including their physical structure, chemical processes, molecular interactions, physiological mechanism, development and evolution (Wikipedia). Furthermore, Nakano (2017) posited that biology is the science that deals with the study of living things.

Education on the other hand, according to Longman dictionary of contemporary English, defines it as the knowledge and skills that you gain from being taught. George (2006), posited that education is simply the development of the totality of man, the natural world, the first world of man; implying that through education, man develops mentally, physically, morally and spiritually. Thus, Araoye (2015), explained that biology education is a typical education, which aimed at training and marketing of essential skills for the wellbeing of man. Araoye (2016) added that biology education is the education that serves both individual and social role by inculcating knowledge and right types of attitudes for the survival of both the individuals and their society at large. He added that education, particularly biology education, is central to sustainable development. In the same vein, Sallau, Bilkisu and Sani (2018), posited that biology and biology education contributes immensely to technological growth and development of any nation.

### **Sustainable Development**

Sustainable development can be seen as growth, advancement, conservation and preservation of the achievement of development made for the benefit of the present and future. Olarode (2016) considered sustainable development as that

which meets the needs of the present and aspirations of the present without compromising the ability of the future generation to meet their own needs. Furthermore, Nnabuo, Asiodike and Olarade (2012) stated that sustainable development is an approach that combines the developmental needs and aspirations of the future while also maintaining ecological integrity.

In 2015, the United Nations General Assembly set-up the following sustainable development goals for the year 2030: No poverty, zero hunger, good health and well-being, quality education, gender equality, clean water and sanitation, affordable and clean energy, decent work and economic growth, industrial innovation and infrastructure, reduced inequality, sustainable cities and communities, responsible consumption and production, climate action, life below water, life on land, peace and justice, strong institution and partnership to achieve these goals. These goals can be categorized into three aspects: economic, social and environmental goals.

### **Small and Medium Scale Enterprises (SMEs) and Sub-Saharan Africa**

The term 'Small and Medium Scale Enterprise' covers different types of firms: from fragile zero growth micro-firms (normally employing up to a couple workers generating subsistent level of revenue) to fast-growing medium size firms with up to 250 employees. There are no universal definitions for SMEs that are accepted widely (Mutula and Brakel, 2006). They added that the definitions of SMEs vary across countries and according to sectors' sustainability, but this usually is based on employment, assets and combination of both the two.

According to the United Nations, Sub-Saharan Africa consists of all African countries that are fully or partially located South of the Sahara. 46 out of the 54 African countries were listed by the United Nations Development Programme (UNDP) as Sub-Sahara. These countries are at different development stages with significant differences in industrial structure. Governance and access to natural resources are largely the main causes of difference in growth rate between countries in the region. For instance, the Agricultural structure is larger in Sub-Saharan Africa as compared to other regions of the world. The export in Sub-Saharan Africa consists of 70% of raw materials and agricultural products.

Small and Medium Scale Enterprises (SMEs) make up more than 95% firms in Sub-Saharan Africa. Henry, Ben, Gita and Adjoa (2017) stated that National economies in Sub-Sahara are characterized by a large number of small businesses that provide bulk of employment opportunities. However, these do not have the capacity to generate the number of jobs needed to provide livelihoods for the growing number of small businesses that provide bulk of employment

opportunities. However, these do not have the capacity to generate the number of jobs needed to provide livelihoods for the growing number of young people entering the workforce. Even though the SMEs in Sub-Saharan Africa is bedeviled with poor infrastructure; especially electricity, road, dearth of skilled labour and corruption. Besides the problem of accessing loan where available, most banks operate on a model of issuing short term high-interest loans. Furthermore, SMEs working in agricultural production and processing which are the main enterprises in Sub-Saharan Africa are considered risky proposition for lenders. Nevertheless, there are great potentials for small and medium scale businesses to grow and create meaningful employment and compete favourably in the international market. Unleashing these potentials of small and medium scale enterprise is needed for the sustainable development in Sub-Saharan Africa.

### **Biology Education & Small and Medium Scale Enterprises in Sub-Saharan Africa**

The knowledge of living organisms (plants and animals), their physical structure, chemical processes, development and evolution including their uses and management presents great opportunities for entrepreneurs in Sub-Saharan Africa.

Recent advances in the field of bio-chemistry, physiology, ecology, genetics engineering, biotechnology and molecular biology, have made biology the central focus in most human activities, including problem-solving; like food scarcity, pollution, population, radiation, control of diseases, hygiene, family life, management and conservation of natural resources. For instance, the knowledge of genetics will enable the alteration of genetic codes of plants and animals and consequently, provide job opportunities (Aladejo, 2006). Morenikeji, Oladejo and Olaniyi (2011) stated some specific areas that knowledge of biology can enhance students' engagement in self-reliance, which include; agro-allied ventures such as fish farming, bee farming, mushroom production, enthrotomy/plant biotechnology. Ten (2012) posited that the human society has greatly explored and exploited biological knowledge over time to produce food, feed, beverages, fibre, and the advent of modern technologies, and new biological knowledge has vastly expanded application of biology. The knowledge of plant hormones and destruction of epical dominance, which provide several branches in plants could be used by vegetable farmers to increase productivity and generate income. Likewise, the introduction of improved varieties of plant species could increase yield and boost harvest within a short period.

Sallau, Bilkisu and Abubakar (2018), discussed the role of biology in attaining sustainable development in the following aspects; bio-fermentation, which is the

process whereby food and organic products are produced through fermentation in a bio reactor by organisms including yeast, fungi and algae. Biofuel – it is a gaseous, liquid or solid fuel that contains energy contents derived from biological source.

Bioformatics – is the collection, storage and analysis of DNA and protein sequence data using computerized system.

Bioremediation – is the technology that focuses on removing contaminants from the environment. Wastes are biologically degraded under controlled conditions better than incinerator.

In this paper, the role of biology education in small and medium scale enterprise in Sub-Saharan Africa will be discussed in the aforementioned aspect.

### **Bee king (Apiculture)**

Apiculture is the practice of keeping bees as well as the manufacturing of honey and bees wax. Honey and bees wax have a wide range of uses among which are:

Honey:

- Source of concentrated sugar for thousands of generations.
- Facilitate better physical performance
- Reduce fatigue
- Promote high mental efficiency
- Improve food assimilation
- Used in chronic and ineffective intestinal problems
- Serves as remedy for cold and mouth, throat and brochial irritation
- Used in moisturizing and nourishing cosmetics
- Used in pharmaceutical preparation for open wounds, sores, ulcer, burns etc.

Bees wax:

- Used in lip balm, skin moisturizer, candles, itch relief, pain relief, sealing envelopes, additive in soap making, leather shoe polish, lubricant, hair care etc.

These are to mention few uses of honey and bees wax, which offers the entrepreneur a wide range of business opportunities if bee-keeping is improved upon. According to Wilso (2006), statistics of food and agricultural organization 2005 shows that honey exportation from Sub-Saharan African countries in 2004 were 184 tonnes valued at US \$469,000 whereas in the same year, there was import of 874 metric tonnes valued at \$278,000. The same trend applies to bees

wax, implying that Sub-Saharan Africa consumes honey and bees wax more than we can produce. Wilson (2006) posited that honey production in Africa is estimated to be less than 10% of the world population and Africa bees wax is less than a quarter of the world's population. He added that the world's demand for honey and hive product is in excess of marketed production.

In view of the world's demand for honey and bees wax products and the production of Sub-Saharan Africa, bee keeping, if improved upon, can be a money-spinner for entrepreneurs.

### **Fish Farming (Aquaculture)**

Fish farming is one of the most profitable agro businesses in Africa. However, small scale fish farming in Sub-Saharan Africa is rather a recent activity. The enterprise suffered a long period of decline after independence when the colonial masters who brought in a new aquaculture initiative had left, despite the fact that Africans rely on fish as important source of animal protein. But recent exploration in population and decline of captured fisheries has triggered a situation where demand outweighed supply.

According to the statistics of food and agricultural organization, aquaculture, south of the Sahara is still underdeveloped. In the 1990s, the total aquaculture product amounted to 14,700 metric tonnes equivalent to about 0.5% of the world's population with estimated value of \$25 million. The most important producers in the 1990s were Nigeria, Cote D'voire, Zambia and Kenya (1000 metric tonnes and above per year), followed by Zaire, Ghana, Tanzania, Congo, Madagascar and Sudan (200 – 700 metric tonnes per year).

Africa, especially Sub-Saharan Africa is suited for small scale aquaculture because of its large number of river system, inexpensive labour, high demand, land resources and good climate for all year round production. However, they are underutilized. For instance, in 2012, the total aquaculture was 1.6 metric tonnes with Nigeria still leading production, as compared to Vietnam's 3 million.

The UK's all party parliament group on agriculture and food development (Appli Ag Dev) called for the expansion of agriculture in Africa to combat poverty, hunger and malnutrition.

James (1973) posited that the application of scientific knowledge for development of fish industry lies in an intimate knowledge of biology of fish to plan, control and manage fisheries. The knowledge of life, habits and behaviour of fishes is an indispensable tool. Adewale (2017) listed out the following biotechnology techniques needed to improve aquaculture; induced breeding,

hybridization, hormonal sex reversal, ploidy manipulation, triploidy, tetraploidy, unparental fish production, androgenesis, gynogenesis and transgenics.

### **Foods produced through fermentation**

Fermentation refers to the decomposition of carbohydrates to alcohol using yeast, but other fermentation processes involve the use of bacteria such as lactobacillum, e.g. in the making of yoghurt. Fermented foods are generally produced using plants or animal ingredients in combination with fungi or bacteria which are sourced from the environment or carefully kept in cultures maintained by humans (Egwin et-al 2013).

Fermentation, as posited by Egwin et-al (2013), can produce important nutrients or eliminate anti-nutrients. Food can be preserved by fermentation, which enables for better digestion, stronger immunity and create components such as lactic acid, which is good for food preservation. Toxic components in plant food can be removed by fermentation.

Varied kind of fermented food abound. Some like cheese and yoghurt have been produced on commercial scale in Sub-Saharan Africa, where some indigenous fermented foods are now produced on a commercial scale. Okafor (1992) posited that fermented foods (indigenous fermented food) have progressed in the past decades towards being industrialized and to examine the role (if any) that modern biotechnology, particularly genetic engineering, have played in their commercialization. His work showed that the following food have been produced on an industrial or semi-industrial scale in 1981; Ogi, garri, palm wine and sorghum (beer). Two new products are now produced on an industrial or semi industrial scale: first is "dawa-dawa", a Nigerian condiment produced under the trademark. Dadawa by Cadbury in Nigeria from parkia seeds as in traditional fermentation. The second is a Zimbabwean fermented milk product known as lacto. It is similar to Nigerian "nono".

Listed below are some of the fermented foods consumed in Sub-Saharan Africa; Cassava-base;" foo-foo", "chikwangu", "lafun", "kokonte", "cingwade".

Cereal-base: non alcoholic; ogi, koko, mohewu, injera.

Cereal-base: alcoholic; burukutu/pito, sorghum, (kiffis), bear, Merissa, bussa,

Milk-base: Ayib, nono, fermented milk, lacto.

Palm-base; palm wine.

Miscellaneous: iru (dawadawa), ogili, ugba(ukraka), fura and asami.

The present view has shown sub-saharan African fermented food are numerous. It can be further developed and standardize by entrepreneurs for sustainable development.

### **Ecotourism**

Tourism is one of the world's growing industries as well as the major source of foreign exchange earning an employment for many developing countries. It is increasingly focusing on natural environment. Tourism provides opportunities for developing countries and emerging economies. In its best form it allows communities to progress while constructing nature at the same time.

Ecotourism is a form of tourism involving visiting fragile, pristine and relatively undisturbed natural areas, intended as a low impact and often small scale alternative to standard commercial mass tourism. It means responsible travel to natural areas, conserving the environment and improving the well being of the local people (Wikipedia). Ecotourism business industry make up for six (6) percentage of GDP all over the world. The industry is considered as fast growing industry as the yearly growth rate five (5) percent.

The world travel and tourism council estimated that 3.8 million jobs could be created by the tourism industry in Sub-Sahara Africa by 2023. Some of the jobs created by tourism industry which we could take advantage of include: lodging, luggage delivery service, souvenir shop, language translation service, restaurants, clubs, bars, doughnuts and snacks shops, tour guides, transport services, security services, photocopy, event organizers to mention a few.

### **Medicinal Plants**

The world health organization defined a medicinal plant as a plant which some oval of its parts can be used directly in the management of diseases (Acharya and Shrivestara, 2008). It comprises of herbs and tree plants that they have phytochemicals which are chemicals derived from plants, they are secondary metabolic compounds found in plants known to provide protection against insect attacks, plant and human diseases. He further described herbs as plants which lack woody stems, that produce seed and flowers and die after a particular season.

The World Health Organization (WHO) estimated that around 80% of the population in Africa uses traditional medicine in form of plant extracts (Farnsworth and Soe Jarto, 1985). Herbal medicine in Sub-Saharan Africa is something that cannot be done without, it continued to change into different stage and concepts. Its complementary potentials to orthodox medicine has continued to be modified in line with modern trends in therapeutics.

Many of the orthodox medicinal drugs are known to be sourced from plants extracts. An example is Aspirin extracted from a plant called meadow sweet (*Filipendula Ulmaria*) and atermisinin, the WHO's current material drug from



*Atemisia annua*. Bioactive compounds from some herbal medicine include reserphine from *rauwolfia serpentine*, vineristine from *catharanthus roseas*. Quinine is obtained from *narcissus* species (faladun, 2010).

Fawzi (2013) listed out ten medicinal plants found in Africa and mostly Sub-Saharan Africa: *oleo ferox* will, *acacia Senegal*, *Artemisia herba-alba*, *aspalathus linearis*, *centella asiatica*, *catharanthus roseus*, *cyclopia genistoides*, *hapogophytus procumbens*, *momordica charantialinn*, and *pelargonium sidoides*.

Varied plants with medicinal potentials abound in Sub-Saharan Africa. It offers huge contribution to orthodox medicine, socio-cultural and economic development. Entrepreneurs can take advantage of these plant resources by stimulating further research and standardization.

### Conclusion

Biology education has offered to entrepreneurs in the Sub-Saharan Africa, the application of the knowledge of plants and animals to explore and exploit the vast untapped resources in the region. It also helps in creating small and medium scale enterprises that could serve as a means of wealth creation, foreign exchange, employment and economic development as a whole, for sustainable development.

### Recommendation

1. Biology education curriculum in both secondary and tertiary institutions in Sub-Saharan Africa should be restructured to include bio-entrepreneurship so that knowledge from the classroom can be translated into entrepreneurship.
2. Countries in the region should encourage entrepreneurs and support research in the field of biology so as to exploit the vast animal and plant resources to combat poverty.
3. Countries in the region should scale up and standardize their products to serve local and international demand.

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