

Sustainability Developmental Study in Nigeria on the Effect of Biotechnology in Accelerating its Bioeconomy by Looking at South Korea, and USA

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ABSTRACT

The Sustainable Development Goals is a way forward to achieving a facilitating environment to support human wellbeing. some of the best countries on the road map to achieving the United Nations (UN) 17 Sustainability Development goals (SDGs) by 2030 like South Korea and USA should be emulated by Nigeria, by following the pattern of South Korea and USA biotechnology form leading to acceleration of their bioeconomic growth and the continuous growth of the industrial field utilizing the technology, the proportion of bioeconomy in the economic field is increasing. Biotechnology has a positive impact in the agricultural field were farmers and consumers can make informed choices on what crops to grow, to the policymakers and regulators to craft enabling biosafety guidelines for commercialization, on the industry as it creates a lot of employments and it has a positive impact in the health care sector as it helps to know how new medical approaches work on people via clinical trials. This paper reveals the income level economies of Nigeria, USA and South Korea on the context of Lower-middle-income economies, Upper-middle-income economies, High-income economies, and High-income OECD Members. The impact of government of the three countries on Research and development (R&D) investment as a percentage of their (GDP) shows the reasons why USA and South Korea are doing fantastic and Nigeria is seriously lagging far behind. Investments on biotechnology are important driver of economic growth as it spurs innovation, invention, and progress of a particular country. For this study many reports, research papers, and press releases were reviewed.

KEYWORDS: Sustainable Development Goals (SDGs); Nigeria; South Korea; USA; biotechnology; bioeconomy; economy; research and Development (R&D); expenditure; percentage of GDP

INTRODUCTION

The ability to maintain and creates growth, progress, positive change or the addition of physical, economic, environmental, social and demographic components at a certain rate or level is the main idea while UN brought about Sustainability Development goals (SDGs) to enhance human livelihood and to make our world a beautiful place to live in. The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people

enjoy peace and prosperity [1]. Evaluation of Nigeria performance on the seventeen Sustainability Development goals on the global stage and how they can make impact in improving each agenda in order to create a facilitating environment to support human wellbeing.

Table 1 provides the overview of the ranking of Nigeria on the global stage from 2017-2022 to achieving the UN SDGs agenda by 2030. According to UN report on Vanguard newspaper, Nigeria is not on track to meet the UN SDGs agenda by 2030 [2].

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TABLE 1 NIGERIA OVERALL SDG PERFORMANCE ON GLOBE

Year	Nigeria Ranking	Number of UN Rank Countries	Nigeria Score (%)
2017	145	157	48.6
2018	150	156	47.5
2019	159	162	46.4
2020	160	166	49.3
2021	139	163	54.2
2022	139	163	54.2

TABLE 2 UN 17 SDGS AND NIGERIA PERFORMANCE

SDGS	Name of SDGS	Performance
SDG1	No Poverty	Decreasing
SDG2	Zero Hunger	Stagnating
SDG3	Good Health and Well-Being	Stagnating
SDG4	Quality Education	Information unavailable
SDG5	Gender Equality	Moderately improving
SDG6	Clean Water and Sanitation	Moderately improving
SDG7	Affordable and Clean Energy	Stagnating
SDG8	Decent Work and Economic Growth	Stagnating
SDG9	Industry, Innovation and Infrastructure	Stagnating
SDG10	Reduced Inequalities	Information unavailable
SDG11	Sustainable Cities and Communities	Decreasing
SDG12	Responsible Consumption and Production	On track or maintaining SDG achievement
SDG13	Climate Action	On track or maintaining SDG achievement
SDG14	Life Below Water	Stagnating
SDG15	Life on Land	Decreasing
SDG16	Peace, Justice and Strong Institutions	Stagnating
SDG17	Partnerships for the Goals	Information unavailable

3 UN Sustainable Development Goals 2022

Table 2 illustrate Nigeria performance to achieving SDGs agenda. [3] evaluating some of the best countries on the road map to achieving the UN SDGs by 2030 like South Korea and US. Nigeria should follow suit in order to achieve or even come close to achieving the UN SDGs agenda by 2030 by following the pattern of South Korea and USA biotechnology form leading to acceleration of their bioeconomic growth. Recently, due to the development of biotechnology and the continuous growth of the industrial field utilizing the technology, the proportion of bioeconomy in the economic field is increasing. So, in order to preoccupy biotechnology in accelerating the bioeconomy and establish a new economic growth engine, a lot of countries have been preparing a national bioeconomic blueprint and actively participating in the global competition. In order to boost the bioeconomy via biotechnology, each needs an innovative change involving long-term approaches and interactions at all levels of society. The use of the term “bioeconomics” can, according to [4] be traced back to Zeman, who used the term in the late 1960s to designate an economic order that appropriately acknowledges the biological bases of almost all economic activities[4] The term

bioeconomy became popular in the first decade of the 21st century following its adoption by the European Union (EU) and the Organization for Economic Cooperation and Development (OECD) as a framework for promoting the use of biotechnology to develop new products and markets[5] According to the United Nations Food and Agriculture Organization (FAO), the bioeconomy is "the production, use and conservation of biological resources, including related knowledge, science, technology, and innovation to provide information, products, processes and services to all economic sectors with the aim of moving towards a sustainable economy. In 2012, the Obama administration released an official strategy on the bioeconomy entitled the “National Bioeconomy Blueprint” [6] Bioeconomy based on the use of research and innovation in the biological sciences to create economic activity and public benefit. The term "Bioeconomy" encompasses all industries and economic sectors that produce, manage and otherwise exploit biological resources and related services. Over the last decades biotechnologies have led to innovations in many agricultural, industrial, medical sectors and societal activities. Bioeconomy responds to the environmental challenges the world is facing,

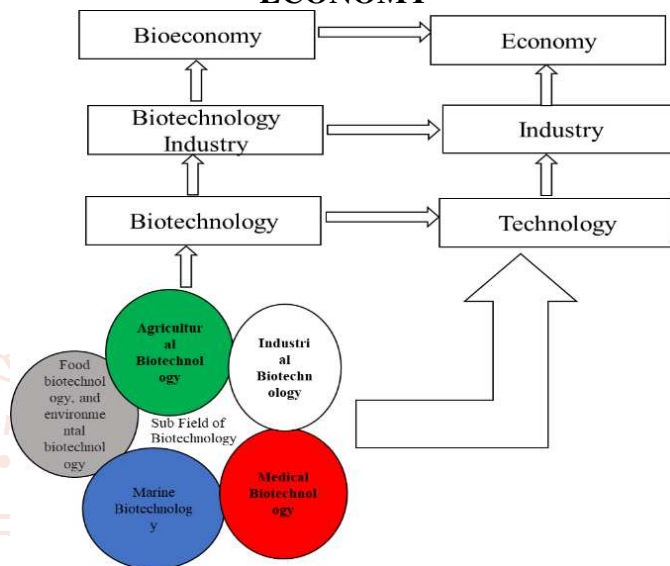
oriented to reduce the dependence on natural resources, transform manufacturing, promote sustainable production of renewable plant, microbial and animal resources and their conversion into food, feed, materials, bio-based products and bio-energy, while growing new jobs and industries. The bioeconomy is based on the idea of applying biological principles and processes in all sectors of the economy and to increasingly establish livelihood enhancing infrastructure that can boost the bioeconomy that provides opportunities for achieving a number of different Sustainable Developmental goals. [5]

Biotechnology is not new. Man has been manipulating living things to solve problems and improve his way of life for millennia. "Biotechnology" was first coined in 1919 by Karl Ereky meaning products are produced from raw materials with the aid of living organisms. [7]

In view of this study the main purpose is to know the sustainability development situation in Nigeria so as to create commercial value, companies and thus enhance the livelihood of the citizen and also boost the Economy of the country by using Biotechnology which is one of the keys enabling technologies to sustain a new green and sustainable economy (i.e., bioeconomy), offering solutions for an efficient and sustainable production of plant, create an efficient employment opportunity, and increase the biomedical sector which is relatively low when compare to amore advance countries like South Korea and USA. Biotechnology is one of the key sectors of the 21st century economy, it is enabling investments in innumerable areas, making production more efficient, and helping to conserve resources. Last but not least, it is opening up huge economic opportunities [8] With an estimated biotechnological market value of about \$23.2B in South Korea and \$152.4B in US [19] [10] The high investment in biotechnology market value has currently increased the bioeconomy which contributes significantly to South Korea and USA economy. Due to the significant investment required in biotechnological research, it was considered necessary for Nigeria to encourage and emulate such investment which ultimately enhance South Korea and USA competitive position in biotechnology and also encourage Nigeria to invest big in biotechnology which can also boost their bioeconomy. Biotechnology has impacted many different sectors, including agriculture, medicine, industry, marine, food and eco system. According to a report on Nature Public Health Emergency Collection the main subfields of biotechnology are medical (red) biotechnology, agricultural (green) biotechnology,

industrial (white) biotechnology, marine (blue) biotechnology, food biotechnology, and environmental biotechnology [7]. The trend through which biotechnology is evolving to boost bioeconomy leading to a sustainable economy is summarize in Figure 1.

FIGURE 1 BIOTECHNOLOGY ACCELERATING BIOECONOMY TRAJECTORY TO SUSTAINABLE ECONOMY



METHOD

The purpose of this paper is to understand the sustainability development Study in Nigeria on the Effect of Biotechnology in Accelerating Bioeconomy looking at South Korea and USA. A framework for the boosting of bioeconomy through biotechnology. For this study various reports, research papers, and press releases were review.

RESULTS AND DISCUSSION

A. Income Level and Biotechnology Crops Status
Recently, a lot of countries have been preparing a national bioeconomic blueprint and actively participating in global competition due to the preoccupancy of biotechnology in accelerating the bioeconomy. Out of them, I focus on South Korea, USA and Nigeria. South Korea is the country of my studies, one of the best countries in biotechnology in Asia, it has a high-income level and also a member of OECD, USA is the world leading country in biotechnology, in bioeconomy, it has high income level and also a member of OECD and Nigeria which is the country of my origin is a member of Lower-Middle-Income Economies country. According to a report edited by Biotechnology Industry Organization [11] High income level, human capital, infrastructure for research and development, intellectual property protection, regulatory environment are some of the essential factors that can immensely boost the

bioeconomy of a country. National biotechnology industry development strategies globally organization [11] classified income level economies. Income level and area of planting of biotech crops of South Korea, USA and Nigeria is depicted in Table 3. The economic benefits, health improvement, and social gains obtained through biotech crop adoption must be made known to the global community so that farmers and consumers can make informed choices on what crops to grow and consume, respectively to the policymakers and regulators to craft enabling biosafety guidelines for commercialization and adoption of biotech crops; and to the science communicators and the media to facilitate correct and effective dissemination of the benefits and potentials of the technology. Adoption of biotech crops declined slightly in 2019 at 190.4 million hectares worldwide in the 24th year of commercialization of biotech/GM crops in 2019, 29 countries grew 190.4 million hectares of biotech crops – a slight decline of 1.3 million hectares (3.2 million acres) or 0.7% from 191.7 million hectares in 2018 [12] Socio-economic benefits of biotech crops have been documented in the last 23 years (1996-2018) showing that biotech crops have contributed to: increasing productivity that contributes to global food, feed, and fiber security; supporting self-sufficiency on a nation's arable land; conserving biodiversity, precluding deforestation and protecting biodiversity sanctuaries; mitigating the challenges associated with climate change; and improving economic, health, and social benefits. climate change; and improving economic, health, and social benefits.

Planting area of biotech crops, importing of biotech crops, exporting and the consumption of biotech crops in a country helps us to know the accessibility and acceptability of biotech crops in that country. According to RDA (Rural Developmental Administration) report in 2017 South Korea plant biotech crops only for scientific research purpose [13] and in a very small area of about 0.0073.1MHA and does not permit planting of biotech crops for commercial purpose “In 2017, RDA (Rural Developmental Administration), the leading government research agency, announced that they would not allow domestic commercial production of biotech crops, in part responding to domestic anti-biotech NGOs [14] Because of this anti-biotech NGOs' laws South Korea is mainly base on importing biotech crops for domestic consumption and some research purposes. USA has 71.5 million hectares of land for planting of biotech crops both for research and commercial purposes [11] USA is the world leading country in planting of biotech crops. The output of biotech crops planted in USA has immensely boost the bioeconomy in USA and also help to curb the menace of hunger in some part of the world. Nigeria is using less than 0.1 million hectares for planting of Biotech Crops for both commercial and research purposes [11] Though has millions of arable lands that is not in use and there is no law that is preventing planting of biotech crops either for commercial and research purposes and this has increasingly cause hunger and high dependent of foreign aids for survival because of the high population of the country.

TABLE 3 INCOME LEVEL AND BIOTECH CROPS STATUS

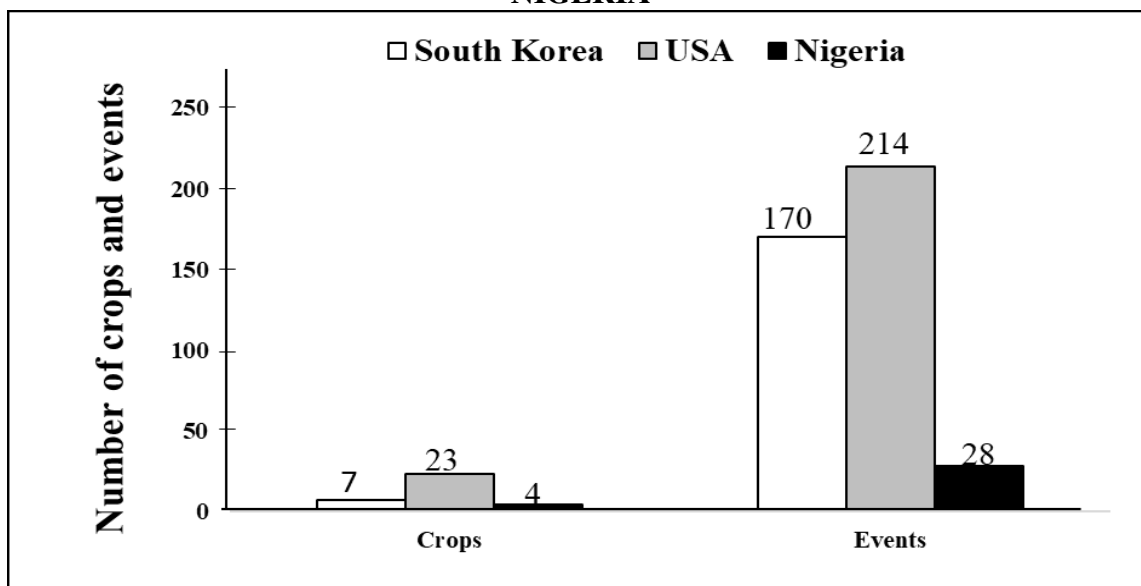
Country	Income Economy Level	Planting Area (MHA)	Biotech Crops	
			Commercial	For research
South Korea	High-Income OECD Members	0.0073	N/A	Only plant for research
United State of America	High-Income OECD Members	71.5	Maize, soybeans, cotton, alfalfa, canola, sugar beets, potatoes, papaya, squash, apples	Both commercial and Research
Nigeria	Lower-Middle-Income Economies	<0.1	Cotton	Both commercial and Research

B. Acceptability and Accessibility of Biotech Crops

Number of crops and events in GM database proves the level of agricultural biotechnology and acceptability of biotech crops in South Korea, USA and Nigeria. According to a report in GM Database [15] Shows the number of biotech crops that has been approved either for commercialization/planting and importation (food and feed) regulations and are based on the same objective that each GM crop is safe for human or animal health and the environment in South Korea, US and Nigeria respectively. 7, 23, and 4 represent the number of crops that has been approved in Korea, USA and Nigeria and also the number of events (modified plants varieties) 170, 214 and 28 represent the number of events that has been approved in Korea, USA and Nigeria as shown in Figure 2. Comparing the three countries, the acceptability of biotech crops differs greatly, South Korea is relatively doing great based on the fact that South Korea does not permits the planting of biotech crops for commercialization

purpose and only permit planting of biotech crops for research and for academic purpose, USA is the World leading in biotech crops and is relatively doing well based on the number of crops and events approved in GM database , Nigeria is among the countries that has adopted biotech crops in the world but the progress is relatively slow based on the number of biotech crops and events Nigeria approves in GM database

FIGURE 2 NUMBER OF CROPS AND EVENTS IN GM DATABASE IN SOUTH KOREA, US AND NIGERIA



15. The number of crops and events (modified plants varieties) that has been approved by each country in GM database for commercialization/planting and importation (food and feed)

C. Market Size of Biotechnology Industry

Table 4 illustrate the market size of industrial Biotechnology in South Korea, USA and Nigeria. It is very essential to know the estimated monetary worth of biotechnology industry in South Korea, USA and Nigeria. The estimated total revenue in biotechnology industry is generated by the sales of all biotech products and services. The table 4 above illustrate vividly the potential market size of South Korea, USA and Nigeria respectively. According to report by BioPharm International.com The biotech industry in South Korea is estimated to grow from \$19.5 billion in 2018 to more than \$23.2B by 2022 [9] USA biotechnology Industry is estimated to be \$152B [10] Nigeria biotechnology market size is not available (N/A). from the estimated market size from the above table one can say that the USA is most active in biotechnology and also the leading country, South Korea has a big biotech industry, Nigeria has little or no biotech industry to show forth.

TABLE 4 MARKET SIZE OF BIOTECHNOLOGY INDUSTRY

Country	Market Size
South Korea	23.2
USA	152.4
Nigeria	N/A

9. The biotech industry in South Korea is estimated to grow from \$19.5 billion in 2018 to more than \$23.2 billion by 2022

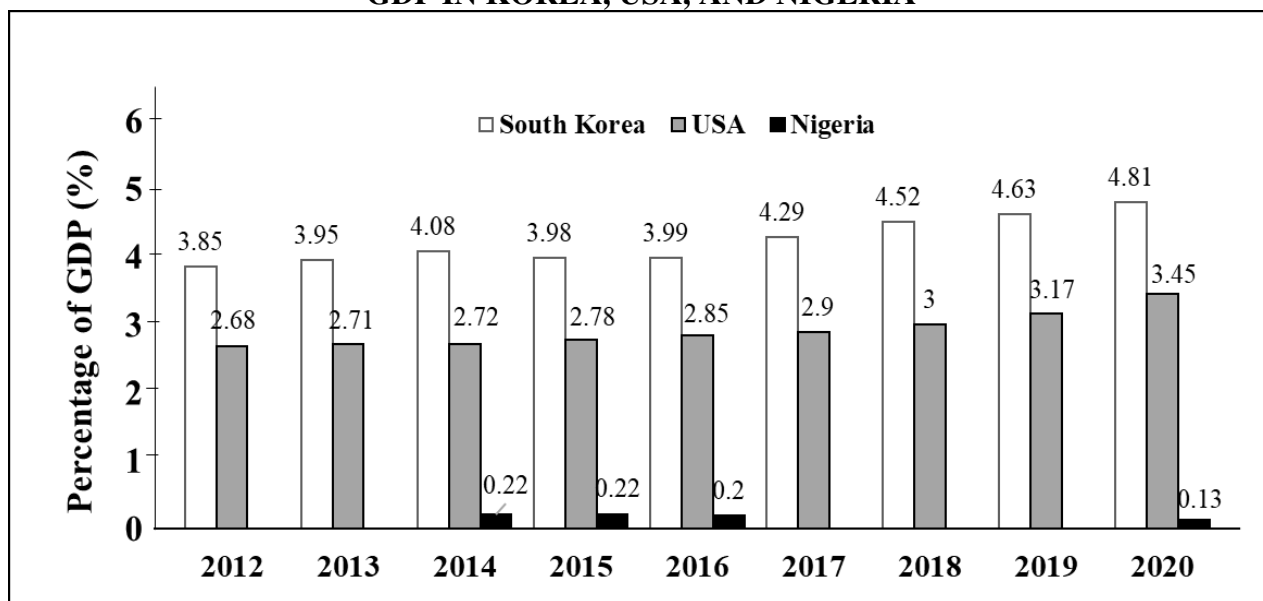
10. IBISWorld 2022, The biotech industry in the US is estimated to be \$152 Billion

D. Research and Development Expenditure as a Percentage (%) of GDP

Research and development (R&D) are important driver of economic growth as it spurs innovation, invention, and progress of a particular country. The figure 3 illustrate the infrastructure expenditure for R&D (% of GDP) in South Korea, USA and Nigeria, The Investment into R&D taking place in each economy as a percentage of that economy’s GDP. This indicator is not biotechnology specific but covers all major forms of scientific and technical fields. According to World Bank data the research and development expenditure (% OF GDP) in South Korea, USA and Nigeria from 2012-2020 is shown in figure 3 [16] Report from Statista Account shows the Infrastructure for R&D (% of GDP) in Nigeria [17] and [18] reported the expenditure for R&D (% of GDP) in Nigeria from 2014-2016. The result gathered by the UNESCO Institute for Statistics from Fig 3 demonstrates that South Korea invested about 4-5% of her GDP on research and development from 2012-2020 and this could more precisely reveal the progress of economic growth in South Korea, USA has a steady growth in Research

and development as they invested about 2.7-3.5% of her GDP on Research and development from 2012-2020, Nigeria never invested on Research and development from 2008-2013 but report from National Innovation System Disconnect: Evidences, Nexus and Way Forward by [18] reported the expenditure on R&D in Nigeria from 2014-2016 also Statista Accounts 2022 Shows that Nigeria invested 0.13% of her GDP on research and development in 2020 which is relatively too small to be compared to South Korea and USA.

FIGURE 3 EXPENDITURE FOR RESEARCH AND DEVELOPMENT AS A PERCENTAGE OF GDP IN KOREA, USA, AND NIGERIA

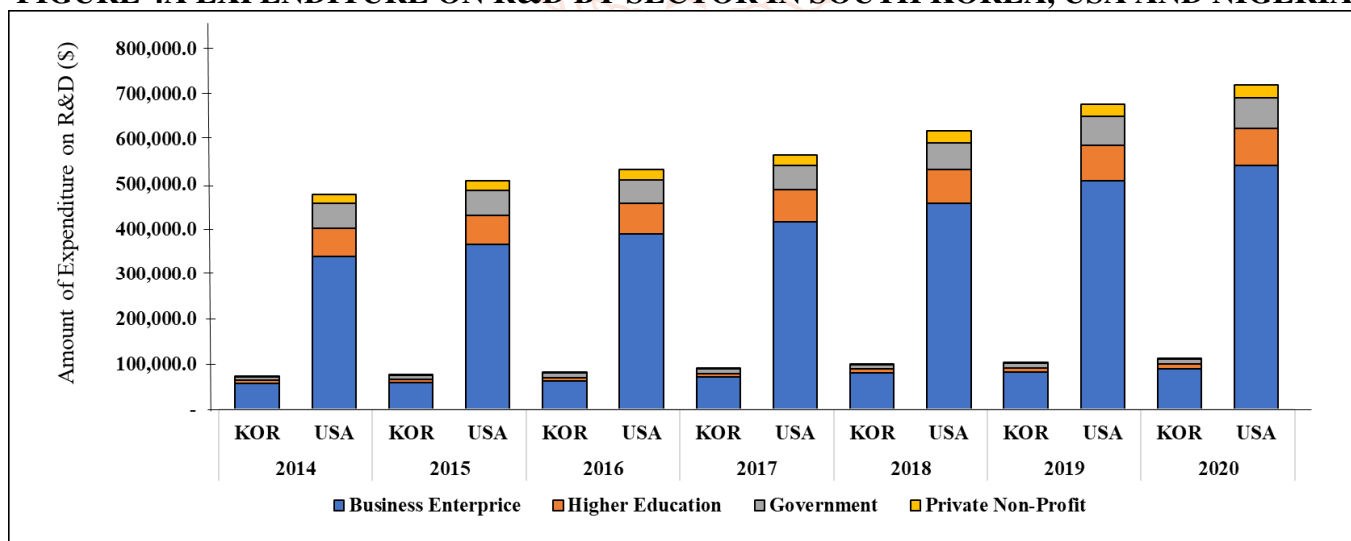


16-18. The investment into R&D taking place in each economy of Korea, USA, and Nigeria is presented as a percentage of GDP in each country. The R&D covers all major forms of scientific and technical fields. The data in South Korea and USA

E. Gross Domestic Expenditure on R&D by sector

Gross domestic expenditure on R&D indicates the value of total spending within the borders of a country, expenditures for R&D that are performed within a statistical unit or sector of the economy. Domestic gross expenditure on R&D by sector taking place in Korea and USA covers all forms of expenditure in government, higher education, business enterprise and private non-profit R&D is shown in Figure 4a [19] Nigeria data on Gross domestic expenditure on R&D is not available either it has done little or nothing to show forth.

FIGURE 4A EXPENDITURE ON R&D BY SECTOR IN SOUTH KOREA, USA AND NIGERIA



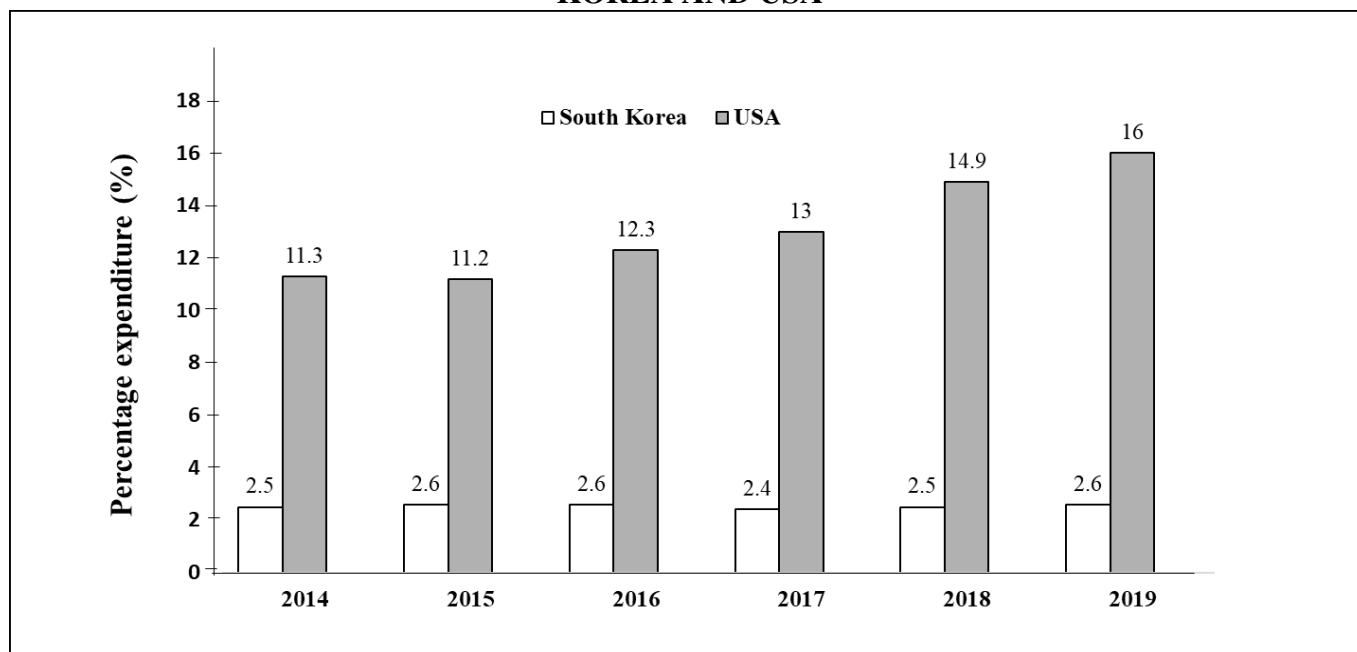
19. Domestic gross expenditure on R&D by sector taking place in Korea and USA covers all forms of expenditure in government, higher education, business enterprise and private non-profit R&D

F. Expenditure in Biotechnology R&D

Business enterprise research and development (BERD) expenditures on biotechnology provide a better measure of the research effort progress on biotechnology in a country. Biotechnology R&D on business expenditure

refers to R&D expenditures that are specific to the biotechnology field as a percentage of overall business enterprise R&D spending. According to a report from Key Biotechnology Indicators [20] illustrate the Percentage of Biotechnology R&D on Business Expenditure in OECD countries which South Korea and USA are members and Nigeria Business enterprise research and development is not available as shown in fig 4b above. The result gathered by OECD’s Directorate for Science, Technology and Innovation (DSTI) from Fig 4b above demonstrates that South Korea percentage expenditure on Business enterprise research and development (BERD) ranges from 2.4-2.6 % of overall business enterprise R&D spending on biotechnology expenditure on Business enterprise research and development (BERD). USA percentage expenditure on Business enterprise research and development (BERD) ranges from 11.2-16.0 % of overall business enterprise R&D spending on biotechnology expenditure on Business enterprise research and development (BERD) the data above provide a better measure of the research effort progress on biotechnology in USA as the leading country in biotechnology and how progressive South Korea has gone on biotechnology, Nigeria has done little or nothing to show forth in biotechnological world from 2014-2019.

FIGURE 4B PERCENTAGE OF R&D EXPENDITURE IN BIOTECHNOLOGY IN SOUTH KOREA AND USA



20. R&D percentage expenditure that is specific to the biotechnology field, it accounts for all expenditures for R&D that are performed within a statistical unit or sector of business R&D in South Korea and USA

G. Creation of Biotechnology Firms

One of the enabling factors that can allow employment to take place is the creation of firms. According to a report from Key Biotechnology Indicators [21] Illustrate the number of biotechnology firms created by each member of OECD countries as shown in table 5 above and the data for biotechnology firms for Nigeria is not available (N/A). The result gathered by OECD, Main Science and Technology Indicators Database from the above table demonstrates that South Korea biotech firms varies slightly from one year to another and created a lot of employment to South Koreans [22] US biotech firms varies slightly from one year to another and created a lot of employment to the people living in USA [23] the data information shows that the biotechnology industry in South Korea and USA has created a lot of jobs and thus enhance the livelihood and wellbeing of their citizens while Nigeria data on biotechnology firms is not available and because it is not available the progress of biotechnology cannot be ascertained.

TABLE 5 NUMBER OF BIOTECHNOLOGY FIRMS

Year	South Korea	USA	Nigeria
2015	948	3418	N/A
2016	940	2562	
2017	946	1772	
2018	956	2470	
2019	966	2470	

21-23. Number of biotechnology firms created by each member of OECD countries

H. Creation of Institution of Higher Learning

The objectives of universities and colleges are to develop students' personality, teach and research the profound theories of science and arts necessary for national development and human society as a whole, Higher education institutions measures the investment into center of learning where high skilled acquisition can be acquired. Higher educational institutions include not only universities and colleges but also various professional schools that provide preparation in such fields as law, theology, medicine, business, music, and art. Higher education also includes teacher-training schools, junior colleges, and institutes of technology. According to South Korea Ministry of Education report 2022 there are 426 higher Education Institution in South Korea [24] US college statistics reported in 2022 that there are 4360 higher education institution in the United State [25] PUNCH reported that there are 690 higher education Institution in Nigeria [26] From the table 6 above one can deduce that USA has many high skilled personalities due the high number of learning institutions, based on South Korea size and population, South Korea has a very high skilled personalities due to the high number of higher education Institution, Nigeria has moderate number of higher Education Institution base on the population and size of Nigeria.

TABLE 6 HIGHER INSTITUTION

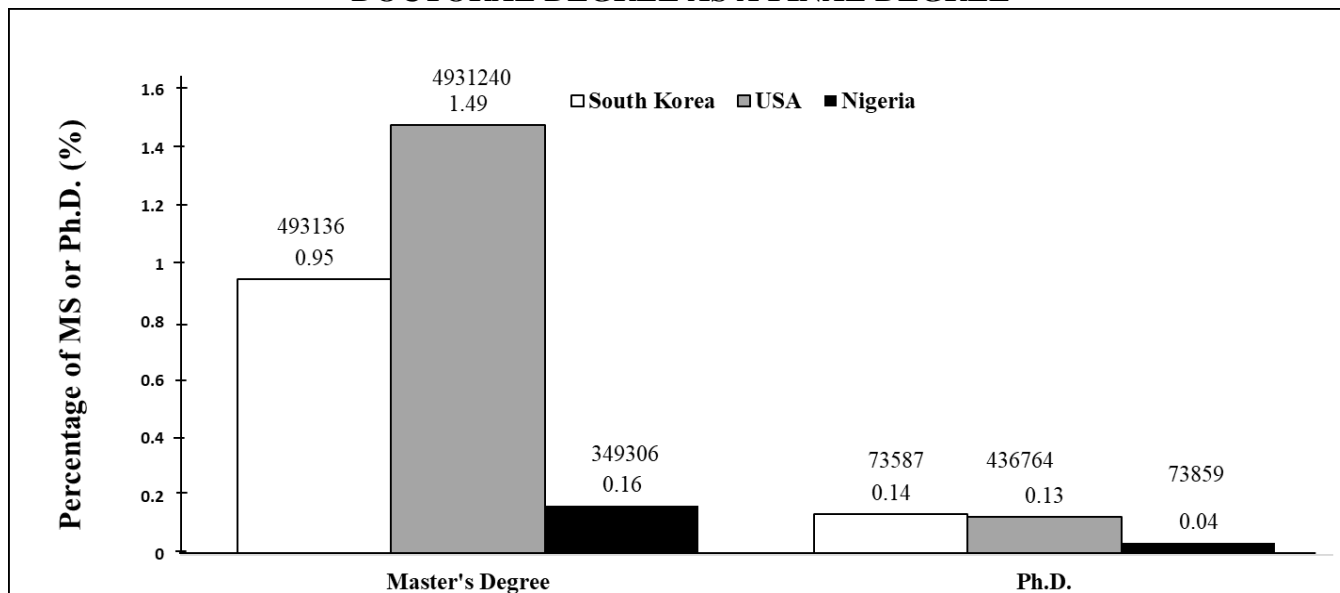
Country	Number of Higher Institution
South Korea	426
USA	4360
Nigeria	690

24-26. total number of higher institutions in South Korea, USA and Nigeria

I. Human Capital

One of the keys enabling factor for innovation in accelerating bioeconomy through biotechnology is the human capital. Human Capital estimates the level of technical capacity and human resources available within a given country by measuring the number of researchers in R&D activities, number of people with Master's Degree and Ph.D. Degree. Number of people With Master's degree and Ph.D. Degree in Korea, USA and Nigeria are stated in Figure 5. Report from Statista Accounts indicated the number of people with Master's degree and Ph.D. Degree in South Korea [27] From a total population of about 51.7 million people. The Survey of Earned Doctorates (SED) indicates the number of people with Ph.D. Degree in the USA in 2021 NSF [28] and Statista Accounts indicates the number of people with Master's degree in the USA in 2021 [29] from a total population of 331.9 million people, also a report from Ripples Nigeria breaks down the number of graduates including Master's degree and Ph.D. Degree holders in Nigeria [30] From a total population of about 211.4 million people. Evaluating the level of skilled human capital in South Korea, USA and Nigeria based on the total population of each country, it's imperative to ascertain the reason USAA is the leading country in biotechnology and also a member of OECD countries, South Korea has a high skilled human capital and also a member of OECD countries, Nigeria has a very high population but low skilled human capital.

FIGURE 5 PERCENTAGE OF NUMBER OF PEOPLE WITH A MASTER'S DEGREE OR DOCTORAL DEGREE AS A FINAL DEGREE

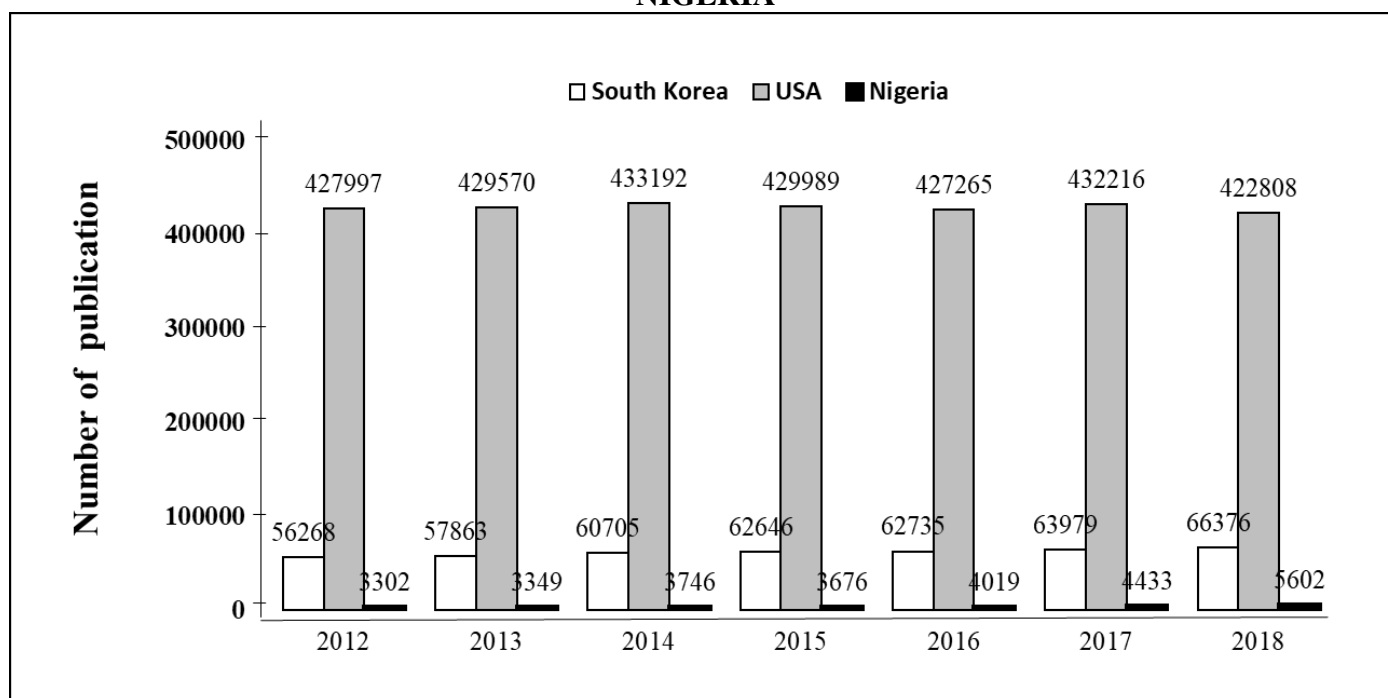


27-30. Capacity for R&D and human resources in Korea, USA, and Nigeria is presented as a percentage of people with MS or PhD as a final degree to the population of each country.

J. Scientific Prowess

Figure 6 provides an indication of a given economy’s overall level of scientific and academic proficiency and output, this indicator is not biotechnology specific but covers all major forms of scientific and technical fields such as physics, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences. According to World Bank data 2018 the number of Scientific publications of South Korea, USA and Nigeria from 2012-2018 is shown in the figure above [31] From the result gathered by the National Science Foundation, Science and Engineering demonstrates that the amount of Scientific publication from the USA exceeds the total amount of both South Korea and Nigeria and USA retains the leading country in the field of Scientific publication and this could more precisely reveal the innovative activity in the science field As illustrated by Figure 6, the USA is most active in scientific innovation, Scientific Publication in South Korea increased steadily though far below USA, Nigeria scientific publication is very low and not to be compared with US and South Korea.

FIGURE 6 SCIENTIFIC AND TECHNICAL PUBLICATION IN SOUTH KOREA, USA AND NIGERIA

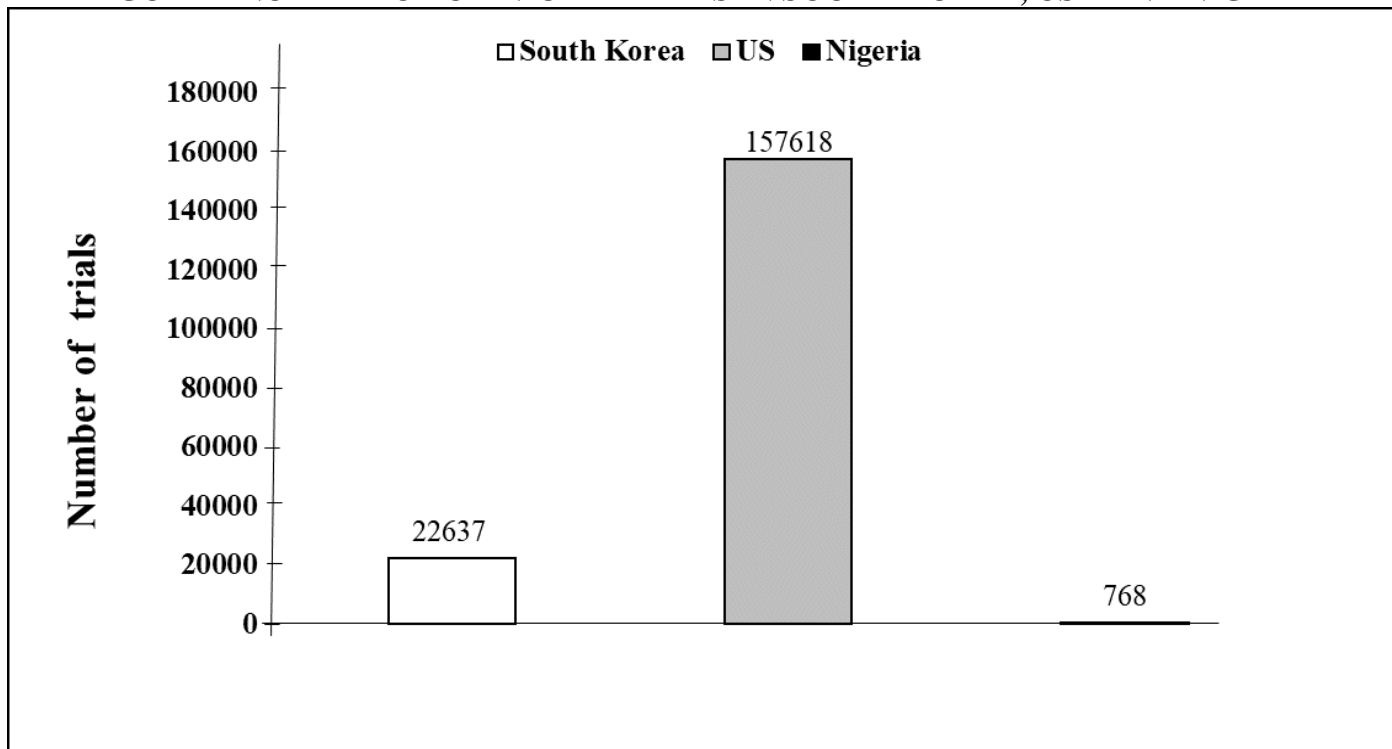


31. Academic and technical proficiency is illustrated as the total Number of Scientific publications in South Korea, US and Nigeria. The number of scientific and engineering articles published in the following fields: physics, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences.

K. Clinical Trials

Clinical trial is a type of research study that tests how well new medical approaches work in people. The number of clinical trials in a particular country is evidence on how a country has advance in a medical biotechnological world. A report on World Health Organization 2021 shows the Number of clinical trials by country [32] Shown in Fig 7, above. based on the data above the number of clinical trials indicate a lot about the advancement and progress of medical biotechnology in a country. USA has the highest number of clinical trials in the world and that has placed them as the number one in medical biotechnology in the world, South Korea keep striving harder by increasing the number of clinical trials and that has placed them in a good standing position, Nigeria has carried out just few clinical trials that has little or no significant in the world of medical biotechnology.

FIGURE 7 NUMBER OF CLINICAL TRIALS IN SOUTH KOREA, USA AND NIGERIA



32. Clinical trial refers to research study that tests how well new medical approaches work in people. These studies test new methods of screening, prevention, diagnosis, or treatment of diseases.

L. Clinical Trials Ranking

Without the necessary laboratories and clinical research facilities biotechnology R&D would be next to impossible. The regulatory and clinical environment in a given country or region plays an important role in shaping incentives for innovation and establishing adequate levels of quality and safety for biotech products, particularly biopharmaceuticals. The table 7 above shows the world clinical ranking of South Korea, USA and Nigeria from 2016-2020. [33, 34,] reported the clinical ranking position of South Korea as shown in the table above, [36] revealed the USA clinical trials world standing ranking position, Nigeria clinical world ranking position is not available due to few amount of clinical trials. South Korea is taking a bold step in clinical trials by building the necessary laboratories and clinical research facilities which help to shape the incentives for innovation and establishing adequate levels of quality and safety for biotech products, particularly biopharmaceuticals. USA maintains the leading country because of the number of trials and the position they occupy in world ranking

TABLE 7 CLINICAL TRIALS RANKING

YEAR	South Korea	USA	Nigeria
2016	8	1	N/A
2017	6	1	
2018	7	1	
2019	8	1	
2020	6	1	

33-34. Number of clinical trials

CONCLUSION

Biotechnology goes beyond industrial growth and GM crops, as it provides opportunities for progress towards many of the UN sustainable development goals (SDGs). biotechnology has a positive impact in the agricultural field, farmers and consumers can make informed choices on what crops to grow, to the policymakers and regulators to craft enabling biosafety guidelines for commercialization, on the industry as it creates a lot of employments. In the

health care sector with the aid of biotechnology on clinical trials which tests how well new medical approaches work in people, this can help improve the health of the people. Middle and low-income countries' activities like Nigeria in the medical healthcare, biotechnology sector is basically low and for them to improve they have to emulate countries like USA and South Korea whose standard are very high. The challenges include the cost of the technologies, infrastructure requirements, human

capital or skill worker and the enabling regulatory requirements. Biotechnology offers solutions to many developmental challenges our world faces today, from feeding and fueling a growing population to addressing a worldwide epidemic of chronic diseases. the potential of industrial biotechnology can be harnessed for the inclusive and sustainable industrial development of developing countries. Furthermore, biotechnology for inclusive and sustainable industrial development can contribute to our responsibilities towards the achievements of the Sustainable Development Goals (SDGs) particularly, Goal 2: to end hunger and achieve food security; Goal 3: to ensure healthy lives and promote well-being for all at all ages; Goal 4: to enhance quality education at all level of learning. Goal 9: to promote inclusive and sustainable industrialization and foster innovation and Goal. this report has reflected on how the right implementation of biotechnology can help build thriving bioeconomy. The government of developed country such as South Korea and USA is nurturing the biotechnology industry as one of the national major support industries, and the technology is now receiving the spotlight from the world. At this point, it is significant that systematic and balanced support for the bio-industry has become possible with two fundamental pillars: technological innovation and industrialization.

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