Bio-Entrepreneurship and Blue Bioeconomy as a Panacea for Achieving Sustainable Development Goal 1

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Abstract
Nigeria as a nation is currently experiencing economic downturn as a result of high level of insecurity, geometric increase in prices of goods and services and removal of fuel subsidy. This has led to high cost of living, and further increases the number of the populace below the poverty line. In order to increase the economic power of the nation, there is the need to embrace bio-entrepreneurship and by harnessing opportunities in development of blue bioeconomy. This paper discusses the importance of incorporating the concepts of bio-entrepreneurship and blue bioeconomy into the curriculum. It also delves into the various types of bio-entrepreneurship and blue bioeconomy opportunities that could be explored by the populace. The paper further highlights how bio-entrepreneurship and blue bioeconomy can be promoted among the teaming number of unemployed youths. The challenges and possible opportunities as well as the potential bio-entrepreneurs and blue bioeconomist can provide were also discussed. The paper concluded by establishing that, provision of supportive policies by the government can increase the adoption of bio-entrepreneurship and blue-economy principles to alleviate poverty and assist in accomplishing sustainable development goals.

Key words: Education, Bio-entrepreneurship, Blue bioeconomy, SDG 1

Introduction

Nigeria as the most populous black nation is currently passing through a turbulent time that has manifested itself into a myriad of problems ranging from a high level of poverty, and insecurity to high inflation among others. Nigeria as a country like every other nation is currently faced with lot of economic challenges as a result of the government drive to reposition the country among the commit of nations. The changes in the nations fiscal as well as monetary policies led in part to the removal of the fuel subsidy regime which has resulted in increase in the prices of goods and services. The high cost in prices of goods and services had reduced the purchasing power of the citizens and the gap between the rich and the poor is steadily increasing.

In September 2015 the world's governments signed a historic agreement to eradicate poverty, improve the living standards and well-being of all people, promote peace and more inclusive societies and reverse the trend of environmental degradation. The 2030 Agenda for Sustainable Development commits to promoting development in a balanced way—economically,

socially, and environmentally—in all countries of the world, leaving no one behind and paying special attention to those people who are poorest or most excluded. The Agenda contains 17 Sustainable Development Goals (SDGs) with associated targets to assess progress. The 2030 Agenda builds on earlier commitments, and aspirations set out in the Millennium Development Goals (MDGs) and Millennium Declaration. The SDGs are, however, universal, more ambitious, and comprehensive than the MDGs. For example, the 2030 Agenda affirms explicitly with a dedicated goal that sustainable development requires building peaceful, just, and inclusive societies. The SDGs aim at completing the unfinished business of the MDGs and also include targets on areas that have deteriorated or become more challenging since the turn of the century, including growing income disparities within countries, insecure and low-paid employment, climate change, and environmental degradation.

The seventeen agenda that the SDGs intend to tackle are: Ensuring that there is no poverty, Zero hunger, Good health and wellbeing, quality education, gender equality, clean water and sanitation, affordable and clean energy, decent work and economic growth, industry innovation and infrastructure, sustainable cities and communities, responsible consumption and production, climate action, life below water, life on land, peace, justice and strong institutions, and lastly partnership for the goals. Sustainable development recommends a holistic framework and calls for socially inclusive and environmentally sustainable economic growth (United Nations, 2015). To achieve the economic, social, and environmental objectives, a fourth objective must also be achieved: good governance. Good governance requires that the governments carry out many core functions to enable societies to prosper. Among these core functions of government is the provision of social services such as healthcare and education; the provision of infrastructures such as roads, ports, and power; the protection of individuals from crime and violence; the promotion of basic science and new technologies; and the implementation of regulations to protect the environment.

A large number of problems bedeviling the nation such as high rate of poverty and insecurity can be solved if the government makes the education of her citizen top priority, because education has the capacity of serving as the fulcrum upon which the nations overall growth can be hinged on. Education that is affordable and available to all irrespective of gender, ethnicity, or religious affiliations is one of the core mandate of Sustainable Development Goals. Goal 4 of the SDG advocated for the provision of qualitative and affordable education for all. Education is an instrument for advancing social, economic, and political development in any society. Section 1(4a)

of the (FRN 2013) states that education is an instrument for national development; to this end, the formulation of ideas, their integration for national development, and the interaction of persons and ideas are all aspects of education. Earlier, section 1 (2a) had indicated that the overall philosophy of Nigeria is to live in unity and harmony as one indivisible, indissoluble, democratic, and sovereign nation founded on the principles of freedom, equality, and justice (FRN, 2013).

Science education as an enterprise plays significant role in the development of any nation. It is because of this, that nations that intends to maintain their place in the committee of nations must adequately fund science education. Science is viewed as a body of knowledge, a way or method of investigating, and a way of thinking in the pursuit of understanding nature (Abimbola, 2013). Teng (2012) posited that biology as an integral part of science education at school level needs to be related to "everyday" circumstances to have pertinence to the social issues. Biology is one of the branches of science that deals with the study of life and living organism. It is a valuable subject at the secondary school level in Nigeria that provides job pathways for students after graduation to become experts in areas such as medicine, pharmacy, agriculture, food science among others (Ndayambaje *et al.*, 2021). Biology education as a field is concerned with the teaching of biology and other related disciplines within the school system (Abimbola, 2017a). For a teacher to effectively teach biology, the teacher needs to be aware of the interaction that exist between biology and other school subjects such as statistics, physics, chemistry, language, geology and entrepreneurship and so on and so forth (Abimbola, 2017b). This in part accounts for the reason why biology has become indispensable in all spheres of human society (Bello, Alabi, Ahmed, Sulaiman, Bello & Bello, 2020).

Entrepreneurship development which has become a tool for poverty reduction across the globe is the study of how new businesses are created and managed (Olateju, Danmola & Aminu, 2020). The Nigerian government in her quest to encourage the citizens to be job creators rather than job seekers, through her different agencies such as Nigerian Universities Commission and the National DREC has introduced the acquiring of entrepreneurial skills into the school curriculum. Abimbola (2017b) submitted that NUC in 2010 made entrepreneurial studies a compulsory subject for all universities and in 2011 it was also included in the curriculum of secondary schools. For the act of entrepreneurship to be a worthwhile venture for a biologist, there is the need to combine conventional business practices with environmental awareness so as not to endanger the existence of living organisms and disrupt the balance of nature. In line with the objectives of the Nigerian

Entrepreneurship Education, biology can become a veritable tool for poverty alleviation when the inter-relationship it shared with other disciplines is clearly spelt out. It has the potential of militating against poverty and improving the economic well-being of Nigeria.

The inter-relationship that exists between biology, entrepreneurship and economy led to the emergence of fields such as bio-entrepreneurship, bioeconomy and blue bioeconomy. Sinha, Singh and Kumar (2021) opined that bio-entrepreneurship is an emerging field of biology that involves the integration of biotechnology and entrepreneurship by exploring the use of ideas from biology to serve humanity, and acquire profit through the establishment of a business enterprise. Wulandari (2024) defined bio-entrepreneurship as the process of creating value from life science innovation and further submitted that bio-entrepreneurship is an evolving new area of biology that is sometime refer to as bioscience entrepreneurship, life science entrepreneurship or bioscience enterprise. This field of study has made it possible for biologist to venture into businesses in order to solve societal problems and also better their own lives by generating profits from goods and services rendered.

Bioeconomy on the other hand is an umbrella term that encompasses the concept of blue bioeconomy. Blue bioeconomy is defined as all economic activities related to the use of renewable aquatic biological resources to generate economic and social value (Berkowitz, 2020). Albrecht and Lukkarinen (2020) opined that bioeconomy and its marine subsidiary the blue bioeconomy remains mutually components of a broader green economy transition that plays substantial role towards sustainable society. Verissimo *et al*, (2021) stated that there exists a synergy between the blue and green economies.

Verissimo *et al*, (2021)

Bio-entrepreneurship Opportunities

There are different bio-entrepreneurship opportunities that the teaming under-employed youths in the country can venture into in order to create economic value for themselves and also increase the GDP of the nation. Some of the bio-entrepreneurial enterprise include

1. Mushroom Farming: Mushroom farming is the act of cultivating mushroom for both health and economic gains. In Nigeria, the practice is still at its infancy stage despite the country having a large potential for mushroom production (Startup Tips Daily Media, (2023). The mushroom industry is a multimillion-dollar industry, and in Nigeria can be cultivated all year round as the substrate for its cultivation in form of food and agriculture waste are readily available (Agriculture Nigeria, 2022)
2. Bio-fertilizer production: Biofertilizers are substance which contains microbes, that assists in promoting the growth of plants and trees by increasing their assess to essential nutrients (BYJU'S, 2024). Biofertilizers are eco-friendly, improve soil texture, destroys harmful substances and can be used even in semi-arid conditions (Poptech Biosciences Ltd, n.d). By investing in the production of biofertilizers, prospective investors can create an eco-friendly, biodegradable and affordable fertilizers, thereby increasing crop yields and making food readily available for the populace.
3. Bio-pesticide production: The word biopesticides are biological agents that are used to regulate the level of pests which involves the use of agents like pathogenic microorganisms such as bacteria, fungus, and viruses, as well as natural rivals of pests such as nematodes, parasitoids, and predators (Tripathi, 2024). Generally speaking, biopesticides are frequently break down quickly, effective in small quantity, less hazardous by nature than traditional pesticides, and often only affect the target pest and closely related organisms (United States Environmental Protection Agency, 2023)
4. Tissue culture: This is a technique in which fragments of plants are cultured in a laboratory using broth or agar in order to produce disease-free plants and increase plant yield (BYJU'S, 2024b). It is a promising biotechnology technique that has the potential to improve agriculture in many nations is tissue culture. It offers cutting-edge solutions to the hunger issue in underdeveloped or disadvantaged nations. It is a highly profitable business venture if one can actually understudy the needs of the society. Singh (2024) reported that the Indian market mostly focused on the tissue culture of ornamental plants, bananas, and sugarcane, while the Iranian market is also engaged in the micropropagation of ornamental plants. In Nigerian context, prospective entrepreneur can venture into the production of rare ornamental and medicinal plants.

5. Biology online businesses: Online businesses are enterprise that generates income mainly through the internet. A graduate of biology can also leverage on the wider coverage of the internet to promote different forms of businesses and be earning reasonable amount of money. Bello *et al* (2020) identified online biology courses, biology blogging and bio-edutainment which include biology songs, games and films as an integral part of business opportunity for graduates of biology.
6. Aqua culture: The commercial, recreational, and scientific uses of aquatic plant, animal, and other organism propagation and husbandry is termed aquaculture. Farrow (2023) defined aquaculture as the breeding, raising, growing and harvesting of aquatic organisms in fresh and salt water for human consumption and conservation alike. It involves the raising of organisms like see weeds, shellfish, mussels, oysters, fishes among other aquatic organisms for commercial purpose. It can also serve as the solution to overfishing which is likely to distort the ecological balance of the aquatic environment.
7. Biofuel production: These are fuels that are derived from biological materials such as animal products, trees, agricultural wastes, crops or grasses or any carbon source that are easily replenishable (learnbioenergy.org, 2024).
8. Petting Zoo: A petting zoo is an open area where small or young animals that can be held, touched and sometimes fed are kept. Some of the animals that could be kept in the zoo include; goats, sheep, rabbits, ducks, geese, chickens, turkeys, miniature horses and donkeys.
9. Waste to wealth: Nigeria as a country generates tons of wastes from both domestic and commercial enterprise. These wastes are in form of liquid effluents from industries, cans, pet bottles, nylon bags and so forth which are highly undegradable. These wastes find their ways into drainage systems and rivers causing flooding and pollution. These wastes can be collected and utilized for economic purposes. For instance, pest bottles have been utilized in constructing buildings and giant Christmas tree

AlJazeera, 2021

Bello (2023)

10. Animal Husbandry: Animal husbandry is the controlled cultivation, management, and production of domestic animals, including improvement of the qualities considered desirable by humans by means of breeding (Britannica, 2024). There exists numerous animal husbandry practices that people can engage in as means of sustenance and breaking the poverty line. Some of these activities include: poultry, rabbitry, cow and goat rearing among others. All these activities when properly planned and implemented can generate lots of income and also reduce the food deficit.

Blue Bioeconomy Opportunities

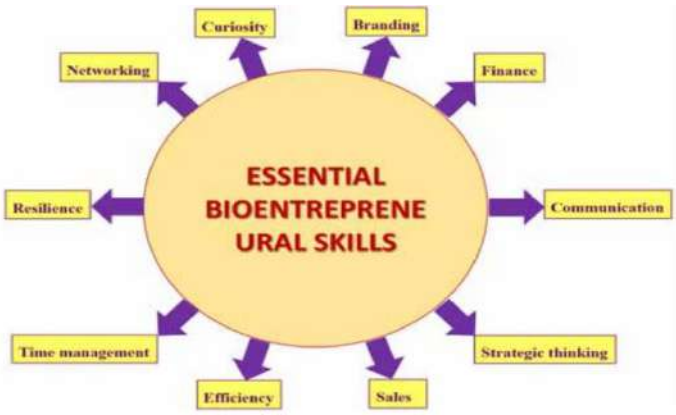
Income generating activities within the blue bioeconomy include but not limited to the following:

1. Aquaculture involves cultivating fish, shellfish, and algae for food, feed, or other products. Nigeria is the second largest aqua-culture producer in Africa and one of the highest consumers of fish in the world (Subasinghe, et al, 2021).
2. Pharmaceuticals and nutraceuticals are extracted from marine organisms for medicinal or health-related purposes. Several pharmaceutical products like agar and carrageenan, vitamins A and D are derived from fish liver oil, while polyunsaturated fatty acids like eicosapentaenoic acid and docosahexaenoic acid are also gotten from marine organisms (Francesch et al, 2024)

3. Biofuel production using algae or other aquatic biomass for biofuel production. Microalgae are good sources of biofuel production because of its relatively high oil content and rapid growth however, its cultivation in commercial quantity is hindered by difficulty in maintaining desirable species, low yield of algal oil and high cost of harvesting (Mohanta, 2021)
4. Cosmetics are made from marine ingredients. Marine ecosystems harbor a rich diversity of organisms that habours marine collagen such as jellyfish, sponge collagen (spongin), and fish collagen, as a key component in skin rejuvenation (Makgobole et al, 2024)
5. Seafood is harvested and processed for human consumption. Several seafoods that are beneficial to human health and are majorly consumed in Nigeria include; fish, shrimp, prawns, periwinkle, and lobsters most of which are gotten from the riverine areas of the country.
6. Developing sustainable materials from marine resources from bio-based chemicals and materials.
7. Production of feed for farmed fish and shrimp.
8. Natural pigments are extracted from algae or other aquatic organisms.
9. Innovative solutions using marine organisms are researched and developed.
10. Guided tours or other activities related to marine environments are called eco-tourism.

Steps for Promoting Bio-entrepreneurship and Blue Bioeconomy Opportunities

In order to promote bio-entrepreneur and blue bioeconomy opportunities, prospective bio-entrepreneur must develop some essential entrepreneurial skills. These skills will not only ensure that the prospective entrepreneur succeed but also prepare them for the challenges that lies ahead. According to Singh, Sinha, and Kumar (2021), curiosity, networking, branding, finance, communication, time management, resilience, strategic thinking, sales, and efficiency are all necessary for anyone hoping to succeed in a bio-enterprise.



Source: Sinha, Singh and Kumar (2021)

Steps in Promoting Investment in the Blue Bioeconomy

There are several steps that can be taken by all the stakeholders in the bioeconomy sector towards promoting investment in the sector. Some of these steps include:

1. Awareness and Education: There is the need to inform interested parties of the Blue Bioeconomy's potential and also increase public knowledge of sustainable practices and their financial advantages. This will go a long way in creating awareness and also possibly inviting investments in the sector. Creating awareness allows investors to make informed decisions about potential blue bioeconomy policies and also reduces resistance to bioeconomic products by the populace
2. Research and Innovation: There is the need for the government and captains of industries related to marine to make investments in marine resource-related research and development. They can also encourage innovation in marine-based products, biotechnology, and aquaculture. This will ensure that prospective investors benefit from advanced aquaculture techniques and increased profitability
3. Building Capacity: There is the need to provide professionals and business owners with pertinent skill training, and offer networking events, workshops, and lectures. This will go a long way in equipping the potential investors with the requisite knowledge needed to survive in the business.
4. Policy Support: There is the need for the government to formulate laws that promote environmentally friendly behavior and also provide rewards for initiatives in the blue

bioeconomy. The government can formulate policies to discourage overfishing and discharge of industrial wastes into the aquatic environment.

5. Infrastructure Development: It is imperative to upgrade the distribution, processing, and aquaculture infrastructure, and also upgrade transit systems and port infrastructure. The provision of basic infrastructural facilities such as good roads, and stable electricity among others has the potential of lowering the operational costs incurred by prospective investors.
6. Cooperation and Partnerships: Encourage cooperation among government, business, and academics. There may be the need to engage with other NGOs, commercial companies, and research institutions. Cooperation and partnership among all stakeholders has the tendencies of opening new market opportunities and ensuring rapid growth.
7. Finance Accessibility: Boost investment and capital accessibility and support emerging and small-scale businesses operating in the industry.
8. Market Development: identify products market sectors for the blue bioeconomy. Promote maritime goods having added value globally.
9. Sustainable Practices: Place a high value on preserving resources wisely and encourage transparency and eco-certification.
10. Networking and Clusters: Create bio entrepreneurial partnerships and create regional hubs for the sharing of expertise.

Challenges and Opportunities of Embracing Bio-entrepreneurship and Blue Bioeconomy

Despite the importance of bio-entrepreneurship and blue bioeconomy in ensuring sustainability and achieving sustainable development goals, a number of challenges has been identified in literature to hamper the embrace of these two specialized fields. European Union (2019) identified: policy, environment and regulation; finance and business development; consumer and value chain; and science, technology and innovation. Other major challenges that have been identified to hinder investment in blue bioeconomy include: lack of understanding of the investment landscape; lack of funds and human resource needs (European Union, 2019). FasterCapital (n.d) recognized scientific uncertainty and risk assessment, steering regulatory pathways, obtaining funds, intellectual property management, market access and commercialization, team assembly and talent retention, and ethical considerations and social impact as challenges in bioentrepreneurship. Okunomo (2023) highlighted pollution, acidification,

climate change, maritime insecurity, and environmental management among other factors as some of the challenges mitigating against investment in blue economy in Nigeria. Similarly, Ife (2024) in the Nigerian context, identifed unsustainable extraction of natural resources, excessive waste production, and unalterable climate change, food insecurity, energy inaccessibility, deforestation, soil deterioration, poverty, and inadequate industrial output as some of the challenges that hinders the embracement of bio-entrepreneurship and bioeconomy.

Sevaral countries around the world, having identified the numerous challenges have taken pro-active steps in addressing them. For instance, the nordic countries like the advanced countries like USA, Britain and China are leveraging on the use of technology for bioprospecting, while South Africa and Malaysia have developed a comprehensive bioeconomy programmes with emphasis on expanding their agricultural sector and developing high-value bio inputs respectively (Khan, Palmer, & Chang, 2024).

Despite the challenges, opportunities still exist for those who wish to pursue careers. Among the opportunities are some of the following:

1. Participating in bioentrepreneurship and the blue bioeconomy enables potential investors to have a real-world influence by guaranteeing that the results of laboratory research are converted into worthwhile businesses with a service-oriented bent.
2. The discipline offers a wide range of options, and its effects are felt in almost every endeavor undertaken by humans, including those related to food, medicine, agriculture, biofuels, and so forth.
3. It fosters the growth of inventiveness and creativity
4. It fosters collaboration by allowing people from diverse field to share ideas and proffer solutions to societal problems among others.

Conclusion

The significance of bio-entrepreneurship and the blue bioeconomy in attaining sustainable development in Nigeria cannot be overstated. If the full potential of the venturing into bio-entrepreneurship and tapping into the blue economy is fully realized, it will go a long way toward reducing the country's employment rate while also fostering wealth and therefore reducing poverty. To promote quick development and successful establishment of bio-entreprises, the government should create an enabling environment and supportive policies such as tax breaks on imported

machinery and access to low-interest loans. This will go a long way towards motivating the teaming unemployed youths in the country to pursue professions as bio-entrepreneurs.

Recommendations

1. Government at all tiers should raise awareness on the potentials inherent in investment in bio-entrepreneurship and blue bioeconomy,
2. The government should enact supportive policies through her numerous agencies such as Small and Medium Entreprises Development Agency of Nigeria to encourage investment in bio-entrepreneurship,
3. Tax holidays can be introduced to ease the burden of paying taxes especially during the first three years to enable such investments to stabilize.
4. Loans and financial aids can be provided through agencies such as Bank of Industries to provide start-up capital for prospective investors

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