MEDITERRANEAN PUBLICATION
E-ISSN: 1115 – 8492 P-ISSN: 3027 – 0693
MPRI-JNSAR
INTERNATIONAL JOURNAL – NSAR
INTERNATIONAL JOURNAL OF NATURE AND SCIENCE ADVANCE RES.
VOL. 06 NO. 9 OCTOBER-2024

THE ROLE OF INFORMATION TECHNOLOGY IN ENSURING ENVIRONMENTAL WELLNESS IN DEVELOPING COUNTRIES

ADEREMI DAVID OYEDAPO; UGONNA VICTOR. OKOLICHUKWU; & EMMANUEL ONYEMA OGUGUA

Computer Science Department, Federal College of Education, Eha-Amufu.

Corresponding Author: *adoyedapo@gmail.com*

DOI Unique ID: 10.70382/mejnsar.v6i9.006

Abstract

In recent years, the world has witnessed the introduction of several new information technologies (IT) that have significantly contributed to the safety of our environment. Ozone Layer depletion and other environmental hazards have given man serious concern most especially in developing countries. This paper therefore examines the contributions of IT to environmental safety in developing countries. It adopted a survey research design approach and use five Likert scale questionnaire with 15 items drawn from three research questions to [redacted] collect quantitative data. SPSS was used to compute the mean and standard deviation of the responses from the respondents. The result shows that digital closed circuit television is one of the powerful IT devices that can be used to ensure environmental safety. Other information technology devices such as

Key words: Information Technology, Environmental wellness, CCTV, Internet of things and Environmental hazards

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

wearables technology, Internet of Thing, weather forecasting application and so on are of tremendous benefit to environmental wellness in many form. The study also reveal that the developing nations can benefit greatly if they invest on making Information Technology available and accessible to all citizen. It emphasizes the use of renewable energy to power those devices for maximum performance..

INTRODUCTION

Information Technology is a general term referring to Internet facilities and its application in various fields including sustainability and environmental wellness. According to Bédard and Henriques (2002) Information technology has brought a new revolution leading to the introduction of new expressions such as 'Global Village', 'Information Society', and 'Digital Earth' to describe this new connectedness being experienced. Bédard and Henriques further argue that these new technologies are being implemented extensively in developed countries and in isolated pockets of developing nations and are having major impacts in such areas as environmental health surveillance. Merriam-Webster Dictionary defines **environment as** the circumstances, objects, or conditions by which one is surrounded or the aggregate of social and cultural conditions that influence the life of an individual or community. The influence of an environment on an individual wellness that cumulate to community wellness is enough reason to research on the factors that affect the environment. Gorodnova (2023) briefly describes the ecological environment as the habitat of man and his interaction with this external environment. In this environment, man seeks to create the most comfortable conditions for life since he is the major determinant factor of the state of this external environment. In recent years, Information Technology has been seen to be a strong management tool for quick decision making in various sectors of their economy. Environmental issues are very sensitive area where decision making should be based on fact and figure which IT provides effectively and efficiently. The relationship of

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

information technology with the environment is a multidimensional issue as it demonstrates significant effects on every aspect of environmental wellness. Information Technology is used to identify, measure, verify, track and evaluate data regarding environmental wellness and its indicators in developing country. In developing countries today, Information Technology is being embraced among various sectors of the economy as a positive powerful tool to protect the environment and improve its wellness around the inhabitant but the facilities are grossly inadequate (Bédard and Henriques, 2002). The application of information technology (its effective use) daily improves the quality of a country's development which in turn directly affects its environmental wellness.

The wellness of an individual involves all factors that contribute to its complete health and well-being, including physical, mental, emotional, and social aspects of life Stoewen (2017). However, Environmental wellness refers to being aware and having a complete and sound knowledge of the relationship between oneself, its community, and its natural environment, and making effort to preserve and improve the health quality of the environment. It encompasses the understanding that our surroundings including air, water, land, and ecosystems directly and greatly impact our health and well-being. Achieving environmental wellness involves making conscious choices to protect and sustain the environment and this is where the role of information technology becomes essential in a developing country. This paper therefore seeks to investigate the awareness of the indispensable contribution of Information technology to environmental wellness in developing countries.

Review of related literatures

Xu and Lili (2023) argue that ICT play a pivotal role in reducing environmental pollution by enabling remote work and telecommuting through advanced communication and collaboration tools. This leads to decreased commuting, resulting in reduced traffic congestion, lower fuel consumption, and decreased greenhouse gas emissions. This assertion illustrates one of the ways IT ensures

environmental wellness and very related to the finding of Economic Commission for Latin America and the Caribbean (ECLAC) in the study conducted in 2021 which shows that, the development of advanced technologies such as 5G, the Internet of things and artificial intelligence should help reduce global carbon emissions by up to 15%, or almost a third of the 50% reduction proposed for 2030, via the development of solutions for the energy, manufacturing, agriculture and natural resource extraction, construction, services, transport and traffic management sectors

Bédard and Henriques (2002) state that new Information technologies are being implemented extensively in developed countries and in isolated pockets of developing nations and are having major impacts in such areas as environmental health surveillance. Hilty, Lohmann and Huang (2011), throw more light on how IT improves environmental heath surveillance by opining that Processing environmental information has been supported by ICT applications for decades in the form of monitoring systems, databases and information systems, analytical and simulation models, spatial information processing and other kinds of ICT applications for environmental protection, research, planning, and disaster mitigation.

Gorodnova (2023) believes that Implementation of the main directions of the "Smart City" concept ("Smart City") with application of artificial intelligence and neural networks, along with such basic elements as "smart government", "smart human capital", "smart economy", assumes inclusion of projects connected with "smart ecology", based on principles of natural resources saving and environmental pollution control. The implication of this assertion is that building a smart city is tantamount to preserving natural resources such as ozone layer and controlling environmental pollution. Edinburgh Sensors (2021) describes smart city as technologically control city and argues that Smart home technology means using devices such as linking sensors and other appliances connected to the Internet of Things (IoT) that can be remotely monitored and programmed in order to be as energy efficient as possible and to respond to the needs of the users. The Internet of Things (IoT) can be

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

describe as a network of internet-connected objects that is able to collect and exchange data using embedded sensor, WiFi or Bluetooth technologies. The data collected allows devices in the network to autonomously 'make decisions' based on real-time information. It is 5G Internet networks that make it possible to build smart city and take advantage of technologies such as automation and robotics, artificial intelligence, augmented reality and the Internet of things at different stages of the value chain (ECLAC, 2022).

According to Zeeshan, Han, Rehman, Ullah and Mubashir (2022), ICT is not only improving people's lives but is also enhancing the economic development of countries. Urbint (2022) supported this statement and list four safety technologies that help ensure environmental safety in the workplace as Robotics, Sensors and wearables, Software and analytics. In fact, environmental safety is synonymous to environmental wellness which is one of the eight dimension of wellness outline by Stoewen, (2017). Others include: physical, intellectual, emotional, social, spiritual, vocational and financial wellness. The purpose of this study is to examine the role and contribution of Information Technology to environmental wellness in developing countries.

Method

Descriptive survey research design is employed in this study to gather quantitative data through five (5) Likert scale structured questionnaire with fifteen items drawn from three research questions that guided the study. The study was conducted at Ebonyi State University, Abalaliki, Ebonyi State and Federal College of Education, Eha-Amufu, Enugu State, both in Nigeria. Three questionnaire could not be recovered out of 500 administered, using simple random technique, to the respondents; consequently, the analysis was done based on 497 questionnaires that returned. The reliability of the instrument was done on the 15 items at different location and obtained 0.82 as Cronbach's Alpha reliability value using SPSS for the computation, which prove the reliability of the instrument used. Two experts also validated the questionnaire to ensure that the instrument meet expected quality standard of both face and

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

content validation. The data collected were analyzed using SPSS to compute the mean and standard deviation of responses from the respondents. The mean value of five Likert scale response of strongly agree, agree, neither agree nor disagree, disagree and strongly disagree with scale value of 5, 4, 3, 2 and 1 which was computed to be 3.00 form the basis for decision rule. Any mean score that is up to 3.00 and above is accepted to be the true reflection of the statement/item otherwise the assertion is rejected or counted not true. The use of questionnaire ensures confirmation and completeness of data as well as increase confidence in the credibility of our findings. Extensive review of relevant articles and related literatures were also carried out in addition to personal observation to help establish the current status in this domain.

Research Questions

The burden that necessitated this study was to verify the role of ICT in improving better living condition in 21st century. Consequent of this burden the following research questions guided the study.

1. How does CCTV ensure environmental safety?
2. What other Information Technologies are good for environmental safety besides CCTV?
3. How does Information Technology enhance the sustainability of environmental wellness?

Result

Table 1: Mean and Standard Deviation of the responses for research question 1

The following are various ways by which CCTV ensure environmental safety:	N	Mean	Standard Deviation	Decision
CCTV reduce crime in our environment	497	4.12	.842	accepted
CCTV enforce environmental law and order	495	4.18	.825	accepted
CCTV can expose reptile hide out	494	4.27	.639	accepted

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

CCTV can be used for general environment monitoring	497	4.00	1.134	accepted
CCTV reveals secrete	496	4.36	.482	accepted
Valid N (listwise)	491			

The mean value of the items in table 1 are greater than 3.0 therefore all the items were accepted to be true. By implication Close Circuit Television (CCTV) reduce crime, enforce environmental cleanliness, expose reptile hide out, reveals any other secret bad behavior and it is generally used in environmental monitoring anywhere it is installed.

Table 2: Mean and Standard Deviation of the responses for research question 2

The following Information Technologies are good for environmental wellness besides CCTV	N	Mean	Std. Deviation	Decision
Wearables technology for environmental monitoring	497	4.01	.88	accepted
Internet of Things for tracking and sustaining environmental wellness	496	4.36	.63	accepted
Weather Forecasting for environmental planning	497	3.82	1.19	accepted
Robotics for ensuring environmental cleanness	497	4.21	.40	accepted
Smart technology for environmental safety	496	4.15	1.24	accepted
Valid N (listwise)	495			

Table 2 also shows that there are other Information technology gadgets which can be used to ensure environmental safety. These devices include: wearable technology, Internet of things, weather forecasting technology, robotics technology and smart technology. The mean value of these items are greater than 3.00, therefore all of them were accepted to true.

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

Table 3: Mean and Standard Deviation of the responses for research question 3

The following are different ways by which Information Technology enhance the sustainability of environmental wellness?	N	Mean	Std. Deviation	Decision
IT reduces the rate of Ozone layer depletion	497	3.42	0.50	accepted
IT reduces human exposure to environmental risk	496	3.32	0.62	accepted
IT reduces environmental pollution	496	3.90	1.03	accepted
IT facilitate the design and production of other products use for environmental wellness	497	4.27	1.28	accepted
IT gathers, processes and generate information use in taking any environmental decision	497	4.36	0.48	accepted
Valid N (listwise)	495			

In table 3 reveals how Information Technology enhance the sustainability of environmental wellness. The mean value of all the items exceeded 3.00, therefore they are all accepted to be true.

Discussion of the major findings

There is a lot innovation that Internet technology has brought to the use of close circuit television nowadays that make it indispensable in monitoring environmental activities. From the responses of the respondents in this study, it can be observed that CCTV reduce crime in any environment where it is

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

installed. In a systematic review and meta-analysis of the effects of CCTV surveillance cameras on crime reported by Ceccato (2022), the findings show that CCTV is associated with a significant and modest decrease in crime. The largest and most consistent effects of CCTV were observed in car parks. The results of the analysis also demonstrated evidence of significant crime reduction in other settings, particularly residential areas. The truth is that people like doing evil when they cannot be noticed. Once they discover that there no hiding place for them, nobody will make attempt of committing crime. The same explanation goes for how CCTV enforce environmental cleanliness in public place. Many people may not abide by the rule and regulation guiding the use of public place except there is a measure to fix out the defaulter and sanction such. The ability of CCTV to capture what somebody thought he has done secretly is what make it an ideal tool for environmental surveillance.

There are several other information technology devices that are very useful in ensuring environmental wellness. The respondents in this study totally agreed that all the devices and technologies mentioned in table 2 play significant role in environmental safety of humanity. Wearables Technology for example is being used in industry and many other places to read environmental situation and report through alarm, voice call or SMS to appropriate quarters when there is danger. Urbint (2022) describes wearables as sensor-equipped devices that monitor systemic risks like fatigue as well as situational risks like extreme temperatures or presence of hazardous gasses. Wearable is not only for monitoring systemic risk or situational risk but also has the ability to report or alert concern individual upon the discovery of any such risk in the environment. Urbint also argue that Robotics can be used in a variety of industries and many other places such as public places to prevent minor and major injuries. One of the great benefits of Robot is its ability to work perfectly well without any implication in an environment that is not safe for human being. It can be very useful in waste management. Hilty, Lohmann and Huang (2011) assert that smart technology has innovative feature such as accurate monitoring of a situation, ability to forecast/predict a situation, ability to learn human habits

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

and ability to act intelligently beyond human expectation. Edinburgh Sensors (2021) opine that sensors, microprocessors, Internet and software gave birth to smart technologies and "Internet of Things" that is now transforming the world.

Hilty, Lohmann and Huang (2011) believe that if there continue to experience increased innovation in ICT sector itself and in other sectors with the aid of ICT, continued growth and steps towards a low carbon economy can be stimulated at the same time. The Global e-Sustainability Initiative (GeSI) study #SMARTer2030 as quoted by ECLAC, 2022, estimated that by implementing digital solutions in different sectors of the economy, total global carbon dioxide equivalent (CO_2e) emissions could be reduced by 12 gigatons (Gt) by 2030, providing a path to sustainable growth. Carbon has been a major element that is responsible for Ozone layer depletion because of its spontaneous reaction with oxygen. Most engine that uses fuel produce Carbon monoxide as waste product which is unstable and require one molecule of Oxygen to become stable, hence, the reason for the visibility of CO_2 after released into the environment. This fact forms a strong basis for ECLAC to further argue that Real-time traffic information, smart logistics and lighting and other digitally enabled solutions could reduce CO_2 emissions by 3.6 Gt, including savings in emissions from journeys forgone. The journeys forgone as a result of easy communication and collaboration enabled by Information technology has another greater advantage of reducing the risk of accident on the way and save precious time.

For better understanding of how IT facilitate the design and production of other products use for environmental wellness Hilty, Lohmann and Huang (2011) use a linked life cycle approach to explain how ICT can modify the life cycle of other products and summarize the role of ICT as follow:

1. optimizing the design of other products;
2. optimizing the production of other products;
3. optimizing the use of other products;
4. optimizing the end-of-life treatment of other products;

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

5. modifying the demand for another product, either by
    a. substitution (decreasing demand) or by
    b. induction (increasing demand).

Conclusion

Information Technology plays a very significant role in ensuring environmental wellness of any nation. The developed nations have fully adopted the use IT in every sector knowing fully the role of IT in exponential growth of their economy and its benefit in the safety of their environment but developing nations still face challenges in full implementation IT driven society. Some of the areas where IT is used for environmental sustainability are environmental planning, protection, health surveillance, safety, research, disaster mitigation, pollution control, information and environmental monitoring. Digital closed circuit television camera when used effectively has the ability to reduce crime, enforce orderliness and ensure proper monitoring of the environment. IT has the potential to reduce the rate of Ozone layer depletion by reducing carbon emission through its energy saving effect.

Recommendation

There is need for government at all level and the citizen to see community safety and crime prevention as a possibility through IT gadgets such as digital closed circuit camera, gas detector and meta detector and take proactive approach to install them in every public places that are prone to crime. It is also very necessary to take Immediate action on providing enable environment in our educational system to bridge the gap between technical education and industry which is achievable through the provision of adequate IT facilities. Developing countries should learn how focus on using renewable energy to power ICT devices since power is one of their major challenges. Awareness campaign for the adaptation, deployment and utilization of ICT gadgets in industries, ministries and parastatal can be carried out by non-governmental organization or concern citizen. The federal government should develop a

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

policy that will encourage, support and provide enabling environment for innovation.

Reference

Bédard, Y. and Henriques, W. D. (2002), Modern Information Technologies in Environmental Health Surveillance An Overview and Analysis, Canadian Journal of Public Health, 93(1), 829-833

Ceccato, V. (2022), Architecture of crime and fear of crime: Research evidence on lighting, CCTV and CPTED features, Taylor and Francis Group available at http:/taylorandfrancis.com

Economic Commission for Latin America and the Caribbean (ECLAC), (2021), Digital technologies for a new future (LC/TS.2021/43), Santiago, available at https://www.cepal.org/sites/default/files/publication/files/46817/S2000960_en.pdf

Edinburgh Sensors (2021), The Impact of Technology on the Environment and How Environmental Technology Could Save Our Planet

Gorodnova, N. (2023), Application of End-to-End Technologies in Environmental Safety,https://www.researchgate.net/publication/368473523_Application_of_End-to-End_Technologies_in_Environmental_Safety

Hilty, L. M., Lohmann, W. and Huang, E. M. (2011), Sustainability and ICT – An overview of the field, notizie di POLITEIA, (104), 13-28

Merriam-Webster Dictionary available at https://www.merriam-webster.com/dictionary/environment

Stoewen, D. L. (2017), Dimensions of wellness: Change your habits, change your life, Canadian Veterinary Journal, *58(8):* 861-862

Urbint (2022), Top Environmental Health and Safety Technologies for 2022, available at https://www.urbint.com/blog/top-ehs-safety-technologies#:~:text=Predictive%20analytics%2C%20artificial%20intelligence%2Fmachine,ideally%2C%20implement%E2%80%94this%20year.

Xu, S. and Lili, W. (2023). "Do Green Information and Communication Technologies (ICT) and Smart Urbanization Reduce Environmental Pollution in China?" *Sustainability* 15(19), 14492. https://doi.org/10.3390/su151914492

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]

Zeeshan M, Han J, Rehman A, Ullah I and Mubashir M (2022) Exploring the Role of Information Communication Technology and Renewable Energy in Environmental Quality of South-East Asian Emerging Economies. *Front. Environ. Sci.* 10:917468. doi: 10.3389/fenvs.2022.917468

EDITOR-IN-CHIEF
Prof. E. Mclenna [Australia]