

Using Artificial Intelligence for Sustainable Environmental Policy Challenge to Developing Economy: Review of Global Best Practices

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Abstract

The paper examines the effects of environmental pollution on sustainable development in the developing economies, and how the adoption of artificial intelligence can address these challenges. It is well known fact that in most developing economics countries for example, Africa and other Asian countries, as the economy progresses the environment deteriorated, this does not match with the increase in technological advancement in this era of artificial intelligence. It has been noted that several problems such as monitoring, planning, controlling, diagnosis, forecasting, can be solved effectively by using artificial intelligence techniques. The paper focus on environmental problem of air pollution, and artificial neural network (ANN) Genetic Algorithm (GA), Fuzzy Logic (FL), Support vector Machine (SVM as some of the techniques used by AI was Reviewed. while artificial neural network was adopted for forecasting the daily average concentration of particulate matters PM2.5. Challenges of AI include issues of structural unemployment, security challenges, climate changes catastrophes and corporate governance etc.

Keywords: Artificial Intelligence, Artificial Neural Network, Environmental Pollution

JEL Classification: Q56

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Introduction

Artificial intelligence (AI) is a broad discipline in the real scenario; because it's contained in many diverse subfields of study and research, this assertion has been pushed forward by (Ashish and Vidhi, 2017). AI has been considered one of the remarkable progress in the history of scientific community that has capture almost all field of research and innovations (Zhiping, Jiaqian, Na Zhong, Xin, Jining and Jiade, 2021). Artificial Intelligence (AI): is simulation of human intelligence processes by a computer system or a robot controlled by a computer to do tasks that normally require human intelligence (kabir, 2022, Fisher, 2018) by obtaining and using knowledge without explicit intervention of the programmer (FSB, 2017). AI is a science devoted to making machines think and act like humans. Examples of application of AI in business include credit decisions, facial/finger recognition banking apps, security surveillance, predicting consumer behavior and product suggestions, robots that deliver food, dynamic price optimization and customer service using a chatbot and voice assistant, among others. More so, it is well known fact that in the most developing economies it has been agreed that as the economy progresses the environment deteriorated these assertions came as a result of industrial productions of goods and services which lead to serious degradation of air, water and land quality (Garba, 2022). And this does not match with the increase in technological advancement through artificial intelligence. As we all know machine learning dominated Mainstream research in this century, A I technology is rapidly

developing and so many AI methodologies are emerging and developing. A.I technology is mainly refer to Artificial Neural Network (ANN), Genetic Algorithm (GA), Fuzzy Logic (FL), Support vector Machine (SVM) excetra, thus are applied in the field of Finance because it has been observed that finance rule the world but soon technology such as A.I will rule finance (Adesola, 2022), further, Climate change, education Engineering Medicine and many more (Chambers and Hong, 2018)

As a result of industrial production and release of hazardous substances on natural resources and aquatic animals and plant are facing extinction, this events which lead to damage to the environment and society in which we live in thus create huge impact to the life of human (Yougendra, 2019). Meaning the natural environment is facing new challenges from both inside and outside the environment. In response emerging economies have to rise up by investing in this new emerging technology. With the coming up of environmental technology such as environmental sensor, geo-awareness, metrological forecast excetra. Due to the high cost of environmental issues, application of artificial intelligence (AI) is becoming more demanding and favorable, specifically the polluted environment where there surrounding is at the wreck.

Majority of environmental processes have a certain degree of uncertainty, and variety of interdependency between environmental factors which consist of air, water and land pollution. Because pollution in whatever form air, water or land is of harmful to the environment. Air pollution pollutes the air that we breathe which cause serious health issues such as Asthma, Cough etc. water pollution degrades the water quality that we use for drinking purpose and irrigation. Land pollution results in degradation of the earth surface as a result of human activities, couple with lack of completed data base from the policy makers. The environmental forecasting and analysis have to deal with the uncertain knowledge. Addressing this issues demand an integrated consideration of the relevant interaction between human and environment (Sydow, Rose and Rufeger, 1998). Considering a new discipline known as environmental information (Radmacher and Page, 1994) which combine research fields such as artificial intelligence, Geographical information (GIS) Modeling and simulation, user interface etc. is emerging an important and difficult task, for this new area of research is to serve as catalyst for the integration of data information and knowledge from various sources in environmental pollution sector (Stephanopoulos, 1996).

Literature Review

As noted by Ashish and Vidhi (2017) artificial intelligence has been coined by John McCarthy as an experimental branch of computer science that pursues of creating an intelligent machine that can perform diverse tasks by using its intelligence. However, McCarthy in his book titled "*Application of circumscription to formalizing common sense (1986)*" it has been reaffirmed that it is the science and engine of making intelligent machine, especially intelligent computer programme". As the environment is becoming more and more attractive and equally challenging on the other hand coupled with more and more science and technology innovations are therefore, increasingly receiving attention from academia and public as put forward by Micheala and Lazaros (2017) of which they assert that, for the continuous improvement of life quality in sustainable environment artificial intelligence is related directly among other to the environmental quality. This can be achieved by using adequate intelligent monitoring analysis, forecasting, decision and control system, based on the available intelligence tools and techniques such as integrated intelligence system are very useful for policy makers, for the management of the environment, critical situation such as serious air and water pollution from industries and natural disasters such as earth quake, landslide and flood. Artificial intelligence played an important role in everyday life in order to alert the entire people of a particular area in which it happened.

Jimoh (2021) posits that environmental issues in recent decades as a major aspect of discussion in the problem of economic growth and development, a policy issues that has been particular interest in recent years is cognitive computing (Matei, Chatterjee, and Raghuwashi, 2009) which also agreed with Jimoh but when further to say artificial intelligence also help environmentalist in risk reduction and increase efficiency.

It has been documented a developing approach to guide human friendly, artificial intelligence is considered one of the biggest unsolved A.I problem today (Celine,2018). As the scale of economic development, particularly in developing country and human impacts from deteriorating national environmental grow. Therefore, A.I as the technology evolved is directly or indirectly application for the environment will henceforward better understand by the majority of the populations in order to harness the opportunities. While assessing the potential risk involved and finding new approaches for mitigating them for example, A.I could be developed to improve natural disaster reliance planning and corporate social responsibilities. Hunt(1998), assert that many environmental problem such as damage to echo system, local air pollution, the separate of harmful substances by individuals and industries and global climate change challenges cannot be studied by experimentation along. Hence, with the current era of artificial intelligence computer stimulation are desperately needed as the most appropriate means to get more insight into the environmental issues. It has been predicted that AI will be able to create knowledge and enhance management of air quality by reducing air pollution (Aayush and Hammad, 2020)

Research conducted by Jayaden, Birgit, Jari, Antti and Wenlu 2018 on AI from environmental dimension, it has been put forward that artificial intelligence will enable developing economies countries take better care of the planet if is judiciously used in that direction in term of supporting waste and pollution management with the help of fuzzy inference model for side selection, but also, predictive system can be used for natural disaster management such as earth quakes and weather forecasting to better recognize the likelihood of extreme event occurrence in their country such as Hurricane and flooding . Furthermore, we can also recognize the adoption of knowledge management system integrated with deep learning technology embedded into it, that could help analyze the image of animals captured by motion sensor cameras in the wild. Such analyzed information could provide accurate, detailed and up- to - date information about the location, counts and behavior of animals in the wild, which could be useful in improvement local biodiversity and local conservative efforts.

Artificial Neural Networks (ANN)

According to (Ghedei and Vafaie, 2017, and Zhiping and Jiaquin 2021) ANNs are being broadly employed as approaches for prediction, estimation, classification and optimization in various fields due to their remarkable capacity to capture the nonlinear behavior between independent and dependent variables based on historical data using an applicable training algorithm. Although, there are several different classifications of ANNs, been used in different research paradigm this research work focuses on the typical types of configurations that have been employed in research works of environmental pollution controls, such as feed forward neural networks, specifically multilayer perceptron neural networks (MLPNN) and radial basis function neural network (RBFNN).

Focusing on The Multilayer perceptron neural networks (MLPNN) because is one of the simplest and most well-known types ANN used in the environmental pollution control activities because the structure of MLPNN which include input and output layers because it has a significant impact on predictive capability. Independent and dependent parameters which determine the number of neurons in the input and output layer, respectively. Neuron numbers in the hidden layers are generally determine via the

procedure using the trial and error observation rather than specified at first instance (Zonouz , and Tarjomanejad 2016)

Concept of Sustainable Development

World Bank (2012), “sustainable development is about enhancing human well-being through time while society’s ability to enhance or improve human well-being depends on the choice made preference of individuals, firms, communities, and government on how to utilize their assets.” Therefore, the ability of a nation to sustain a consumption flow (and therefore, to sustainable) depends on the change of its stock of assets or wealth. These assets may include natural assets, human assets, knowledge assets and manmade assets ex-cetra. For these reasons, the ability to manage these assets well is very vital to achieve sustainable development. However, there are limits to sustainability particularly for environmental and social assets that enhance human well-being though their mere existence as well as indirectly through their contribution to production and material being.

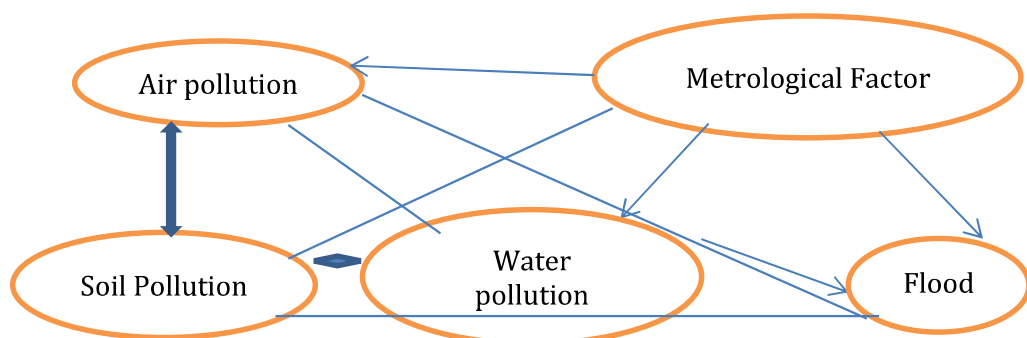
In line with UN authored one of the most-cited definitions of it: “Development that meets the needs of the present without compromising on the ability for future generations to meet their needs” (Jayaden, Birgit, Jari, Antti and Wenlu 2018)

Several environmental problems such as (monitoring, planning, controlling, diagnosis, analysis forecasting) can be solved efficiently using A.I techniques. Therefore, this paper will focus on the problem of environmental air pollution. The approached that was adopted is the use of ruled base system that receives the value of forecasting parameters by an artificial neural network (ANN).

Air pollution forecasting: many AI based forecasting systems were found in different kinds of literature written by many great scholars, a scientist for the prediction of air pollution (Pollat, 2011). For example, the neighbor based scaling that is combined with an ANN model for prediction sulphur dioxide (SO₂)

Figure 1: show the possible some environmental critical situation which is separated to another part of environment, for example, a serious air pollution problem would directly affect the soil and the water and if the two problems combine together, the impact on the environment could likely going to increase significantly, for example if there is serious air pollution problem in a given region the impact on the water and soil will be greater and will subsequently increase the pollution level.

Figure 1: Interdependence between different environmental critical situations



Artificial Intelligence (AI) technologies for environmental pollution controls

AI technologies have been employed extensively in dealing with wastewater, air pollution as well as solid waste, playing a leading role in modeling, optimization, prediction and control. The evolution over the time of the numbers of publications is presented in many studies related to environmental controls are rapidly increasing in the past decade. Modeling complex environmental problems using AI technologies is becoming popular in environmental field, especially in wastewater treatment. The input data are those collected from sensors environmental parameters. The model efficiently predicts the pollutant levels; the model performance is evaluated using statistical parameters, mainly involving the R² and Root Mean Square Error (RMSE). This evaluation criterion can stress the model's performance, the R² indicates the degree of correlation between the experimental and predictive values, which can be expressed as the equation below

$$R^2 = 1 - \frac{\sum_{t=1}^N (y_p - y_x)^2}{\sum_{t=1}^N (y_p - \bar{y}_x)^2}$$

Where N is the number of model output, y_p is the predictive output value, y_x stand for the experimental output and $\bar{y}_x$ denote the average value of experiments the RMSE indicate the error between the experimental value and the model output as shown by the below equation

$$RMSE = \sqrt{\frac{1}{N} \sum_{t=1}^N (y_p - y_x)^2}$$

Here, higher value of R² and lower value of RMSE indicate better prediction performance

Challenges

Developing economy countries like Africa and some Asian countries were actually left behind in-term of Artificial intelligence technology adoption, this has been clearly seen from the manifestation of environmental abuse is always at increase which does not match with the present reality. The following are some of the A.I to the developing economy on the bases of Literature and empirical study.

- i. Adoption of A.I: many developing economy countries are very poor economically and technologically, whereas others are extremely poor with very low GDP and are technologically at disadvantage too in order to meet its current environmental challenges as of know they are trying to make public awareness to their teaming citizens on the need to adopt A.I technology in their industry and social activities.
- ii. Fear of structural unemployment: it has been predicted as time goes on A.I technologies will bring economic changes trough an increase in productivity hence, reduce human labor input. Because with the new advance technological improvement machine is capable to form new task far better and effective which man is doing before, such as self-driving car, advance robots etc., this will create a device view in a labor market and society as a whole.
- iii. Corporate Governance: the institution process, and organization involved in the corporate governance of A.I are still in the early stage in developed countries. This needed to be extended to the developing countries, and therefore, this led to the great extent the echo system overlaps the subject related to internet governance and policy. For example, the rights to privacy and data laws are good example.
- iv. Security challenges: Since the A.I agents interact with its environment; it may lead to falling in the hand of harmful behavior, which will include

- indifference to the impact of its action. For example, the issues of Hackers and adversarial learning.
- v. Possible threat to Mankind: A.I machine May likely led to a clash of ideas and lead to some disagreement at some point in time between the operator and the machine itself. This is therefore, can give rise to struggling for supremacy between human being and the machine, because it has been predicted earlier that A.I machine will eventually conquer the mankind as they are exceptional good in everything compare to mankind effectively and efficiently
 - vi. Climate change: climate change is the depletion of the stratospheric ozone layer has been identified as the leading environmental issues globally for more than quarter of the century (Agnus, 2001). Climate change is concerned with how carbon dioxide, methane, particulates matters and other greenhouse gas emission emitted by human activities are altering the climate system (Harvey, 2000). Climate change is the greatest pressure of global environmental problem particularly in developed countries like USA, UK, China and Germany (Wang Jin-nan, 2012). A large body of scientific evidence proves that human activities arise from industry or individual causes global warming, with its main sources been greenhouse gases; since the preindustrial era, global concentration of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities due to increased use of fossil fuels land use change and agriculture (IPCC, 2007). Evidence shows that many natural systems in the land water or Air were been affected by climate change, particularly by raises in temperature (UN, 2013). Climate change thus involves an externality; greenhouse gas emissions damage other on no cost attached to the agent responsible (Stern, 2006) thus leading to a market failure which justifies the need of government intervention (OECD, 2011) but know the situation is affecting even the developing countries.

Conclusion and Recommendations

The paper has presented an artificial neural network (ANN) for short time forecasting depending on the type of environmental problems that need to be solved. The main purpose for this system is to give a quick answer to the communities or population on the environmental decision factors in order to reduce the impact of air pollution on the environment and on the population. Artificial intelligence is still in its phase stage and in changing continuously, it is therefore important to know that AI can gather data from various sources to create data base for environmental pollution which covered all possibility for impact so that it will be most beneficial. It has been recommended that now AI is a new technology which is desperately needed in both developed and developing countries particularly the developing economies adopting AI is of paramount important for effective environmental protection and its sustainability. The successful implementation of Artificial Intelligence (AI) in environmental policy management can be made by using drones and robots for analyzing the impact of environmental pollution.

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