

**BOOSTING ENVIRONMENTAL SUSTAINABILITY THROUGH
EFFICIENT MANAGEMENT OF GLOBAL WATER RESOURCES**

Asaasuen, T.

Geography Department
College of Education, Katsina-Ala
07062673956, 07054702878

Ako, Benjamin Tavershima

Integrated Science Department
College of Education, Katsina-Ala
08078787514

AND

Ikyor-Tyo Iorwuese

Integrated Science Department
College of Education, Katsina-Ala
08091924994

Abstract

Environmental Sustainability is central to the continued existence of mankind in his ever- increasing population all over the earth. The endowments of nature in all their ramifications especially water resources play vital roles in basic life sustaining routines both within the spectrum of natural cyclic operations and human activities that eventually translate to a meaningful life by the human society. This paper using documentary sources and field observation as a basis for descriptive analysis views environmental degradation through phenomenal pollution, erosion deforestation through grazing and cultivation which provokes desertification among others as major challenges facing environmental sustainability. The paper further suggests measures like protection of water-shades, afforestation, dredging of inland waterways, rain and dew harvesting, control of pollution, cloud seeding, and sinking of boreholes among others as strategies for effective management of water resources so as to broaden the scope of water availability and supply sources for use by the human society.

Keywords: Environment, Sustainability, Water, Management.

Introduction

The earth's environment is home to an incredible number of biodiversity comprising all humans, plants and animals as well as bacteria which all together amount to well over 8.7 million species in the terrestrial and marine environments. According to Yeqino (2020), terrestrial ecosystems host approximately 6.5 million species of biodiversity. In the same vein, aquatic environments which includes all the inland surface water, oceans and seas as well as groundwater account for about 2.2 million species of life forms on the earth, (Chapman and Reiss 1995, Richard 2012).

Of greater interest and significance in all manifestations is the fact that among all the aforementioned life forms, the human society made up of ever-growing world populations makes the most profound impact on the water supply sources of the natural environment, (Jordan and Grotzinger (2008). The world population estimated to be eight (8) billion people by mid-November, 2022 from an estimate of the first one (1) billion in 1800 and 2.5 billion in 1950 through a sequential natural increase to six (6) billion in the year 2000 by 12.6% growth rate which implies a drop from 18.9% in 1950, (Worldometer World Population 2022). Alongside this phenomenal growth are corresponding increases in the magnitude of environmental degradation through continued advancements in agricultural and industrial activities which intensify the proliferation of urban centers and remarkable sophistications in lifestyles within same.

According to Norton (2008), and Rose (2010), all above anthropogenic activities constitute a heavy blow against the existing global sources of natural water supply such as rainfall, precipitation, groundwater, oceans and seas as well as inland rivers and other water channels. For instance, while it is common knowledge that a growing population size translates unavoidably to increased demand for food and other essential services, the entire phenomenon leads to a boost in agricultural and industrial production with the end result of urbanization. Lugazo (2017), in his research on the impact of rapid population growth on forest resources notes that an increased population results in forest depletion, soil erosion and increased rate of general degradation of the environment which reduces the natural balances within the climatic parameters thereby lowering chances of precipitation.

Similarly, Ebe, Njoku and Nwachukwu (2018), note that human activities are the major sources of environmental pollution with agrochemicals of pesticides, herbicides and fertilizers contributing greatly to upsetting the delicate balance of

groundwater while land clearing for cultivation depletes vegetal cover and in the long run promotes drought and desert encroachment in just the same manner as does extensive grazing of animals. These and other issues tend to undermine environmental sustainability and the overall sources of water supply such as marine affiliations of oceans and seas on the one hand and terrestrial sources like rivers, springs, inland lakes and ponds alongside precipitation and ground water on the other, all of which individually and collectively determine the survival of life forms of the earth including the human society, (Sakiyo, Musa and Badgal 2020).

In the heat of all the prevailing circumstances expressed in the foregoing, water remains the most essential need and precondition for life forms to exist. Infact, the need for water supply increases day by day alongside world population growth. Ironically, the existing and known sources of water supply however tend to decrease and or jeopardize at every stage of increased sophistication in the quality of life the human population attains due to increasing levels of complications in agricultural and industrial productivity that offer little or no attention to nourishment of the natural environment which remains the primary source and chief custodian of the ingredients from which those products derive source, (Kilic 2020).

Based on the foregoing, it becomes imperative that for the healthy living of the humans and the entire life forms of the earth in their great diversity as well as the natural environment itself to sustain, water resources must be carefully harnessed and accordingly utilized. This contention which remains the focus of this paper is aptly captured in the Millennium Development Goals (MDGs) of the United Nations put in place in the year 2000 which has metamorphosed to and now known as Sustainable Development Goals (SDGs) under item seven (7) as follows: “To Ensure Environmental Sustainability” through the following ways:

- Integrating the principles of sustainable development into member countries’ development policies and programs and reverse loss of environmental resources.
- Reduce loss of biodiversity.
- Reduce the proportion of the world population that has no sustainable access to safe drinking water and basic sanitation.

It is in light of the above and the desire to boost public awareness on the vital role of water that this paper seeks to examine the challenges facing water and its supply sources with the view to suggesting mitigating measures that would go a long way to save global water supply sources and ultimately enhance

environmental sustainability for the general well-being of mankind, plants and animals as well as the efficient and effective functioning of the physical earth.

Conceptual Clarifications

This segment of the article attempts a clarification on some fundamental terms and concepts as used within the context of meeting the demands of the focal concerns here. To some extent therefore, meanings may not tally rigidly as contained in normal usage in English.

Environment – The environment literally means the circumstances, objects or conditions by which one is surrounded. Wright and Boorse (2011), sees the environment from a geographical perspective as the complex of physical, chemical and biotic factors that act upon an organism or ecological community thereby determining its form and survival.

Sustainability – This refers to the ability to be maintained at a certain rate or level.

Environmental Sustainability – This refers therefore to the responsibility to conserve natural resources and protect global ecosystems to support the healthy living and wellbeing of life forms including man, plants and animals now and in the future.

Water – This refers to an inorganic, transparent, tasteless, odourless and nearly colourless chemical substance representing the major constituent of the earth's hydrosphere and fluids of all known living organisms. It has a boiling point of 100%.

Water Resources – This Resources within the context of this article refers to water bodies in all their ramifications of oceans, seas, inland water channels like rivers, lakes, streams, ponds, springs and by extension all forms of groundwater and other potential sources like precipitation including rainfall, dew, fog, snow, polar ice etc, which can be harnessed or utilized directly for the satisfaction of one need or the other by man, plants and animals as well as the natural environment itself.

Towards Efficient Management of Global Water Resources

In attempts to boost environmental sustainability, it is imperative that water resources must be carefully managed within the context of available natural, scientific, technological and socio-economic means. This is because water in its multiple manifestations facilitates the effective functioning of many environmental processes of physical and biochemical affiliations which go a long way in improving the quality of our natural environment thereby boosting its ability to

sustain and hence its value, (Yuan 2021). The following among others are some of the strategies for efficient management of global water supply sources.

Forestation Programs

It is common knowledge that trees contribute a great deal in adding to the amount of water particles in the air that eventually add up in the process of building a framework of hydroscopic budget, (Kaushik and Kaushik2014). Meanwhile, one of the most common strategies of enhancing water resources is massive planting of trees in forestry development. According to Sharma (2014), government can make policy statements that promote massive afforestation programs. The forests help to boost atmospheric moisture which builds up to enhance rainfall in many places. The forests thus discourage drought and desert encroachment.

In close relationship with afforestation is the strategy of orchard farming. Orchards are types of farms that grow fruits and nuts through cultivation of tree crops like pears, oranges, apples or oil palms, and shrubs like bananas and cherries. Just like the forest, the trees and shrubs help to speed up the rain formation process through their biochemical routines of photosynthesis and transpiration, (Trikat 2010). The long term impacts of trees or forest whether by design under forestation or as an aspect of agriculture practice all facilitate the rain formation process as the two constitute a platform for increase absorption of water particles by air. On the other hand, the presence of leaf canopy especially in forested areas tend to shield excessive insolation and loss of water from the ground as the canopy act as natural agent for regulating temperature.

Dam Construction

Similarly, another efficient management strategy for global water resources involves the construction of dams across stream channels of rivers to regulate the flow of water. Though according to Mantilla (2021), dams usually accumulate sediments with passage of time thereby increasing the tendency for overflows leading to excessive loss of water and raises growing concerns about the benefits of water projects of dam affiliations, if technical rules governing universal operations of dams and reservoirs are followed carefully, the benefits of dams and reservoirs become economic realities which overweigh the risks.

Rain Harvesting

Efficient management of water resources can embrace the use of high technology apparatus to harvest fog, rainfall, snow and dew from the air, roofs of

houses, run off and leaves of plants. With growing sophistication in industrial operations, many countries in the dry mountains of the world including Morocco in North Africa have acquired and are successfully experimenting fog and dew harvesting technology which traps fog and dew through nets and channels and directs same to devices that process them and supply for public consumption, (Patniak 2017). The advantage internet in harvesting technology is that the amount of water that would otherwise flow on the ground as run-off to trigger soil erosion is reduced in volume thereby lowering soil erosion potentials in areas where such technology is adopted, (Rosgrant, Cai and Cline 2002).

Cloud Seeding

Another strategy for effectively and efficiently managing water resources is through the technology of cloud seeding. This technology which is highly advanced and capital intensive involves enhancing the amount and type of rainfall by dispersing substances into clouds which constitute condensation nuclei that alter the micro-physical properties of clouds and speed up the process of precipitation, (Yuan 2021). This may be done through use of aircrafts or shooting devices into the clouds containing the substances. Although, the arguments against this method of boosting rainfall in semi-arid regions is that seeded clouds may scatter into locations not actually planned due to atmospheric disturbances, while on the other hand, this technology sometimes leads to the rain shadow effect thereby resulting in drought in neighbouring areas. Stakeholders can employ greater care in ensuring the seeded clouds are technically controlled to produce rainfall in planned locations, (Czy, Bruintjes and Mather 1994).

Dredging of Inland Waterways

Dredging of inland waterways to improve on their depths for enhanced navigation is yet another viable strategy to effectively manage water resources. The River Niger in Nigeria for instance, can be improved upon by dredging its course up to Lokoja and the Benue. Such measures will boost water transport and diversify the use of those rivers. Additionally, ground water can be effectively harnessed by way of sinking boreholes and hand driven open-wells locally made to tap water from the ground. It is interesting to note here that lots of communities in Benue State, Nigeria and the developing world's resort to open wells and boreholes as good sources of water supply which serve for domestic, agricultural and industrial purposes such as cooking, washing, irrigation and dyeing respectively. These have so far represented a source of pride and mark of cultural heritage in Africa, (Liu and Liptik 2019). Thus, if the groundwater sources are well

maintained and protected against pollution would make a great impact on rural livelihoods.

Control of Pollution

Water resources can be effectively managed through pollution control. By reason of increased demand on food and essential goods and services as well as public utilities due to continuous expansion in the size of human population, agricultural and industrial productivity have proportionally intensified so as to meet the increasing demand, (Sarbpriya and Ishitya 2011). This development has translated to a great deal of environmental degradation manifesting particularly in water pollution from solid, liquid and gaseous sources. These can be carefully controlled through appropriate measures like a reduction in the use of toxins in fishing by fishermen, channeling of industrial dust far away from portable water channels and supply points while on the other hand, indiscriminate disposal of waste materials into natural water channels can be checked so as to improve on water quality and ultimate health of the human society and that of wildlife, (Dunca 2018, Oko 2019).

Environmental Education

Also of paramount importance is the strategy of environmental education which seeks to equip youths and the general masses with the basic awareness on the important and indispensable role of water in both cyclic operations of nature and its survival as well as the healthy living of mankind, plants and animals. This knowledge according to Kaushik and Kaushik (2014), is necessary to change poor attitudes towards the environment and minimize wanton destruction to potential water supply sources like forests and grasslands while at the same time cultivate a friendly attitude towards the environment and water resources in particular.

Poverty Reduction

Poverty reduction is very critical in attempts to articulate efficient and effective strategies to manage water resources. According to Oyeshola (2008) and Ayo (2013), the poor who substantially outnumber the average class live and depend directly on the natural environment for their sustenance. For instance, without any other source of livelihood, they harvest fruits, stems and roots of the forest as food, out-rightly cut down trees massively for fuel wood in domestic cooking and sale as source of money. It therefore becomes imperative to lower over-dependence on the natural environment through poverty eradication programs by governments and other development stakeholders especially in developing countries before attempts to effectively boost environmental sustainability in any

form can yield expected results. If poverty levels drop, the use of alternative sources of domestic fuel in cooking and heating in tropical and temperate locations respectively will increase appreciably as more and more families will opt for and afford gas cookers and kerosene-powered stoves in their cooking operations.

Environmental Policies

These are guidelines that are expected to govern and or regulate human interference with such attributes of the environment like flora and fauna as well as soils. In attempts to effectively and efficiently promote environmental sustainability through careful management of water resources by the human society, a sound administrative machinery involving implementation of efficient environmental policies is required. According to Sharma (2014) and Dunca (2018), the administrative machinery constitutes an efficient strategy for ensuring that environmental policies are fully implemented at all levels of government and society. Under strict and routines checks, water shades, dams, forests, and other potential sources of water supply can be well protected through stringent rules and regulations with harsh punitive measures for defaulters.

Factors Militating against Global Water Supply

Water availability is central to the survival of all life forms of the earth. The sustained availability of water is however constrained by a multiplicity of issues and challenges as outlined and discussed below.

Deforestation

One of the major problems facing environmental sustainability and global water supply is massive disappearance of the world's vegetal cover. According to Mfon, Olorundami (2014), Nigeria's vast portions of swamp and tropical rainforest as well as the Savannah with a vast land area and species diversity of amphibians, birds, mammals and reptiles are fast disappearing in the face of increasing human population size. This development is due substantially to increased agricultural and industrial production which translates to urbanization and eventual consumption of the land areas that were previously forested. It is interesting to note that approximately 60% of the world's population lives in urban areas.

Given above scenario of disappearing forestlands, there is therefore a drastic shortfall in the amount of atmospheric moisture that derives source from vegetation. The implication according to Wahlquist (2001), is that reduced rainfall becomes the case especially in tropical areas that share boundary with arid regions. In the same vein, reduced precipitation goes a long way in adversely affecting

nutrients cycling in their routine cyclic operations within the environment. The same thing applies to other parts of the world's forests in Brazil, Central Africa and is enhanced by atmospheric attributes like rainfall which helps to distribute water into the soil. Through this vital cycle, nitrogen is phenomenally converted to a multiplicity of chemical forms as it circulates among atmospheric, terrestrial and marine ecosystems consecutively from the air, soil, organisms and then back into the atmosphere. Without water playing its vital role, this process would not be a natural reality, (Reed and Cleveland, 2013).

Also, of similar impact on vegetation is agricultural productivity along water shades which is noted for its adverse impact of clearing the vegetal cover which facilitates the entire process of rain-formation. With massive destruction of water shades, rainfall diminishes gradually resulting in drought.

Another dimension of deforestation which intensifies drought and desertification is extensive grazing of cattle in pastoralism which leaves vast areas devoid of vegetal cover and as such prone to erosion, development of badlands and drought, (Nwangwu, Mbah, Ike (2020). The overall result of over-grazing is brought to bear adversely on water supply as both the rainfall regime of affected areas are affected over time in climate change which builds gradually on the one hand while on the other, the water retentive capability of the soil is robbed due to absence of plant cover and soil erosion.

Environmental Pollution

The earth's environment has suffered a high magnitude of water pollution through domestic sewage, industrial dust and other forms of wastes as well as agricultural inputs sources like chemical fertilizer, herbicides and pesticides. The inland waterways, lakes, oceans and seas have become increasingly polluted thereby compounding daily routines which relate to water utilization especially as water plays major roles in biodiversity conservation, (Nwonumara 2018).

Climate Change

Long term shifts in weather parameters involving gradual changes in the temperature and rainfall conditions over a given place go a long way in affecting water supply in other places. Because the earth operates as a segmented body – a system where all things are connected, changes in one area can affect or influence changes in all other areas, (Findlay 2020). With continuous increase in world population and the proliferation of agricultural and industrial landscapes which destroy the vegetal cover that naturally absorbs excess carbon to a tune of about 200 billion metric tons annually in addition to heat emanating from same

agricultural and industrial activities, the earth's temperatures rise resulting to wildfires and other issues that gradually tend to factor climate change and water scarcity, (Shi 2018 and Mukhopadhyay, 2020). The adverse effects of climate change on environmental sustainability are that climate changes reduce rainfall drastically thereby translating to acute shortage in water supply for food production. Ground water also runs short due to lower rainfalls, while wildfires may cause serious environmental catastrophes provoking large scale deforestation and its inherent odds. All these issues according to Ghali and Ramakrihnan (2015), tend to impact negatively on effective cycling of atmospheric nutrients which are central to the overall process of rainfall and other sources of water supply towards boosting the quality of the natural environment.

Conclusion

This article has examined a multiplicity of strategies that can be adopted in human attempts to boost environmental sustainability through management of water resources. Among other things the paper considers the indispensable role of trees towards enhancing the quality of the natural environment by way of booting the cycling of environmental nutrients and ultimately the rain formation process, dam construction to store and regulate water flow, multiple rain harvesting options and cloud seeding as well as dredging inland waterways. The paper also considers some humanitarian strategies like control of pollution, policy matters and poverty reduction issues. The paper furthermore notes particularly that there are some serious challenges which usually compound the noble endeavours to attain environmental sustainability and the fact that some are based in human activities. These includes deforestation, pollution, and climate change. It is crystal clear that the various adverse forces that interplay in unbalancing nature operate under the canopy of population growth over time which intensify the drive for food and basic services through a boost in agricultural and industrial activities resulting in accelerated degradation of the environment that tends to impact negatively on water supply sources such as water shades, precipitation and groundwater. It is the humble submission of the paper that if these are objectively and decisively pursued as contained herein, water supply sources across the world and Sub-Saharan Africa in particular will significantly improve thereby boosting the sustainability of the environment.

Suggestions

The following measures are suggested in attempts to boost sustainability of the environment. There should be massive forestation programmes by communities and government at all its tiers. At individual level, for any tree cut down at least three (3) should be planted especially as the rate of regeneration is usually lower than that at which felling of trees occurs. This measure will ensure gradual regeneration of vegetal cover destroyed through routine human activities and will go a long way in boosting precipitation.

Dams should be constructed to regulate water flow during rainy seasons and conserve water for use in the dry seasons. Countries with the financial capabilities should invest in rain harvesting, dredging of inland water ways and cloud seeding technologies in order to boost their water supply sources. These will respectively save water that would have been lost through run-off during rains, deepen existing rivers and streams for more elaborate uses and boost cloud fertility to improve rainfall chances.

All development stakeholders including governments, non- governmental organizations (NGOs) and individuals should do well to minimize water pollution through refuse and toxic dumps as well as other processes. This will reduce the rate at which water quality is being adversely affected. The central role of water in boosting environmental quality and all aspects of development should be well taught in schools under environmental education. This will cause a more friendly attitude to be developed towards water conservation among the populace that use water. There should be sound environmental policies protecting our natural environment especially water supply sources with harsh punitive measures against offenders.

References

- Ayo, M. (2012). *Issues of Development and Poverty Reduction in Nigeria*. Makurdi: Destiny Ventures.
- Bhende A.A., Kanitkar T. (2003). *Principles of Population Studies*. 6th Revised Ed. Delhi: Himalaya Publishing House.
- Chapman J.L, Reiss M.J. (1995). *Ecology: Principles and Applications*. Low Priced Edition. Cambridge: Cambridge University Press.

- Cleaver K.M., Gotz, A.S., (1994). *The Population, Agriculture and Environment – Nexus in Sub-Saharan Africa. Directions in Development Series. Washington DC: World Bank.*
- Czy, R.R., Brintjes, R.T. (1994). A Review of Hygroscopic Seeding Experiments to Enhance Rainfall. *International Journal of Weather Modifications*. Vol. 26(1).
- Dunca, A.M., (2018). *Water Pollution and Water Quality Assessment of Major Transboundary Rivers from Banat, Romania. Special Issue. New Trends in Monitoring and Removing Pollutants from Water. International Journal of Chemistry*. Vol. 2018 ID: 8394086.
- Findlay, A. (2020). *Conservation Under Climate Change. Nat. Clim. Chang.* 10,6069. <https://doi.org/10.1038/s41558-020-00961.z>
- Ghaly A.E., Ramakrishnan V.V. (2015). *Nitrogen Sources and Cycling in the Ecosystem and its Role in Air, Water and Soil Pollution: A Critical Review. J Pollut EFF Cont* 2015 3:2 <http://dx.doi.org/10.4172/2375-4397.1000136>
- Jordan T.H., Grotzinger J. (2008). *The Essential Earth*. New York. W.H. Freeman and Company.
- Kaushik A., Kaushik C.P. (2014). *Perspectives in Environmental Science. Multi-Coloured Edition. New Delhi. New Age International (P) Ltd. Publishers.*
- Kilic, Z. (2020). *The Importance of Water and Conscious Use of Water. Research Gate. Doi:10-15406/ijjh 2020.0400 250.*
- Liu, D.H.R., Liptik, B.G. (2019). *Groundwater and Surface Water Pollution*. New York. Routledge.
- Lugazo S.C. (2017). *Impact of Rapid Population Growth on Forest Resources Management in West Usamb Area of Tanzania. Unpublished Dissertation Submitted in Partial Fulfillment of the Requirement for the Degree of Master of Arts in Natural Resources Assessment and Management of Open University of Tanzania.*
- Mantilla, C.A. (2021). *Implementation of Strategies for the Management of Dam with Sediment Reservoirs. Water Resources Management Blueprint Vol. 35 No. 5. Doi: 10.1007/s11269 – 021 – 02956-7.*

- Mukhopadhyay, B. (2020). *Entwining Climate Change Adaptation and Mitigation with Development. International Journal of Research in Engineering, Science and Management. Vol. 3 No. 1. Jan. ISSN: 2581 – 5792 (Online).*
- Nwangwu C., Mbah P.O., Ike C.C. (2020). *Transhumant Pastoral Economy and Human Security in Nigeria: Whither Civil Society Organisation. Journal of Asian and African Studies. <https://doi.org/10.1177/0021909.620905042>.*
- Nwonumara, G.N. (2018). *Water Quality and Phytoplankton as Indicators of Pollution in a Tropical River. Proceedings of the 6th NSCB Biodiversity Conference, University of Uyo. (83-89).*
- Oko, P.E. (2019). *Strategies for Quality Environment and Community Services. Paper Presented at the Faculty of Environmental Sciences Retreat. University of Calabar. October, 2019.*
- Oyeshola, D. (2008). *Sustainable Development. Issues and Challenges for Nigeria. Ibadan: Daily Graphics Nig. Ltd.*
- Patniak, P. (2017). *Impact of Industrialization on the Environment and Sustainable Solutions: Reflections from a South Indian Region. Singapore: 10P Publishing Ltd. Journal of Earth and Environmental Science. Vol. 120.*
- Reed S.C., Cleveland C.C. (2013). *Biological Nitrogen Fixation: Rates, Patterns and Ecological Controls in Terrestrial Ecosystems. Phil Trans R. Soc B 368 – 2013. 0119. Royal Society Publishing.*
- Rose J. (2000). *Population Problems: Topical Issues. New York: Routledge.*
- Rosegrant M.W., Cai X., Cline S.A. (2002). *Global Water Outlook to 2025: Averting an Impending Crisis. A 2020 Vision for Food, Agriculture and Environment Initiative. Washington D.C: IFPRI and IWMI.*
- Sarbapriya, R., Ishitya, R. (2011). *Impact of Population Growth on Environmental Degradation: The Case of India. Journal of Economics & Sustainable Development. Vol. 2. No. 8. ISSN: 222 – 2855 (Online).*
- Sharma, V. (2014). *An Effective Water Resource Management: The Role of Administration in Preserving Water Resources. International Journal of Earth Sciences and Engineering. Vol. 7 No. 1.*
- Shi, Z. (2018). *Impact of Climate Change on the Global Environment and Associated Human Health. Open Access Library Journal. Vol. 5 e4934. ISSN: 2333-9721 (Online), 2333 – 9705 (Print).*

- Sakiyo, D.C. Musa, A., Badgal, E.B. (2020). Impact of Deforestation in Some Selected Rural Communities in Adamawa State Nigeria. *International Journal of Agriculture and Forestry*. 10 (3) DOI10:5923/j.ijaf.20201003.01.
- Trikat, G.L. (2010). *Introduction to Climatology*. New York: Longman.
- Wahlquist A.K. (2009). *Water and its Role in Food and Health Security*. *Asian Pacific Journal of Clinical Nutrition*. Vol. 18 (4) 5016.
- World Commission for Environment and Development, WCED (1987). *Our Common Future*. Oxford: Oxford University Press.
- Wright, R.T. Boorse D.F. (2011). *Environmental Science: Towards a Sustainable Future*. New Jersey: Pearson Education Inc.
- Yegiao W. (2020). *Terrestrial Ecosystems and Biodiversity*. New York: CRS Press.
- Yuan, J. (2021). *Cloud Seeding Evidenced by Coherent Doppler Wind Lidar*. *Journal of Atmospheric Sciences*. Vol. 13. No. 10. 3390/151393815.