



Seasonal Flood in Sudan and its Environmental, Health and Socieconomic Impacts on the Livelihoods

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Abstract

Sudan suffers annually from torrential rains coming from through Ethiopian plateau vis the Blue Nile River or through the White Nile rivers as well as seasonal rains in the country. This has led to a lot of negative consequences on the local population due to the recurrence of floods through the last decades. This paper is coincided with worth situation which is facing nowadays the local population living on rural as well as urban areas. This paper is an attempt to highlight the roots causes of this seasonal phenomenon rather than symptoms of this this serious environmental problem and its impacts on the living conditions of the Sudanese people as well as possible remedies through drawing a road map to attain smart livelihoods. This paper is dependent on reviewing some of the relevant literature, published articles and personal experience of the other using holistic attitudes that combine between different related disciplines which are closely related to the overall urban and rural livelihoods of the Sudanese. Root causes of this problem are combination between anthropogenic or induced man activities, structural deterioration in the available infrastructure from one side and natural phenomena like climate change and alternating wet and dry period from the second side. Nevertheless, one can easily find that the human factors are the main causes of frequent recurrence of floods rather than the natural factors. Anthropogenic factors could be summarized as follows: deforestation in the Ethiopian plateau as well as the deterioration of natural forests inside Sudan not only in areas neighboring the river Nile and its tributaries, seasonal rivers like Gash and Atbara rivers but also areas far away from seasonal or permanent water streams; unplanned expansion of settlement on rain water drains due to increase in population, migration or internal displacement as a result of civil war and natural disasters like drought and desertification; poor or absence of the essential infrastructure from engineering and environmental points of view to face the impacts of floods as well as the torrential seasonal like badly constructed rain water drains; absence of comprehensive land use plans; construction activities along the Blue Nile River in Khartoum which had narrowed the stream water flow and therefore enhancing version Down steams; construction of Dams along the Blue Nile such the Grand renaissance dam in Ethiopia, heightening of Roseries dam and Merowi Dam over the River Nile in Northern Sudan. Environmental, health and socieconomic impacts can be summed as follows: loss of life and properties, displacement, lack of clean potable water due the collapse of pit latrines that pollute the water and so enhancing the spread of diseases such as diarrhea and cholera. People lost their sources especially I rural areas where the local people are thought to lose their livestock or herds and their crops as well as their agricultural lands. Facing this worse situation is seemed to be beyond the capacity of Sudan. However, a lot of aids in form of foodstuffs and tents, drugs and insecticides are used to be received from Saudi Arabia, other Arabian Gulf countries and international organizations such as Red crescent. The following conclusion should be mentioned that the main cause of the flooding in Sudan is the natural human activities and partially due to natural factors. One general recommendation can be drawn that Sudan should think seriously to adopt smart land use planning, urban re planning, development of efficient infrastructure, capacity building and raising the environmental awareness of the all societies and finally any proposed development activity should be preceded by Environmental Impact Assessment Study to avoid unnecessary financial consequences or loss of life, properties and spread of infectious diseases.

Introduction

Natural disasters in the contrasting forms of drought and flooding have historically occurred frequently in Sudan and have contributed significantly to population displacement and the underdevelopment of the country. A silent and even greater disaster is the ongoing process of desertification, driven by climate change, drought, and the impact of human activities. Despite serious water shortages, floods are common in Sudan. The two predominant types of floods are localized floods caused by exceptionally heavy rains and run-off (flash floods), and widespread floods caused by

verflow of the Nile and its tributaries. Severe flash floods were recorded in 1962-1965, 1978-1979, 1988, 1994, 1998, 1999 and 2006. This last flood was directly observed by UNEP in the field. Though generally short in duration, these events can cause major damage tovillages and urban and agricultural areas located in catchment and drainage zones.

Nile floods usually originate from heavy rainfall in the (now largely deforested) catchment areas of the Ethiopian mountains, which causes unpredictable surges in the flow of the Blue Nile. The

sequence of severe Nile floods – which were recorded in 1878, 1946, 1988, 1994, 1998 and 2006 – clearly shows that the frequency of flooding has increased dramatically over the last twenty years [1].

Objectives

- a. This paper is an attempt to highlight the roots causes of seasonal Sudan flood rather than symptoms of this this serious environmental problem
- b. Its impacts on the living conditions of the Sudanese people
- c. Identify the possible remedies through drawing a road map to attain smart livelihoods.

Methods adopted

This paper was dependent on reviewing some of the relevant literature, published articles and personal experience of the author using holistic attitudes that combine between different related disciplines which are closely related to the overall urban and rural livelihoods of the Sudanese people.

Causes of Floods in Sudan

These causes can be grouped into two categories: induced human activities or man-made and natural factors.

Manmade Causes

Deforestation and Forest Degradation in Ethiopia:

Deforestation in Ethiopia were attributed to three major categories:

- a) sociodemographic factors
- b) Production factor constraints and
- c) Policies and resource governance issue.

a. Sociodemographic factors: Among the key sociodemographic factors affecting forests was the rising demand for forest products due to increasing the rural and urban population communities. The increase in wood demand was also exacerbated by limited by limited access to alternative energy sources such as electricity, solar panels, etc.

b. Production factor constraints: shortage of land for agriculture caused by rapid population growth and settlements and poor land productivity are two major production factors that enhance deforestation and degradation of forests.

c. Policies and resource governance factors: community was left out and began to claiming the right to use the forest through all possible, though non legitimate response was given to their queries. Such management regime, which gave no attention to the needs of local population gave negative a negative impression concerning forest management officers.

The deterioration of natural forests inside Sudan not only in areas [2] neighboring the river Nile and its tributaries, seasonal rivers like Gash and Atbara rivers but also areas far away from seasonal or permanent water streams. Both the previously mentioned factors enhance soil erosion down and upstream of the

Blue Nile River. So, flood water is used to carry a lot of suspended eroded soils due to the removal of trees which help in reducing the water velocity which in turn helps in increasing water infiltration rate. Moreover, the roots of trees increase the coherence between soil particles and keep them tied to each and consequently help in preventing soil erosion upstream and downstream. So, increase in the amount of suspended eroded soils is usually resulted increase in the amount of water leading to over its over flow along the river banks leading to destruction of agricultural fields, horticultural crops and settlements in both urban and rural areas where the river Nile and its tributaries as well as seasonal rivers like Gash are passing.

Unplanned expansion of settlement along the River Nile and its tributaries in the flood plains on rainwater drains due to increase in population, migration or internal displacement as a result of civil war and natural disasters like drought and desertification.

Poor or absence of the essential infrastructure from engineering and environmental points of view to face the impacts of floods as well as the torrential seasonal rainfall for instance badly constructed rainwater drains; absence of comprehensive land use plans. Poor infrastructure in cities which were manifested in the lack of adequate and efficient drainage of rains water. As the flood waters recede, pools of stagnant water increase the risk of spreading waterborne diseases, particularly in crowded areas like IDP camps [1,3].

No proper system of sewage treatment increases the hazards facing urban environmental health and may lead to the manifestation of water –borne diseases and pollution of the river Nile water. Though there is a sewage network in Khartoum, it does not cover the entire city and no longer works properly, as it is stretched well beyond capacity [1].

Construction activities done along the Blue Nile River in Khartoum which had narrowed the stream water flow and therefore enhancing erosion Down steams.

Construction of Dams along the Blue Nile such as the Grand renaissance dam in Ethiopia, heightening of Roseries dam and Merowi Dam over the River Nile in Northern Sudan. There is no dissemination of the results of The Environmental Assessments EIA in Sudan to the public. Moreover, the local population inhabiting areas downstream and upstream Merowi were involved in these studies. Therefore, some of them refused to leave their native home without any essential community services after the submersion of their villages subjecting them to the attack of scorpions and death of some their children when on their way to schools in the newly developed villages (Personal experience of the author).

Expansion of illegal settlements to ill-suited areas lying on the natural streams or the flood plains in main urban centers which are subjected annually to the flood;

Absence of Land use Plan maps for the whole countries depending on their capabilities, location, landforms, Topography, physical and chemical properties of the soil and its types [4];

Most of the development projects were established prior to conducting any proper Environmental Impact Assessment (EIA) and absence of agreed format for writing this study [4].

Natural Factors

They were represented here by the concentrating on climate change as a cause of floods on the recurrence of flooding. Climate changes are increasing the number of weather related disasters, according to the Red Cross's World Disasters Report 2003, published in July: "Weather-related disasters continue to rise, from an annual average of 200 between 1993- 1997, to 331 per year between 1998-2002... Floods, however, affected more people across the globe (140 million per year on average) than all other natural or technological disasters put together," it said. "Climate change seeks out the people living on the margins of survival," said Dr Mick Kelly of the University of East Anglia's climate research unit. "It's often a cumulative process as the current Sudanese floods demonstrate. Falling agricultural productivity pushes people into marginal lands, leading to deforestation of highlands that causes flooding below."

Environmental pressures lead to increased competition for land, and people move to areas where they don't have experience of particular diseases, he said. Sudan has had several outbreaks of leishmaniasis, which killed tens of thousands of Newcastle herders who were pushed into previously uninhabited land and had no idea of the threat. "As the climate changes, it is inevitable that there should be a shift in the pattern of infectious diseases," said Dr Kelly [5].

Environmental, Health and Socioeconomic Impacts of Floods and Runoff rainwater

General Historical review about the impacts of Flood in Sudan

Torrential rains caused massive flooding across Horn of Africa in 2007. In Sudan, at least 500,000 people were affected. Rains started in July 2007, one month earlier than usual, and caught many unprepared. The level of precipitation was unusually high. Twenty-two of Sudan's 25 states were inundated. Manmade factors exacerbated the impact. Various assessments highlighted road construction techniques, specifically inadequate drainage channels, were partly responsible for the scale of the disaster. The situation was compounded by weather conditions in neighboring countries. Heavy downpours in Eritrea, Ethiopia and Uganda swelled Sudan's rivers and caused river flooding and destruction in surrounding areas. Nearly 60,000 residential houses were grounded and at least 50,700 homes were damaged and not suitable for habitation [6].

Most of the damage, however, was caused by flash floods and heavy rains that lashed the country unabated for several months

dissolving mud-brick walls and roofs of traditional Sudanese homes.

Last year, over 200,000 people year across the country affected by heavy rains and flash floods and the table below explains the number of people affected throughout the Sudanese states which were affected by the floods of 2018 (Table 1).

Table 1: Source: Humanitarian Aid Commission (HAC), 2018.

State	No. of people affected people (in thousands)
Kassala	47,480
Sennar	33,830
West Kordofan	33,175
Gedaref	23,975
Red Sea	19,100
Northern	16,450
Central Darfur	14,200
White Nile	13,645
Khartoum	4,240
NorthKordofan	4,125
West Darfur	3,215
River Nile	3,100
Blue Nile	2,825
El Gazira	2,015
North Darfur	900
Total	222,275

Over 200,000 people in 15 of Sudan's 18 states have been affected by heavy rains and flash floods between June and early November, according to the Government's Humanitarian Aid Commission (HAC). This is almost double the 122,500 people affected by floods the same time last year. The worst affected states are Kassala (47,500 people), Senna (33,800 people) and West Kordofan (33,200 people).

Over 19,640 homes were destroyed, according to the Government of Sudan and partners. Aid organizations continue to respond with food, emergency shelter and household supplies, and provide health, nutrition, water, sanitation and hygiene services to affected people.

Government authorities had required each state to stockpile a sufficient quantity of emergency supplies for 2,000 people. In addition, vital medicines and medical supplies for more than a million people have been made available as part the Government of Sudan and partners national emergency preparedness plan for the rainy season.

Red Sea State affected by heavy rains and flash floods

Red Sea is the latest state to witness heavy rains and flash floods, with over 19,000 people in four localities (Port Sudan, Hyia, Tokar, and Dordeeb) affected between October and November, according to HAC. In Port Sudan locality, 90 homes were destroyed

and another 507 damaged, affecting about 3,000 people. In addition, 586 latrines collapsed, and six shops sustained damage. In Hiya locality, 56 homes were destroyed and 163 houses damaged affecting about 1,000 people.

In Tokar locality, 751 homes were destroyed and 2,253 damaged affecting about 15,000 people. In addition, 70 water sources were contaminated by floodwaters. In Dordeeb locality, 30 shops were damaged, and 50 heads of livestock were died. The people affected by floods are in urgent need of emergency shelter and

household supplies as well as water, sanitation and hygiene assistance, according to HAC [7].

Environmental, Health Socioeconomic impacts of Sudan Floods

Water Damage

Flood as cause of Riverbank erosion: Riverbank erosion is a natural phenomenon in Sudan that can,

in extreme cases, be characterized as a local disaster due to its social and environmental impacts. This problem is most acute on the main Nile downstream from Khartoum, where peak wet season flows, and river channel changes result in very rapid removal of land from riverside terraces.

The destruction witnessed by UNEP field teams is impressive. For example, an estimated 17 percent of Ganati (1,420 ha), 25 percent of El Zouma (200 ha) and 30 percent of El Ghaba (1,215 ha) cooperative societies in Northern state have been swept away in flood peaks. Moreover, bank erosion leads to sedimentation problems elsewhere (Figure 1).



Figure 1: The submerged Sunut Forest wetland in the metropolitan Khartoum area, August 2006.

The flooding of the Nile is an annual natural event Flash flooding 20 km north of Khartoum, September 2006 on the main Nile in Northern state. One of the causes of riverbank erosion is the increased frequency of sand dune migration into the Nile, as the

rapid influx of sand alters the river flow, resulting in downstream Flooding. The increase in Blue Nile flooding is considered to result partly from deforestation and overgrazing in the Ethiopian highlands. Besides, the impact of floods in Khartoum state is generally highest in the slums and IDP camps located in low-lying areas previously left unoccupied as they are known by locals to be flood prone.

While adjustments in river morphology are a natural phenomenon, human action in altering stream discharge and sediment loads has played a significant role in accelerating the process. The main impacts include watershed degradation from deforestation, overgrazing and poor farming practices that increase stream

turbidity, and the effects of dams on the Blue Nile and Atbara rivers. The removal of riverbank vegetation through fires or grazing further aggravates the problem, as it weakens the banks' ability to withstand the erosive power of flood peaks. In this context, UNEP anticipates that pulsed water released from the new Merowe dam will become a major cause of downstream riverbank erosion on the main Nile [1].

Health Impacts

1. The floods deteriorated hygiene conditions in the areas where latrines were destroyed, damaged or washed away. Human waste and excreta was in many localities carried into water sources triggering severe outbreaks of acute watery diarrhoea (AWD), a cholera-like disease, Nearly 200 people were killed by another contagious disease which spreads rapidly in floods, the Rift Valley Fever (RVF)1.
2. The flooding, described by many Sudanese as the worst in their living memory, compounded the already grim humanitarian conditions in the country, where majority survive on less than one US dollar a day and preventable disease kill unacceptably high number of people [6].
3. Annually some 7.5 million people in Sudan are affected by Malaria, of which 35,000 die. Near to 40 percent of the population in Sudan does not have sustainable access to safe drinking water while only 24 percent have access to improved sanitation. About 17 percent of children under the age of five are underweight.
4. Extensive damage was done to the water supply and distribution systems in several locations. Subsequent analysis confirmed the water in the town's main distribution line was contaminated with high e-coli [6].

Socioeconomic impacts can be summarized in loss of properties such as houses and personal properties, loss of agricultural fields which include horticulture trees and cropped land, loss of harvested crops, loss of life and social disturbance due to displacement

Impact of Floods in Roads leading to the affected villages or urban areas

Floods paralyzed some roads and many in flood affected communities found themselves isolated from the outside world and therefore delay the evacuation of the affected settlers and delay the relief activities.

Health Impacts of Sudan Floods

Record flooding in east Africa has made hundreds of thousands of people homeless in Sudan, with millions more at risk as the rising water of the Nile threatens to inundate Khartoum, spreading disease and overwhelming sanitation services. Kassala, the largest town in eastern Sudan, has been declared a disaster zone, with 80% of the population homeless after the River Qash overflowed on 28 July. Sudan's Red Crescent organization has reported that the city hospital and main water plant are out of action.

"The health situation is alarming, with a fivefold increase in cases of acute diarrhea," it said, adding that the area has twice the seasonal caseload of malaria and warning that millions more are threatened as rains continue unabated. Dr Saleemul Huq of the International Institute for Environment and Development said: "Such record-breaking events around the globe show that climate change is already impacting on us and is having negative effects on people's health across the world" (Figure 2).



Figure 2: One of thousands of families made homeless by flooding in Kassala (2003)

Urban Flooding and its impacts

Urban flooding is increasingly important issue which may shape the densities of whole cities or substantially change the face of them for decade to come. Disaster statistics seem to show flood events are becoming frequent, with medium scale events increasing fastest. The impact of flooding is driven combination of natural and human induced factors. During this year floods in Sudan, more than 60 people killed after heavy rain. Torrential rain and floods hitting Sudan in the last few weeks have killed more than 60 people, with hundreds of thousands forced to leave their houses. The river

Nile has burst its banks in Wad Rami in the Sudan's Khartoum State. Moreover, runoff water coming from nearby high lands has destroyed earth leading to destroying the settlements of the all population living Gaili area which lies on the northern boundary of Khartoum State with the River State. It is worth to mention here that this dam was built to protect this densely populated area from seasonal runoff rainwater.

Recommendations

Action required in addition to more studies and plans

1. Reducing the vulnerability of communities to natural disasters is the core principle of disaster risk reduction. Environmental protection is one component of an integrated response to the issue. For Sudan, this translates into the need for practical risk-reduction measures, such as better rangeland management to create a buffer capacity to deal with periodic droughts, or catchment protection to mitigate flood risk.
2. Livelihoods recovery depending on socioeconomic surveys to compensate for loss in properties, livestock agricultural land
3. Urban re-planning for the affected areas using remotely sensed techniques to select appropriate areas which free from any future hazards of floods or runoff water i.e. areas far away from riverbanks or natural drainages or seasonal streams
4. Strengthen monitoring capacities at all levels: example develop monitoring tools and/or guidelines;
5. Establish multi-sector monitoring and evaluation teams and using of early warning systems which disseminate the knowledge among the public.
6. Improve and scale up community-based risk reduction work.
7. Invest into reviving local traditional early warning systems to strengthen community preparedness for disaster, a
8. Strengthen ties with state authorities, particularly with Civil Defense and HAC.
9. Develop a contingency plan based on the past experiences and lessons learned.
10. Establish contingency stock of the emergency relief and/or shelter items. Tarpaulin, blankets, mosquito nets are needed immediately after the disaster. At least minimum emergency stocks must be pre-positioned closer to disaster-prone areas to enable efficient response.
11. Recruit more staff to beef up the National Society's logistics management capacity.

12. Formalize agreements with authorities (customs, civil aviation, seaports and HAC) to facilitate speedy customs clearance. Health

13. Focus on health education [6].

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