

An Appraisal of Innovative Approach to Plastic Waste Disposal Using Recycling Technique in Nigeria

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Abstract

Plastic waste in Nigeria has undeniably been a leading source of pollution since the inception and use of plastic for packaging food and beverages. The rapid increase in its production and usage has become of significant concern and has contributed to the problem of waste disposal. Its effects cannot be overemphasized considering its environmental hazards such as clogging of water ways, release of chemicals into the soil, endangerment to animals living in and around water bodies. It has become imperative that proper actions be taken to manage plastic waste disposal. The approaches considered in this paper are mostly circled around innovative recycling technique. Descriptive statistics was employed in analyzing the data and hypotheses were tested using Chi-square test. The analysis of the result shows that there exists poor management practice on plastic disposal and reveals that the perceptions of male and female respondents to sustainable plastic waste disposal management differs. The findings of this study concluded that this paper looks into certain methods that are already being implemented to manage plastic waste in Nigeria as well as the approaches that may be more effective in ensuring proper disposal so as to maintain environmental sustainability.

Keywords

Plastic waste, Recycling, Sustainability, Environmental hazard, Waste disposal

Introduction

It seems unimaginable in our present world to do without plastics or synthetic organic polymers. The quest for better quality of life from people of this world is unlimited and this has led to the rapid increase in the production of plastics for consumption. Since the 1950s, growth in the production of plastic has largely outpaced that of any other material, with a global shift from the production of durable plastics to single-use plastics (including packaging) (UNEP 2018). It has become a household name in the mouth of every manufacturer because of its durability, light weight, low material and production cost and ready availability.

It is no longer new that the marriage between the jet age and the plastic discovery was what gave birth to the novel industrial revolution which midwife the world as we have it now. From cell phone to computer, industrial packaging, home appliances, cosmetics even space station carries tangible amount of plastics. Besides its major usage in packaging, automotive and industrial applications, they are extensively used in medical delivery systems, artificial implants, water desalination, removal of bacteria and other healthcare applications (Verma et al., 2016; Okon, 2018). Plastics are found in almost every nook and cranny of our society.

Unfortunately, the properties of plastic such as its durability, light weight and low cost that make it so valuable also make its disposal problematic. Plastic waste is a major environmental concern because its disposal method is increasingly resulting to health and environmental hazards. Lagos state is said to generate the highest volume of waste in Nigeria. In many cases plastics are thrown away after one use, especially packaging and sheeting, but because they are durable, they persist in the environment (Hopewell et al., 2009).

Research studies shows that the production of plastic is to a great extent subject to fossil hydrocarbons, which are non-renewable resources. If the growth in plastic production continues at the current rate, by 2050 the plastic industry may account for 20% of the world's total oil consumption. (World Economic Forum, 2016).

Plastics produced in Nigeria are manufactured from imported raw materials or from recycled waste and therefore may not be counted as an additional contribution source to the volume of plastic in Nigeria. (Elias and Omojola, 2015). The total amount of plastics imported into Nigeria from 1996-2014 (including plastics from motor vehicles from 1980-2010) was estimated to be 23.4 million tons.

Although efforts have been made to curb the problem, it is yet an unresolved situation. Landfill sites have been used to harbor plastic waste and the fact that they are not compostable, makes it more of a pressing problem which therefore calls for the need to recycle them. Although methods which include incineration can also reduce the tons of plastic waste, it is said to be a threat to the environment as substances released into the atmosphere in the process are hazardous.

The Objectives of this research is to critically examine the disposal technique of plastic waste in Nigeria using recycling method approach. Particular objectives are:

1. To study the various methods used in plastic waste management in Nigeria.
2. To evaluate whether the perception of respondents towards sustainable waste management varies across their employment sectors?
3. To examine recycling as an innovative approach to managing plastic wastes across employment sectors for effective environmental sustainability in Nigeria.

Research Questions

1. What are the methods used for plastic waste management in Nigeria?
2. How do the employment sectors perceive the sustainable waste management practices?
3. How can recycling technique more likely be an innovative approach to effective management of plastic wastes for sustainable environment in Nigeria in respect to employment sectors?

Research Hypotheses

1. Plastic waste management methods used in Nigeria is significantly good.
2. There is no significant difference in the perception of sustainable waste management methods in Nigeria between the gender group.
3. Recycling technique approach do not significantly differ in regards to employment sectors for effective plastic waste disposal.

Plastic waste disposal: Plastic waste is the accumulation of already used plastic objects (bottles, bags, microbeads etc.) in the earth's environment; both terrestrial and marine (Laura, 2018). Because of the increased

production and usage of plastic wastes, it has become a major stream in the municipal solid waste (MSW). According to the report by UNEP (2009), Plastic wastes currently constitute the third largest percentage in MSW after food and paper wastes in most cities. The increased demand and use of these polymeric materials such as shopping bags, packaging materials, polyethylene terephthalate (PET) bottles and electrical appliances that are plastic based have found use in most developing countries and even those with very low economic growth are producing more of the plastic wastes (UNEP, 2009).

Solid waste management is a major environmental issue which the world is confronted with today and prompts to environmental threats ranging from the high rate of infectious diseases, water and soil pollution, environmental degradation, emission of greenhouse gases and all of which impacts the quality of human life negatively (Pakpour et al., 2014) and this affects the developing countries more.

The improper disposal of plastics does not only affect our environment but the world at large, most of these waste end up in water bodies and waterways eliminating the aquatic lives and acting as a threat to biodiversity (Roach, 2003). Plastics has gained wide acceptance all over the world but there is however no environmentally friendly means of disposing them. Research has shown that these plastics do not decompose easily, it takes several years to do so (Lapidos, 2007).

Most plastic waste end up in landfills and some are being disposed into the water bodies. This leads to annihilation and degeneration of the soil and gives rise to an increase in the consumption of these plastics by domestic animals while those disposed-off in the aquatic environment lead to bio-magnification and bio-amplification of these compounds by the aquatic animals hence making the environment unsustainable. (Machovsky-Capuska et al., 2019).

Recycling as an innovative approach: According to Al-Salem et al. (2009), Recycling is a process through which plastic waste is collected, processed and remanufactured by re-distorting, modification, rejuvenation, addition of new components to form new products. Plastic recycling is usually monotonous as it involves plastic material collection, identification, sorting, washing, drying, separating, volume reducing, extruding or compounding and then making it into pellets.

Recycling can be perceived as an innovative approach because it involves the management of plastic waste through the use of creative ideas, thoughts, new technologies, and new imagination. (Maranville, 1992). While using recycling technique, those materials that were considered waste becomes a resource or raw material for the creation of new items. The process helps in breaking down the chain of extraction-production-consumption-destruction and helps to create an ecologically friendly cycle that reduces plastic consumption and its negative effect hence establishing sustainable development (Patel et al, 2000). However only about 5-8% of plastic is been recycled because the method has not been well adopted (Watson, 2007).

Recycling technique for sustainable environment: A sustainable environment is one that must be able to meet the resource and service needs of present and future generations without compromising the health of the ecosystems that provide them (Morelli, 2011). Our consciousness has been awakened to the importance of environmental sustainability due to the impacts of global warming, climate change, environmental pollution, biodiversity and natural resources degradation which are environmental issues that are attached to improper plastic waste management. (Maria and Dwinanto, 2019).

Increase in awareness on the need for a sustainable production and consumption has led to the advancement of recycling techniques over other plastic waste disposal methods (WRAP, 2006). According to Singh and Sharma (2016), Recycling of plastic wastes helps to reduce the carbon dioxide emission that comes from burning of these plastics thereby mitigating these environmental problems that may result from its mismanagement and reduces the unsustainable use of natural resources and depletion of non-renewable resources.

This is the best way to address solid waste management as it helps to decrease the generation of waste which is ultimately dumped on landfills around the world (Robinson and Read, 2005). Recycling of waste products has a lot of advantages which includes: ensuring a clean environment with reduced pollution hence providing a sustainable environment for future generation and reduces greenhouse gases emission which would have resulted from burning on landfills, it also conserves natural resources in the environment by saving energy, protecting wildlife and saving millions of trees (US EPA, 2016).

Research has established that humans have a negative attitude towards recycling as a means of solid waste management (Bao, 2011) for several reasons which includes: its tedious nature, consumes time, requires a lot of space, lack of interest on people's part, lack of knowledge on the materials that can be recycled or not and inadequate recycling plants in the community (Adomaviciute et al., 2012).

The unavailability of plastic recycling may be due to insufficient funds required for the machineries to be used and the complex sorting and processing which it entails (Subramanian, 2000). In order to make recycling practices part of daily household routine, it is important that every household deals with its own waste in the most environmentally friendly way. (Fiorillo, 2013).

Methodology

This study adopted cross-sectional survey design aimed at collecting data that would be prevalent to finding answers to the research questions. Data were collected from target respondents between May and June 2020 to evaluate their knowledge about plastic waste and disposal. The study subjects were selected using simple random sampling technique (Marshall, 1996). This type of sampling is also known as chance sampling or probability sampling where each and every item in the population has an equal chance of inclusion in the sample and each one of the possible samples. (C.R Kothari, 2004). For the data collection, questionnaire design was used as the Research Instrument.

Data were collected using primary data collection through structured questionnaire. A questionnaire is a pre-formulated written set of questions to which respondents record their answers, usually within rather closely defined alternatives. The questionnaire had two sections, the first section aimed at collecting biographical details of the respondents while the later was to obtain insights on the respondent's awareness and solutions to plastic waste and its disposal. Closed ended questionnaire was employed using the five point Likert scales. Glen (2007), Likert scale is probably the most widely used response scale in survey research. Data collected were analyzed using Chi-square inferential method.

Result

The sampling technique used was simple random sampling. Every individual has an equal chance to be selected for the survey. A total number of 500 respondents took part in the survey study. After performing data cleaning, there were found incomplete responses, 10 responses had missing values. Hence, 490 responses were used for the analysis. Table 1 below shows the demographic information of the respondents.

Table 1: Demographic analysis of the Respondents

		Frequency	Percent
Age	18 – 28	254	51.84
	29 – 39	208	42.45
	40 – 50	25	5.1
	51 – 61	2	0.41
	62 and above	1	0.2
	Total	490	100
Gender	Female	206	42.0
	Male	284	58.0
	Total	490	100
Sector of Employment	Agriculture	13	2.7
	Construction	74	15.1
	E-commerce	7	1.4
	Education	145	29.6
	Entertainment	1	0.2
	Environment-based NGO	10	2.0
	Fashion and Beauty	23	4.7
	Finance	24	4.9
	Health	5	1.0
	Home and Hospitality	14	2.9
	ICT	32	6.5
	Indoor and Outdoor Service	11	2.2
	Insurance	1	.2
	Legal industry	4	0.8
	Manufacturing/Production	38	7.8

Unemployed	25	5.1
Oil and Gas	7	1.4
Power	7	1.4
Public Service	26	5.3
Telecommunications	11	2.2
Training and consulting	8	1.6
Transportation	4	0.8
Total	490	100.0

Source: Field Survey, 2020

Hypotheses Testing

Hypothesis One

Plastic waste management methods used in Nigeria is significantly good.

Table 2: Chi Square test

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	218.078 ^a	78	0.002
Likelihood Ratio	84.918	78	0.000

Source : Data Output (2020)

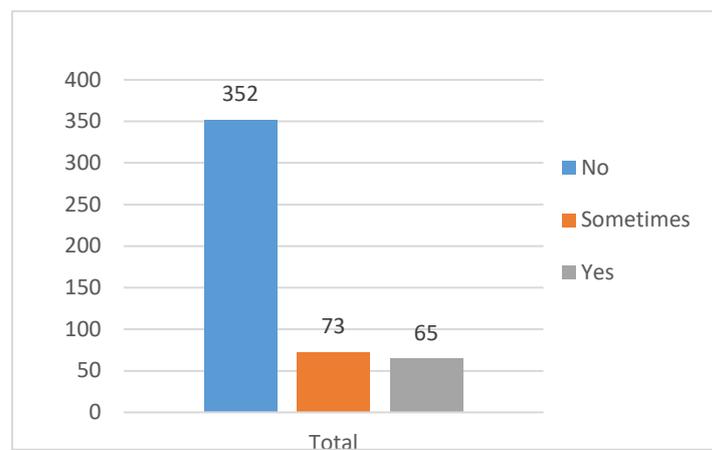


Figure 1: showing if respondents do sort out their waste for recycling

Table 2 shows that Chi-square test of independence was used to examine if there exist a statistical significant relationship between two variables (Plastic waste disposal and the sector of employment). The significance value provides the probability of the null hypothesis being true, the lower the number, the less likely that the variables are unrelated. Using a cutoff value of 0.05 to determine whether the results are statistically significant. From the result obtained, the chi-square test value is 218.078, the significant value is 0.002 with the degree of freedom (df) = 78. Since the significant value is less than 0.05, it shows that the null hypothesis is to be rejected. Rejecting H_0 indicates that the plastic waste management disposal method used by various sectors of employment is poor. Also, figure 1 illustrates that 352 respondents responded that they do not sort their waste, 73 responded that they sometimes sort their waste and 65 respondents do sort out their waste for recycling.

Hypothesis Two

Male and female respondents significantly differs in terms of perceptions of sustainable waste management methods.

Table 3: Chi Square test

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	20.338 ^a	4	.000
Likelihood Ratio	20.398	4	.000

Source: Data Output 2020

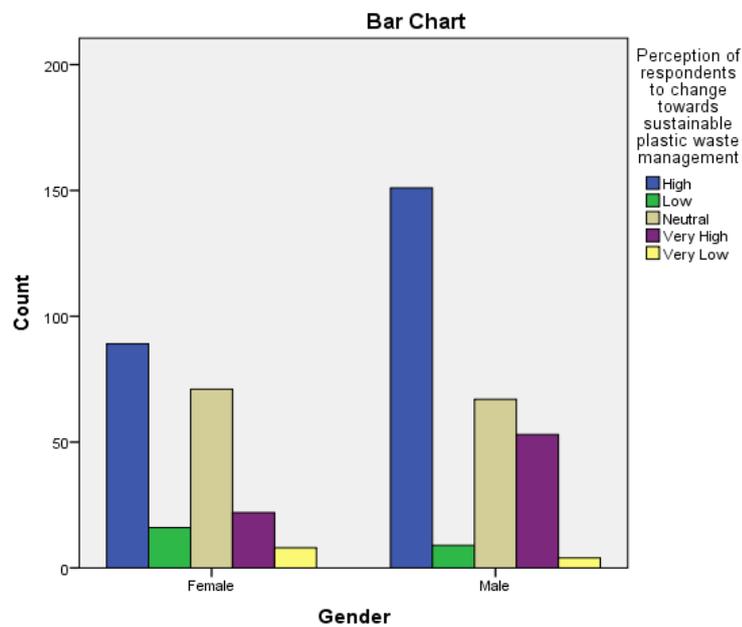


Figure 2: showing the perception of male and female gender towards sustainable plastic waste management

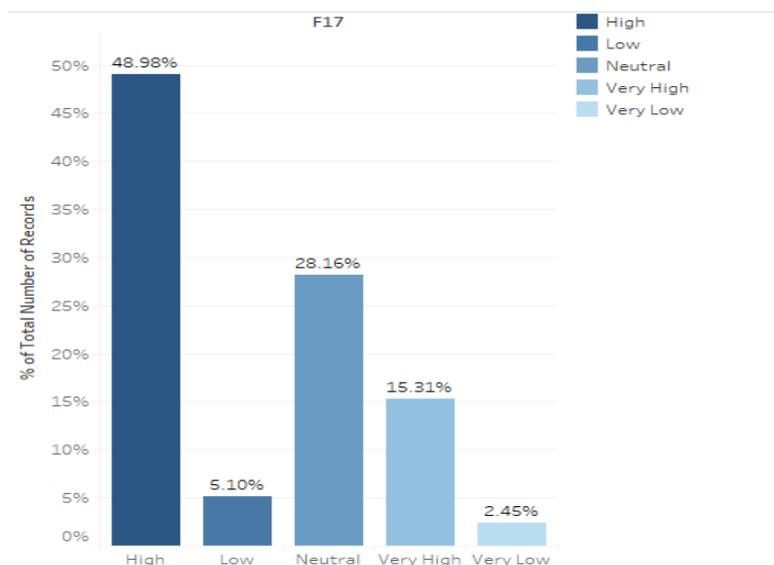


Figure 3: showing probability of respondents changing their behavior regarding sustainable waste disposal

The Chi-square test value in table 3 is 20.338 while the significant value is 0.000 since the calculated value is less than 0.05 ($p = 0.000 < 0.05$), the null hypothesis is rejected. This result showed that the perception of sustainable

waste management methods in Nigeria across the gender groups has a significant effect. Figure 2 shows that both genders have a high perception about changing their attitude towards sustainable waste management. This means that respondents' reason on sustainable waste management is strongly influenced by the genders' perception as shown. Figure 3 illustrates that 15.31% of respondents have very high perception towards changing their behavior towards sustainable waste disposal, 48.98% respondents have high perception, 28.16% respondents are neutral, 5.10% have low perception and 2.45% respondents have very low perception towards changing their behavior towards sustainable waste disposal as measured using the 5-point Likert scale.

Hypothesis Three

Employment sectors are likely to embrace recycling technique approach in Nigeria

Table 4: Chi Square test

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	44.881 ^a	42	0.352
Likelihood Ratio	42.416	42	0.453

Source: Data Output 2020

Examining the recycling technique approach on employment sectors for effective plastic waste disposal, table 4 shows that the Chi-square is 44.881, degree of freedom is 42 and the significant value is 0.352. The actual chi-square is used in conjunction with the number of degrees of freedom (df), which is related to the number of cells in the table. The table 4 shows that since 0.352 is greater than 0.05, H_0 should not be rejected. Accepting the null hypothesis means the recycling technique approach for effective plastic waste disposal was not found significant to the employment sectors.

Summary of Hypotheses Testing

Hypotheses	Description of Hypotheses	Significant values	Remarks
H_{01}	Plastic waste management methods used in Nigeria is significantly good.	0.001	Not supported (Rejected)
H_{02}	Male and female respondents significantly differs in terms of perceptions of sustainable waste management methods.	0.000	Not Supported (Rejected)
H_{03}	Employment sectors are likely to embrace recycling technique approach in Nigeria.	0.352	Supported (Accepted)

Discussion

The findings of this study showed that the plastic waste management methods used in Nigeria is poor as a result of available options provided. The result of the study also revealed that the difference between male and female respondents indicates significant difference regarding the perceptions of sustainable waste management techniques since everyone has a role to play in the environmental menace. However, the employment sectors were found to display more acceptance to recycling technique approach for sustainable plastic waste management.

Plastic recycling technologies is considered the assured path to enhance environmental sustainability. This suggested in research that concerted efforts should be geared towards funding environmental sustainability research and technologies, encouraging recyclers, the adoption of alternative materials and recycling by-products, and the development of recycling infrastructures and policies in Nigeria (Olanrewaju & Oyebade 2019).

Conclusions

The use of plastics in our everyday life has since been accorded much relevance and this has increased over the course of the third industrial age due to its numerous short-term benefits. However, due to its debilitating impact on the environment resulting from improper disposal mechanisms there is a need to change the narrative in utilizing plastics in a more sustainable way which entails recycling. If recycling of these plastics is embraced, it will help improve sustainable development and will also improve marine life and diversity thereby putting a halt to biodiversity loss in the marine world. The environment will also be free from leaching chemicals which includes plasticizers and endocrine disrupting compounds released by the plastics overtime that can affect human and plant health. This study shows that there exist a poor management approach for plastics disposal in the study area and this cuts across all employment types, but there is a better chance of male gender changing their behaviors on plastics disposal to a more sustainable way over the female gender.

Recommendations

The disposal mechanisms currently being utilized are not sustainable and that which is, is faced with a number of attendant challenges as well as differential perspectives on its adoption hence the following are recommend to provide better support for it:

- There exists a dearth of knowledge on safe disposal of plastics hence there is a need for continued advocacy, information dissemination and capacity building by respective stakeholders to promote the adoption of safe plastics disposal by the society.
- Much of the improper disposal of plastics stemmed from lack of safe disposal channels hence the need to create policies that give rise to provisions for proper plastic disposal, sanctions for defaulters and simplifying the mechanisms of safe disposal, especially regulated disbursement and enforcement on its use in industrial, commercial and domestic places.
- Over packaging of goods should be discouraged among producers and manufacturers, policies should also be made and enforced on packaging of goods to be imported and exported. The general public should also be enlightened and educated on the dangers associated with improper plastic waste management.
- Further studies needs be done to fully understand the underlying factors influencing the manner in which humans engage with wastes, especially plastics as we look forward to creating a sustainable environment.

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Biographies

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Olowosile O. Ruth is a graduate of Microbiology from the Federal University of Technology, Akure. She holds certificates in ISO 14001: Environmental Management System, Sustainability and Climate Change, ISO 45001: Health and Safety Environment (HSE), and Quality Assurance and Quality Control. Ruth has previously held positions as the Creative designer and Quality Manager at Bedazzled Nigeria. She is a visionary, a prolific speaker and a seeker of knowledge; a problem solver, creative and a lover of the arts. Ruth is passionate about

Environmental and Health issues, Sustainability, climate change and empowerment; and has previously volunteered and participated in various NGOs and campaigns including the Nigerian Urban Reproductive Health Initiative (NURHI), where she was a Radio talk show host. She also held positions as the President of the Orientation Broadcasting Service (OBS) and the financial secretary of the Editorial Board, when she was serving her country. Her purpose is to make professionals and common man understand the importance of sustainability, saving the earth and educating the masses on how to achieve this.

Adeleke E. Olubunmi is a young passionate, and resourceful individual. She completed her bachelor's degree in Statistics at Federal University of Technology Akure. She is an innovative data scientist with strong educational background and practical application skills in Statistics and data analysis. Olubunmi had worked in both public and private sectors, one of which is National Bureau of Statistics (NBS) which have equipped her with experiences and skills especially in Finance and in Field Work Administration. She also works as a data annotator whose role encompasses categorization and labelling of data for AI/ML Application. She strongly believes that looking after our environment is something we must all be part of and we can achieve sustainable environment through management of the environment and of consumption. She is the research team lead at Sustainable Green Environment Initiative.

Odiase E. Titus is a BA degree holder from the University of Ambrose Alli, Edo State. He possesses a professional qualification in project management. He is also a freelance writer, creating contents for organizations on their various digital platforms. Titus is a passionate individual for content marketing and research writing. He has been involved in various entrepreneurial activities, having worked with a team of great minds. His creative and innovative ability, drives him into creating strategies to solve problems. Also, he is an advocate for the emancipation of the African youth as he believes that the hope of Africa lies in the hands of the youths. Titus has worked in various organizations of which he was the team lead administrative officer at one of the organizations and a team lead business development officer at another where he had a group of marketers reporting directly to him. He also possesses interpersonal skills and ICT skills. His undaunted love for sustainable development spans from the fact that what we do now can decide the fate of what the future would be like for Earth's inhabitants. Nature is basically the bedrock of life and that is why he joined the SGE initiative, so he can be among those that would leave a mark of good work for future generations.

Adedokun A. Victoria is a graduate of Zoology from Bowen University (2017) and currently a post-graduate student of Environmental Health Sciences, University of Ibadan. She interned as a parasitologist at the University College hospital, Ibadan (2016), worked at the Area Veterinary Clinic Gwagwalada (2018) and with Agricultural and Rural Development Secretariat of the FCTA from 2018-2019. Victoria served as the class representative and emerged as the most outstanding and best graduating student in her department (2017). During service year (2018), She was the president of the Gender Vanguard CDS and underwent some certifications in Project Management, Health Safety and Environment (2018). She co-authored a research titled "Malaria HRP-2 Based Rapid Diagnostic Kit Reliability in Testing Febrile Individuals with Malaria in Iwo, Osun State, Nigeria" which is about to be published and currently working on others. As a graduate of Zoology and an aspiring environmentalist, she has passion for nature and research, this has increased her zeal and love for the environment.

Oluwatosin Ogunsola is a development professional in human rights, livelihoods, health, education, leadership, climate and entrepreneurship. Much of his engagement within the development space is centered around projects that impacts the lives of Children and Youth. He is a Peer Educator, Mentor, Open Source Leader and First Aider. He has executed projects with Philanthropy University, Horn Entrepreneurship, Youth for Human Rights International, Pharmacists Leadership Stimulant Program, CareerVillage, as well as Ambassador at Global Goodwill Ambassador, International Youth Society, Theirworld, Tobacco Harm Reduction Nigeria and Fight Cancer Global. A YALI fellow, Commonwealth Youth Climate Network, Youth in Foreign Policy and International Youth Council member. A Researcher, Consultant and Advocate currently living in Akure, Nigeria with interests cutting across Nature-based Solutions, Soil ecology, Food Security, Sustainability, Degradation and Climate change. A Mendeley Advisor with articles in reputable journals and recently named a runner up on the AAS Open Research Photography Competition of f1000 Research by Taylor and Francis. He is the Chief Executive Officer of Templus Agro-Consults Limited, Project Officer of Sustainable Green Environment Initiative, State Coordinator of Impact Youth Sustainability and serves as a Director on the board of Global Socio-Economic and Financial Evolution Network - African Continent.

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Orisabinone Toluwalase is a graduate of agricultural and bioresources Engineering from the Federal University of Oye-Ekiti, Ekiti State. He is currently on the pursuit of his master's degree in Water Resources and Environmental Engineering. He also holds certification in Health, safety and environment, Environmental Impact assessment, Basic First AID/CPR, Web development, Data Science and computing and also Digital Marketing. He has held positions in Cocoa product Ile-oluji in the engineering and environmental section. Toluwalase is a versatile and ingenious individual who is saddled with a great mental strength, skilled in oral and written communication, research. He is a team player but can also work alone if needs arise. He is a quick learner, inquisitive, never afraid to adapt to new responsibilities and highly motivated. He also can work minimal pressure and devise precise, time saving means to ensure effective operations. His purpose is to make professionals and common man understand the importance of sustainability, saving the earth and educating the masses on how to achieve this and bringing more technological approach to achieving this.