Australian Journal of Science and Technology

ISSN Number (2208-6404)
Volume 6; Issue 1; March 2022

Original Article

An assessment of erosion and flood catastrophe in Doko Town Jigawa State-Nigeria, and its socio-economic impacts on rural agriculture

Salami*, Azeez Oyeniyi

Forestry Research Institute of Nigeria, Upland Forest Research Station, Gombe, Gombe State, Nigeria

ABSTRACT

Soil erosion and flooding are one of the top-most hazards which confront humanity in the contemporary world. This is coupled with the incidence of climate change, thereby moving toward wrecking down the global earth and its inhabitants. In view of the density of this catastrophe therefore, a survey was conducted into Doko, Garki Local Government Area (LGA) of Jigawa State-Nigeria, and its immediate four cardinal environments where erosion and flooding are concurrently ravaging annually. Availability sampling technique was used across 100 respondents, which were embedded in structured interview. Discoveries, however, showed that the flooding was more anthropogenic than meteorological or natural, as it is sequel to the annual release of excess water from Wase-Dam in Minjibir LGA of the neighboring Kano State, as well as the incessant rainfall of August these subsequent years. Lives had been lost, farmland degraded, houses collapsed and several other biodiversity complex had vanished among other calamities as a result of the continuum invasion of water excess released from the dam into the hinterland of the neighborhoods on annual basis.

Keywords: Anthropogenic, catastrophe, climate change, environments, global earth, hazards

Submitted: 18-02-2022**, Accepted:** 10-03-2022**, Published:** 30-03-2022

INTRODUCTION

Erosion is the loss of the surface soil due to washing away by run-off water or blowing away by wind.[1] In a more scientific approach, erosion is the action of surface processes such as water flow or wind that removes soil, rock, or dissolved material from one location on the earth's crust, and then transports it to another.[2] There are basically two types of erosion. These are wind and water erosion. Their classifications may, however, be very complex, depending on the purpose for which the ideology or concept is based.[1]

Wind erosion is aided by the blowing wind, often influenced by the North East Trade Wind, with usual occurrence in the dry areas. However, it can also occur in the humid regions when there is a well-marked dry season.[1] On the other hand, water erosion is influenced by the monsoon wind in association with rainfall, and melting of ice or snow due to increase in temperatures, which may also lead to flooding.[3] Water erosion may also be anthropogenically inclined when it originates from lake floods, ocean floods, river floods, or dam discharge/overflow. Other causes of water erosion that may be triggered by man include improper waste disposal practices, poor land management practices (overgrazing and over cultivation), and poor farming techniques, poor environmental management practices, poor legislation and inadequate implementation of existing ones, as well as cruel devegetation and deforestation, among others.[4]

Obviously, water erosion leads to flooding. Flood is a body of water that covers land which is earlier and normally dry.[4] analyzed flood as the oldest and most devastating catastrophe throughout the history of man/environment relationship, and it is a fluvial phenomenon which is associated with inundation, overflowing, or havoc-spills over of water from streams, rivers, lakes, sea, or other water courses, for example, brook, rivulet, torrent, gully exceeding bank-full capacity to the neighboring land surface.

Address for correspondence: Salami, Azeez Oyeniyi, Forestry Research Institute of Nigeria, Upland Forest Research Station, Gombe, Gombe State-Nigeria. E-mail: niyisalamioutreach@gmail.com; faunia717@yahoo.com.

Technically, flood is classified into two main types based on behavioral patterns. These are the normal flood which is a natural fundamental process and can be annual, seasonal, or perennial, and usually leads to no destruction. Abnormal flood on the other hand is the accidental inundation of any area which is not normally covered with water from stream, river, lake, or sea. It subsequently results in loss of lives, properties, and the destruction of biotic and abiotic structures.[4] Flood can also be classified based on the location of occurrence as rural and urban flood [Figure 1].

In a bid to parvert flood catastrophe, adequate monitoring of the inflow of water into water reservoirs such as the Wase Dam that recharges through the natural means (rainfall) apart from other sources becomes inevitable through the determination of the inflow hydrograph into the dam, to regulate the outflow for timely necessary safety actions.[5] Thus, the storage formulae emanating from the processes.[5-7] A flow in which the channel depth and velocity changes with time is expressed as: The difference between inflow volume in time increment (Idt) and outflow volume in time (Qdt) equals change in volume of water stored (dS).[7]

In differential form, however, the expression is:

$$\frac{dS}{dt} = I - O \quad (1)$$

Where: $\frac{dS}{dt}$ = rate of change in dam storage with respect to time; I = inflow to the dam; and O = outflow from the dam.

Further to the above, the equation of continuity is applied to unsteady flow in hydrology to the routing of floods through a reservoir or a reach of a stream. Thus, the relationship between inflow, outflow and storage for a given reach is not easily known, and will be different depending on whether the hydrograph is rising or falling. This is also dependent on the multiple sources of moisture into natural reservoirs (dams) or a reach of a stream.[5] Hence, the above concept [Equation 1] is modified with the moisture continuity equation,[6,7] which also applied to the atmosphere as:

$$\frac{dS}{dt} = I + E - O - P \quad (2)$$

Where: I = the atmospheric moisture inflow; E = the evapotranspiration from the ground;

O = the atmospheric moisture flow; P = precipitation; and $\frac{dS}{dt}$ = the time rate of change of moisture storage in the portion of the atmosphere under consideration.

Nonetheless, the Equation 2 is more commonly applied in practice to a finite interval of time and the various terms becoming mean values in the interval.[7] Moreover, to provide a form more convenient for computational purposes, the equation is usually expressed as a function of average flows,[5] and then:

$$(I_1 + I_2)/2 \times \Delta t - \frac{(O_1 + O_2)}{2} \times \Delta t = S2 - S1 \quad (3)$$

Where: The subscripts refer to the values at the start and end of the time step (dt) and it is assumed that the hydrograph is a straight line during the time step (dt).

In essence therefore, when the proper harnessing of the various relevant factors of production is put in place in the hydrological management concept as modified from the Cobb- Douglas production function, a positive hydrological output is realized. Hence the following:

$$f(L, K) = Q \quad (4)$$

Where: L = the variable factors of production;
K = the fixed cost of production; and
Q = quantity of output.

This exercise, therefore, aimed at the evaluation and assessment of the annual water erosion and flood in Doko, Garki Local Government Area (LGA) of Jigawa State-Nigeria, and its socio-economic impacts on rural agricultural practice in the area.

Study Area

Doko is one of the major towns in Garki LGA of Jigawa State, Figure 2. It is situated along Kano-Gumel road on a geographical coordinates of 12° 20’ 0” North, 9° 6’ 0” East.[8] The inhabitants of the town are mostly farmers. Rainfall is between May and October, but stable for about 4 months between June and September, approximately 510–1140 mm per annum. It is a Sudan savannah ecosystem.[9] Doko is peculiar to annual water erosion and flood, and the catastrophe is not limited to the town alone, but also crippling surrounding towns and villages.

Figure 1: Urban and rural flooding. (a) Urban flooding, Source: www.researchgate.net (b) rural flooding, Source: www.gettyimages.com

Some of these towns and villages are Kureshe and Kaya to the east, to the west are Gidan Ari, Kabawa, Anju, and Limawa. Other villages encroached by the catastrophe are Zango and Sabongari to the north, as well as Daraze and Gidan Kawo to the south of Doko town. These towns and villages are all in Garki LGA same as Doko, except Kaya which is in Taura LGA of the state, an adjoining LGA to that of Garki.

METHODOLOGY

The survey exercise was carried out covering Doko town and its environs in Garki LGA of Jigawa State-Nigeria. Structured interview was used across 100 respondents. Five sampling units were marked out, with 20 respondents targeted in each unit at random. Doko was used as the central unit, with a town/village from each of the four cardinal outreach of Doko Township. These were Kureshe, Gidan Ari, Zango, and Daraze that were selected to represent the east, west, north, and southern Doko, respectively. Convenience Sampling Technique was used. Convenience sampling is the same as accidental or availability sampling, mostly used in the interview research method, and involves a situation where anyone seen or come across is interviewed.[10]

RESULTS AND DISCUSSION

Respondents' expressions were precise on varying issues regarding the seasonal volume of water being gathered annually at Doko along Kano-Gumel road. These expressions affirmed the causes and sources of the annual water mass occurring in the locality, as well as the socio-economic impacts of the scenario as it affects plants, animals, humans, and other socio-economic set-up of the people who are mostly farmers.

Causes of Water Erosion and Flood in Doko Town and Environs

Respondent reports from across the sampling units all over the study area indicated that the erosion and flood catastrophe was not the normal erosion that leads to flooding, but that which occurred mainly as a result of poor management practice. It was further reiterated that the coverage was very wide, spreading over several towns and villages, Figure 3. Moreover, apart from the remote primary causes, the annual catastrophes were heavily induced anthropogenically.

Meteorological Factors

Data collected from the field indicated that the annual disaster in Doko and its environs were partly caused meteorologically through the incessant rainfall these subsequent years. In the current rainy season of year 2020, however, the rainfall pattern in mid-August to the end of the month in the area was on a continuous basis, which at times lasted for some days, non-stop. The occurrence of this erosion and flooding type is supported by Julien[11] and Salami[12] in view of various meteorological factors including heavy rainfall within the catchment area, high tides and winds driving water inland, and melting of ice lands and icebergs due to increase in temperature.

Figure 2: Map of Doko Township. Source:[8] www.maplandia.com/nigeria/jigawa state/doko

Figure 3: Features of flooding in Doko township showing parts of the submerged town and farmlands

Anthropogenic Factors

The above meteorological factors notwithstanding, the case study of Doko and its environs compromised the improper waste disposal and poor environmental management practices according to respondents. The main source of the recurrent disaster was said to be attributed to the release of excess water from Wase-Dam situated at Minjibir LGA of Kano State; an annual occurrence that maimed, destroyed, and killed in this locality according to respondents. The anthropogenic factors are man assisted, which include dam failure, improper waste disposal practices, structural encroachment into flood plains, siltation of river channels as a result of escalated soil erosion, poor land management practices (overgrazing and over cultivation), and poor farming techniques, poor environmental management practices, poor legislation, and inadequate implementation of existing ones; as well as cruel devegetation and deforestation, among others.[4]

Effects of Water Erosion and Flood on Doko Town and Other Local Communities

Erosion and flooding constitutes to great loss of lives and properties, but at times may be beneficial. Maigari[4] enumerated that water erosion and flood are not only devastating but also associated with benefits which supports human development. However, analysis of its long-term effects reveals that the negative consequences of this catastrophe outnumbered its benefits as it affects the atmosphere, the lithosphere, the hydrosphere, and the biospheric environments.[13]

Beneficial Effects

Erosion and deposition of soil nutrients

Consequently, reports from respondents revealed that after the annual water log had subsided, some parts of the water-maimed area may be a very good fertile land to sustain the dry season farming. This is supported in Maigari,[3] enumerating that river carries alluvial materials downstream, which are rich in plant nutrients, and enriching the soil fertility and productivity quality of such affected areas.[4]

Irrigation for dry season farming

Data collected from the field also inclined that the relics of the water that remains on the ground were usually used for dry season farming before the onset of the next rainy season, thus serving a profitable alternative in any year with excess rainfall exacerbated by the excess discharge from the dam which debars the main season's farming activities. Hence, the coping mechanism being adopted as livelihood alternatives.[3]

Building materials

The availability of building materials at the lower and upper courses of the erosion and flooding sites was also corroborated in Maigari[4] analysis that the eroded materials when deposited either by wind or water provide building materials in the form of fine and coarse sand used in the civil and other engineering works.

Agricultural and hydrological importance

Respondents also indicated that the water table in the study area was very close to the surface in the event of sinking a well for sustainable domestic utilization and animal feeds, even in the mid dry season. This assertion indicates that the aftermath of flooding is of great importance to agriculturists, as in most cases, flood recharges underground aquifer, thus raises the ground water table, according to Maigari.[3] It was further stressed that in another dimension, the residual moisture left behind is used in cultivating residual moisture loving crops such as wheat, tomatoes, onions, and potatoes across the dry season as revealed in Maigari[4] analysis.

Seed dispersal and germplasm conservation

It was also revealed that foreign plants that were not originally native to the environment do emerge after the flood recession as wildlings, a good silvicultural material for plants multiplication and germplasm conservation as supported by Julien.[11]

Detrimental Effects

Submergence and death of crops, germplasm resources and other biotic elements

The respondents lamented on the various losses on their farm plots inclusive of the total submergence and death of crops, germplasm resources and other biotic elements such as the economic trees such as the Neem tree, Tamarinds, Parkia, Dyospirus, Anogeissus, and Adansonia species; as well as arable crops such as Millet, Guinea Corn, Cassava, Sesame, and Rice. Others include Mangoes, Guava and Date palm, among others [Figure 3].

Isolated human mortalities had also been unavoidably recorded over time, having a victim in the month of August, 2020, at the event of excess and prolonged rainfall to building collapse on the polygamous husband of two, as revealed by the respondents.[13] However affirmed in its report of September 5, 2020, to the destruction of farmlands in Jigawa State following a 2 day heavy downpour.

Breeding of vectors and incidence of diseases

Mosquitoes' invasion was also very paramount, especially at closer vicinity to the water pool that extends into the township. Consequently, Maigari[3] analyzed that stagnant water left behind after the flood recession encourage breeding of mosquitoes and other pathogenic organisms, constituting nuisance, and causing health hazards to the people.[3,4]

Destruction of roads and other telecommunication networks

The Kano-Gumel road that crossed over Doko Township was also usually wet all days at this period, as the water spills over the road towards Darazo and Gidan Kawo, leading to washing away, and creating pot holes. Sometimes, traffic has to be diverted through the wilderness, cutting out Doko and its neighborhoods. Maigari[4] affirmed to this, portraying water as the main damaging agent during acute water erosion and flood disaster, which usually cutsoff communications by washing away of roads, rail lines, electronic cables, electricity poles, as well as other audio and visual telecommunication devices, buried or hanging.

Land degradation, landlessness, and loss of soil fertility

Respondents across the five sampling units also lamented that they had lost partly or wholly of their land inheritance to the incessant flooding. The degradation was feasible as the land caked and cracked after the flood water subsides over some years now, render the farm plots infertile, and unsuitable for cultivation. Leaching however results after the floods, thereby render the soil barren,[14] technically depriving the agrarian community of their ancestral land, and practically landless,[4] with physical reduction of cultivable land that is demographically exalted.[11]

Displacement and migration

Collapsed buildings in the process led to gross displacement, migration and relocation to other temporary places. This shelter insecurity is supported in Maigari,[4] as flooding leads to the displacement and migration of inhabitants of disaster zone to safer areas, becoming refugees, and putting up in camps and temporary abodes.

CONCLUSION

Water erosion and flooding are the most universally experienced natural hazard claiming scores of lives and properties, and as well damaging infrastructural facilities in a disquieting manner. The calamity of Doko recurrent erosion and flooding is becoming a plague of annual interminable calamity in the community, depicting the inability of the relevant agencies concerned to address and nip the bud of the tragedy on the head and end the recurrent debacle.

Several lives had been lost, farmland degraded, houses collapsed, and other biodiversity complex gone down the rail among others, as a result of the continuum invasion of water excess released from the dam into the hinterland of the other neighborhoods on annual basis.

REFERENCES

1. Youdeowei A, Adesiyan SO, Ogbazi JN, Olowu T. Junior Secondary Agriculture for Nigerian Schools. Vol. 2. 9-year Basic Education Edition. Nigeria: West African Book Publishers Limited; 2009. p. 158.
2. Reusser L, Bierman P, Rood D. Quantifying human impacts on rates of erosion and sediment transport at a landscape scale. Geology 2015;43:171-4.
3. Maigari AI. Flood: Causes and Consequences. Kano: The Triumph Daily Newspaper; 1994.
4. Maigari AI. Introduction to Environmental Problems and Management. Kano-Nigeria: WADEC; 2002.
5. Jacobs. Flood Modeller. 2021. Available from: http://www.help.floodmodeller.com [Last accessed on 2021 Jul 20].
6. AMS. Storage equation. American Meteorological Society; 2019. Available from: https://www.googleweblight.com [Last accessed on 2021 Jul 20].
7. AMS. Moisture Continuity Equation. 2012. American Meteorological Society. Available from: https://www.glossary.ametsoc.org [Last accessed on 2021 Jul 20].
8. Maplandia. Doko 3D Map in Google Earth; 2020. Available from: https://www.maplandia.com/nigeria/jigawa state [Last accessed on 2021 Jul 20].
9. Salami AO. Pre-germination Treatments of some Indigenous Sudan Savannah Tree Species in Nigeria. A Dissertation Report for M.Sc. Award. Department of Geography, Faculty of Earth and Environmental Sciences. Kano: Bayero University; 2018.
10. Salami AO, Nwadike C. An evaluation of the potentials of *Moringa oleifera* Lam), a vegetable and hedgerow plant for diet supplements and multipurpose utilizations. J Plant Stud 2020;9:5.
11. Julien PY. Erosion and Sedimentation. Cambridge: Cambridge University Press; 2010.
12. Salami AO. In-depth of Tropical Plants Propagation. Vol. 1.in press: 2020.
13. Daily Trust. Nigeria: Flood of Tears as Homes, Farmlands Get Washed away. Abuja: Daily Trust; 2020.
14. Jim R. Soil Erosion-causes and Effects. FACTSHEET. Ontario: Queens Printer for Ontario; 2012.