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The Recurrence of Natural Disasters in Jowhar, Middle Shabelle Region, Somalia: The Causes and Impacts

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Abstract

Natural disasters usually involve a phenomenon with consequences that exceed the response capabilities of local communities and have a significant impact on the region's socioeconomic development. Droughts, floods, and hurricanes are all natural disasters that jeopardize the environment and the lives of Somalis. Severe floods have devastated the south and central parts of the country multiple times, destroying infrastructure and homes and killing many vulnerable people. Droughts in the south and central parts of the country, particularly in the Middle Shebelle region, have killed a number of children and mothers. It also had a negative influence on crops and cattle. Objective of this study is to know the recurrence of Natural Disasters in Jowhar, Middle Shabelle region, Somalia: The Causes and Impacts. The Somali people are completely aware of natural disasters such as droughts and floods, and they are self-sufficient in dealing with the consequences of these disasters. Furthermore, the Somali government has not fully created environmental laws to protect and conserve the environment, and the majority of laws, rules, acts, and regulations are not used or administered effectively. We also found that the Somali government is not yet financially prepared to deal with these crises, and that there are no strategic plans in the central government or even state administrations to prevent or at least control these disasters from causing extreme harm to the community and the environment.

Keywords

Natural Disasters, Floods and Droughts, Causes, Impacts of the Environment

1. Introduction

A natural disaster is an unexpected and horrifying occurrence in nature, such as a hurricane, tornado, or flood that frequently results in significant property loss for the affected population as well as a high death toll. According to NASA (2007), there are a number of natural disasters, including wildfires, eruptions, avalanches, tsunamis, earthquakes, landslides, flooding, hurricanes, tornadoes, cyclones, storm surge, lahars, drought, typhoons, diseases, and so forth [1] [2].

Disasters that are both natural and human-caused affect thousands of people every year. Such big bad events have the potential to cause physical destruction and a catastrophic loss of life.

They may startle entire towns and frequently happen by accident. A catastrophe may leave people emotionally disturbed. It is usual to have anxiety before, during, and after disasters, as well as ongoing worry, trouble sleeping, and other depressive symptoms. With the help of friends and the community, many people are able to "bounce back" after disasters, but some people may need additional support in order to cope and continue their rehabilitation. Everyone, including survivors in the affected areas, first responders, and recovery workers, is potentially at risk [3].

Geological disaster refers to the disaster related to geological effects, such as mountain collapse, landslide, and debris flow and ground subsidence, caused by natural factors or human activities that endanger people's life and property safety. The occurrence of geological disasters is mainly affected by geological, landform, lithology, precipitation, soil and vegetation. With the rapid development of economy and the rapid increase of population, the threat of geological disasters gradually increases, and the impact of human activities on geological disasters is more and more obvious. At present, the research on geological disasters mainly focuses on occurrence mechanism, prediction, monitoring and early warning, risk assessment and prevention [4].

Natural phenomena that can release processes causing physical harm, the loss of life and property, and the vulnerability of people and human settlements are the two main causes of natural disasters. Events like this interfere with people's ability to live in groups and as individuals, as well as with national economies. While some originate in violent or unexpected phenomena such as earthquakes, others such as droughts are slow to develop or evolve but still negatively affect societies and economies and, depending on their intensity and duration, may eventually affect food supplies or essential services [5].

To a greater or lesser extent, all countries are subjected to severe natural events. But a catastrophe is not usually the outcome of their impacts. This occurs when vulnerable circumstances are present and a natural event occurs. Hazards are defined as natural occurrences that have the ability to destroy a territory. The ability of people, households, communities, and nations to tolerate and recover from harm is shown by vulnerability, which is both a precon-

dition (which manifests during the disaster) and an indicator of the exposure of capital [6].

Disasters have immediate and direct effects, such as the destruction of tangible assets and deterioration of many people's means of subsistence. Nonetheless, there is a relationship between the extent of the impact and the problems suffered by countries in different spheres (social, political, environmental, sanitary, financial, etc.) that may impair their resilience and response capacity and negatively affect progress [7].

Disasters have had a huge effect both in the developed and developing countries on all forms of industry. The direct and indirect impact and sustainability of natural disasters are devastating for business operations, especially after the disaster. In recent years, these devastating incidents had considerable negative effects on most businesses, particularly small and medium-sized enterprises (SMEs). While several studies have studied the effects of natural disasters in individual homes and the wider macroeconomic environment, the consequences of natural disasters in the discipline of disaster risk reduction remain one of the least explored areas of small business (DRR). According to existing research, SMEs are more vulnerable to natural disasters than big companies since SMEs tend to be located in non-optimal areas. SMEs are smaller and financially poorer and are less often localized [8].

2. General Objective of the Study

The main objective of this study is to investigate the recurrence of Natural Disasters in Jowhar, Middle Shabelle region, Somalia: The Causes and Impacts.

Specific objectives

- To know more about factors that cause of flood and Drought events in Jowhar, Middle Shabelle region, Somalia.
- To determine the impacts of floods and Droughts in Jowhar, Middle Shabelle region, Somalia.
- To compare the one that has the greatest impact on the community in Jowhar, Middle Shabelle region, Somalia.
- To assess the consequences of natural disasters such as floods and droughts on vulnerable populations and the Environment in Jowhar, Middle Shabelle region, Somalia.

3. Review of Literature

Somalia is heavily reliant on its natural resource base and the provision of eco-system services. The country's vulnerability to climate change is projected to increase due to its dependency on its natural resource base. This, coupled with the man-made degradation of natural resources due to charcoal production and overgrazing, has increased Somalia's vulnerability to drought and desertification, leading to a marked reduction in food security. Natural hazards and disasters are endemic in Somalia. The increasing spatial and temporal variability of the rainy

and dry seasons as well as floods and droughts result in serious natural disasters, while El Niño-induced changes in weather patterns continue to impact the region [9].

Historical trends show droughts occurring regularly at intervals of 2 - 3 years in the Deyr (October-December) season and 8 - 10 years in consecutive Deyr and Gu (AprilJune) seasons, extending seasonal hardships [10]. Records indicate that ten significant droughts occurred between 1918 and 1975, while droughts also occurred in 1979-80, 1983-86 and 1989-90 [11]. In the last quarter century, Somalia has undergone three periods of protracted drought and two periods of famine [10].

A famine in 1992 killed nearly 300,000 people and displaced 1 out of 5 people [12]. By early 1992, it was estimated that between one-quarter and one-third of all children had died [13]. During the 2011 East Africa Drought, more than a quarter of a million-people died in Somalia, half of them children under the age of five [14]. The drought resulted in 955,000 Somali refugees in neighboring countries [15] and devastating economic losses to agriculture and livestock. It also brought famine to the south of the country. Somalia is now experiencing the third drought of this period [11].

Somalia is particularly vulnerable to droughts, mainly because of its geographical lo cation, the fragile environment, the variable climate and the political instability in the country. Droughts have disastrous impacts on Somali communities. In recent times, severe droughts in Somalia occurred in 1964, 1969, 1974, 1987, 1988, 2000, 2001, 2004, 2008 and 2011. The number of persons affected is not reliable and differs depending on different sources. This fact, together with other reasons, reinforces the need for developing more objective measures which reflect the real severity of droughts. Without objective indicators it is very difficult to take appropriate mitigation measures to reduce the effects of a drought or move towards any kind of drought monitoring and early warning [12].

A total of 98.9667 million people were affected by natural disasters globally in 2020, of whom 45.95% were affected by storms, reaching 45.4708 million people, accounting for the largest proportion of the total; 33.56% by floods, reaching 33.2156 million people; 18.97% by droughts, reaching 18.7752 million people; less than 2.00% were affected by other types of disasters [13].

A study conducted by Blaikie in 1994 says it is not easy to draw the line between a disaster hazard that is exclusively natural and one that is socio-natural in character. Studies of disasters suggest that a great many hazards are the result of interaction between natural events and environmental conditions that have been degraded by human action (Blaikie and others, 1994). A paradigmatic example of socio-natural hazards of this type are climate events and the environmental alterations expected as a consequence of global climate change induced by the atmospheric concentrations of carbon dioxide resulting from human activity [14].

Sometimes the rivers in Middle and Lower Shabelle regions are significantly above the normal levels. This has resulted in over bank spillage leading to rive-

rine floods in parts Middle Shabelle. Further, two open river breakages in Jowhar district located in Bodale and Halgan village which are 22 km and 8 km south of Jowhar town respectively, have led to massive flooding in the area in August 2021. According to field reports, several households have been affected and hundreds of crop destroyed [15] [16].

Since the beginning of May 2021, there have been floods in jowhar surrounding villages (Baarey, Bananey, Hansholey, Libigha and parts of jowhar town). Flood wave have reached other villages like Dai Gwan. The river breakage in the south of Jowhar at Baarey is at an alarming stage and the community has been unable to close it [17].

The rains are expected to continue within the Ethiopian highlands and the upper parts of middle Shebelle, Somalia. The increasing trend of river levels along the river is expected to continue given the forecast and the current situation, the risk of flooding remains high. Previously, Hirshbelle's government brought 2500 sandbags and Somalia Red Crescent Society delivered 4000 sand bags, however it seems this will not be enough to close the breakage [18].

River water levels continued rising following heavy rains within the Ethiopian highlands, downpour of rain flash in Beletweyne and middle Shebelle. Currently at Jowhar, the level is at 3.95 m, however the rainfall forecast, the levels are expected to continue rising along the Shabelle River with moderate to high risk of flooding. The river breakage at Baarey is yet to be resolved and the waves of floods go further affecting large hectares of farm crops. Most of the vulnerable affected household members also cope with this situation by adjusting meals through reducing times and quantity, borrowing from relatives, etc. [19] [20].

In other cases, environmental degradation results from the alteration of soils by deforestation, repeated monoculture or residential use, increasing the likelihood of landslides or flooding in the event of an earthquake or torrential rain. A large share of the population lives below the poverty line and its livelihood depends on activities extremely sensitive to climate changes and weather conditions [21] [22].

The largest effect on human life and health caused by natural disasters is death, and among the most common direct consequences occur various forms of injury, illness and stress. However, the effects may be indirect, such as environmental pollution or loss of flora and fauna, which in the long term can be dangerous to humans [23].

Methodology

This study employed a cross-sectional and Qualitative research designs. This study was conducted in Jowhar town, Middle Shabelle region, Somalia. A total 200 respondents were participated this study, and used non-probability sampling which means to select the respondents intentionally. Data was be entered, edited, reviewed and to be analyzed by software program statistical package for social sciences (SPSS).

4. Results

Socio-Demographic Data

A total of 200 respondents participated in the study. The majority of respondents by gender shows that 147 (73.5%) of respondents were Male, while 53 (26.5%) were female, the mean Age were 20 - 30 127 (63.5%), and 109 (54.5%) were Single. About 153 (76.5%) had universality degree. Regarding the occupational status of the participants, students were the highest 52 (26%), and the majority of their income of 100-200$ were 63(31.5%) as shown in Table 1 and Table 2.

Table 1. Socio-demographic characteristics of respondents.

Characteristics		Frequency	Percent
Gender	Male	147	73.5%
	Female	53	26.5%
Age	Below 20	7	3.5%
	20 - 30	127	63.5%
	30 - 40	30	15.0%
	40 - 50	29	14.5%
	Above 50	7	3.5%
Marital Status	Single	109	54.5%
	Married	81	40.5%
	Divorced	10	5.0%
Educational status	University degree	153	76.5%
	Secondary degree	11	5.5%
	Intermediate degree	5	2.5%
	Non-formal degree	17	8.5%
	Reading and writing	14	7.0%
Occupation	House wife	15	7.5%
	Public Service	38	19.0%
	Private sector	42	21.0%
	Self employed	42	21.0%
	Student	52	26.0%
	Other	11	5.5%
Monthly Income	50 - 100 $	38	19.0%
	100 - 200 $	63	31.5%
	200 - 300 $	38	19.0%
	300 - 400 $	18	9.0%
	400 $ above	43	21.5%

Table 2. Research related questions.

Variables		Frequency	Percent
Do you have any experience or knowledge of natural disasters in the country, particularly droughts or floods?	Yes	178	89%
	No	22	11%
Have you or anyone you know ever been directly affected by a natural disaster such as a droughts or a floods?	Yes	171	85.5%
	No	29	14.5%
Is there any impact on the community, the environment, livestock, and agricultural production as a result of the Droughts and Floods?	Yes	189	94.5%
	No	11	5.5%
Droughts and floods are the most common disasters in our home country of Somalia; what do you think are the causes?	Natural cause	56	28%
	Lack of community knowledge and government preparedness	56	28%
	Environmental issue (climate change)	52	26%
	deforestation and environmental degradation	22	11%
	political issue	14	7%
Which is more common in Jowhar district: 1: floods caused by river flooding or 2: floods caused by excessive rainfall?	River floods	178	89%
	Excessive rainfall floods	22	11%
What is the greatest impact of floods in Jowhar district, based on your experience and knowledge?	Agriculture	62	31%
	Environment	38	19%
	Building	30	15%
	Livestock	20	10%
	Population	10	5%
	Infrastructure	40	20%
Drought seems to be the most catastrophic problem in the country all the time, what causes the recurrence of droughts, based on your knowledge and experience?	Deforestation	56	28%
	The government does not fully manage environmental issues whole the country	52	26%
	Global climate change	50	25%
	Environmental deterioration	22	11%
	no environmental protection law and Environmental Conservation law	20	10%
Droughts jeopardize cultivation and crop production by affecting the environment and plants; therefore, who is most vulnerable to the drought's effects?	Livestock	107	53.5%
	Agriculture	71	35.5%
	Population specially women & children	22	11%
Do you believe that the current situation in the country and the recurrence of these disasters, particularly droughts and floods, is due to the country's lack of a comprehensive environmental protection law that is the responsibility of the central government?	Strongly Agree	109	54.5%
	Agree	66	33%
	Neutral	17	8.5%
	Disagree	5	2.5%
	Strongly dis-agree	3	1.5%

Continued

Environmental research institutions working on environmental issues in the country are needed to raise public awareness of such issues. Can we say that as a result of this vacancy, people do not fully understand how to protect their environment and prevent deforesting it in order to survive droughts and floods?	Strongly Agree	83	43.5%
	Agree	88	44%
	Neutral	23	11.5%
	Disagree	5	2.5%
	Strongly dis-agree	1	0.5%
The Somali government has the responsibility of responding to these disasters, but they are not sufficiently prepared, why are they not prepared as they are responsible for the country?	Because of financial limitations	73	36.5%
	Due to security reasons, in some places cannot be reached	87	43.5%
	The country is not entirely under the government's authority	28	14%
	Political factors	12	6%

5. Discussion

Somalia has achieved significant progress in recent years with the formation of stable political, economic, and security institutions after more than two decades of governmental uncertainty these points to a more promising future in terms of peace and economic and social development.

Despite bearing little present or historical blame for climate change, the nation is disproportionately affected by it. Droughts, occasional floods, and desert locust infestation brought on by climate change result in the loss of livestock and agricultural production, which accounts for more than 70% of GDP and directly and indirectly supports millions of jobs. The primary sources of income for local populations are being destroyed, which is causing an increase in internally displaced people and the ensuing humanitarian crises. Conflicts, climate change, and variable effects all have an influence on Somalia's most vulnerable populations, including women and children and communities that depend on natural resources. Somalia is making progress due to its recent return to stability, despite several problems in the country's political, economic, and social spheres. Therefore, promoting sustainable economic growth through the use of its natural resources and raising the standard of living for its people will be Somalia's top goal during the next ten years.

Natural disasters, particularly droughts and floods, strike Somalia every year, having a negative effect on the environment, killing livestock, destroying crops, and impacting negatively on infrastructure, sometimes resulting in fatalities. According to the information we have gathered, Somali communities are aware of and have experienced these natural disasters in the country, particularly droughts and floods.

The majority of the respondents were over the age of 30, and the majority of those who completed the research were university educated. This indicates that the information was obtained from reliable sources. Another example of how this information is more accurate is that it is acquired directly from local people

in Jowhar district who have firsthand experience with the situation.

Natural disasters frequently have an impact on the environment as well as the lives of people, animals, and agriculture. Natural reasons are the most common cause, which occur at specific periods of the year when they become dry or disappear during the rainy season.

Other natural disasters are caused by a reason that we are so similar to the rest of the world, which is the deteriorating global climate change, which has resulted in the disappearance of rains that have been accumulating in Somalia for many years.

Deforestation is a major environmental challenge facing Somalia, particularly in Jowhar District; it is one of the main causes of the country's recurrent droughts. If trees are cut down, the landscape will change, soil erosion will occur, CO_2 purification will be reduced, and more carbon dioxide will be released into the atmosphere.

The soil in a forest is more susceptible to erosion when trees are cut down. The remaining plants grow more fire-prone as the forest shifts from a constrained, wet habitat to an open, dry one. Aridity, habitat damage, and biodiversity loss have all resulted from the removal of trees without sufficient replanting. Deforestation results in extinction, climatic changes, desertification, and population displacement, as shown by current conditions and the fossil record. Negative feedback loops that contribute to global warming are produced by deforestation, which also affects the bio-sequestration of atmospheric carbon dioxide. Global warming increases the difficulty for individuals seeking food security by cutting down forests for agricultural use and decreasing the amount of arable land overall. Therefore in Somalia especially Jowhar district, deforestation has been a major factor in the country's vulnerability to natural disasters drought and flooding.

The majority of the flooding in Somalia's Jowhar district in the Middle Shabelle region is caused by river floods. Flooding occurs when sections of the riverbed collapse. There are around three open breakages and more than nine overflows in Jowhar district, which cause river flooding on occasion.

Heavy rainfall Seasons in Somalia include The Xagaa season lasts from July to September, while the Dayr and Jilal seasons are from October to December, December to March, and late March to June, respectively. Drought might happen during the exceptionally dry Xagaa and Jilal seasons. The most rainfall occurs, however, during the Dayr and Gu seasons, with the latter being the heavier. Floods plague the southeast of Somalia every year and are brought on by the Gu rains. The Jubba River valley and the Shabelle River valley are lowlands where rain from the southwest of the nation flows. Furthermore, any extra water that drains from the two rivers may increase the water flow. Massive flooding is caused by the ensuing runoff in the areas close to the two river valleys. Every year when the Gu rains come, the Jubba River and Shabelle River Valleys are vulnerable to flooding because of the height and temperature of the region.

Floods have been occurring in the jowhar neighboring communities since the beginning of May 2021. (Baarey, Bananey, Hansholey, Libigha and parts of jow-

har town) Other settlements, such as Dai Gwan, have been flooded. The river breakage at Baarey in the south of Jowhar is at an alarming stage, and the community has been unable to block it.

Hirshbelle's state government had previously given 2500 sandbags, while the Somalia Red Crescent Society had delivered 4000 sandbags, but it appears that this will not be enough to close the gap. The current river level in Jowhar is 3.95 m, but based on the rainfall forecast, the levels are predicted to continue rising along the Shabelle River, posing a moderate to high risk of flooding. When all of these factors come together, catastrophic floods can occur, causing harm to the environment, crops, livestock, and even death.

The floods have had the greatest impact on Jowhar town's farming system, resulting in the loss of a substantial amount of the harvest. Jowhar residents who depend on agriculture for their livelihoods are now suffering several hardships. Environmental implications of floods include a lot of erosion, environmental structures being destroyed, animals being seriously affected, and infrastructure like roads being severely damaged.

Overbank spilling has happened, causing riverine flooding in portions of Middle Shabelle. Furthermore, since August 14, 2021, two open river breakages in Jowhar district, located in Bodale and Halgan villages, respectively 22 km and 8 km south of Jowhar town, have caused major flooding in the area. Several houses have been damaged, and hundreds of acres of crops have been lost.

In Jowhar Women and children are the most vulnerable groups when it comes to floods and droughts, while livestock are the second. Given their lack of physical sturdiness, IDP camps are considered as one of the most vulnerable places in terms of sensitivity. They are also frequently exposed to flood spots due to their proximity to rivers, making them particularly vulnerable to river breakages.

River breaking points are found in regions where the riparian vegetation surrounding the river is lacking. These are areas where the water overflows without being limited by riverfront vegetation, exposing already vulnerable living structures. When the riparian forest is thicker, the vegetation appears to hold water, preventing the flooded region from spreading and preserving the area's living structures.

There are three main camps in Jowhar district 1) General Da'ud (6512, IDPs) 2) Buulo Makiino (2472, IDPs) 3) Laanta Afaraad (15055, IDPs).

During droughts and floods, the people in these camps do not receive enough food, nor do they receive adequate assistance from the central government, foreign humanitarian agencies, or even the Hirshabelle state administration except for occasional small donations from the humanitarian agencies, in addition to the constant malnutrition and famine.

Other obstacles facing Somalia in overcoming these recurring natural disasters include the need to establish environmental research institutions also complete and implement environmental laws and regulations. Environmental ministries have failed to apply with environmental laws, and just a few of the agreements have been used to enforce them.

It is one of the few things that encourages deforestation and contributes to environmental degradation. If these rules were implemented, there would be less environmental degradation then droughts and floods would be prevented.

The environmental protection law is also not yet in implementation, although Somalia has made significant strides in developing institutional and policy frameworks that are relevant to climate change, natural resource management, and overall national development. Although there are still difficulties with implementation at both the Federal and State levels, policies and regulatory frameworks are positive advances.

Some of environmental national policies are; The Somalia National Climate Change Policy 2020, The National Adaptation Programme of Actions 2013, The National Environment Policy, Draft National Environmental Management Bill, Somali National Disaster Management Policy, The National Biodiversity Strategy and Action Plan 2015, National Drought Plan, Somalia National Action Programme for the UN Convention to Combat Desertification and National Capacity Assessment Towards Implementing the Environmental Treaties of the Rio Convention. Despite that there are all of these policies, laws and more that cannot be summarized here, there are still implementation challenges at both the Federal government and State levels.

Somalia has a long history of disasters caused by both natural and man-made disaster. Weather extremes and climate unpredictability have historically exposed the country's environment to many threats, including periodic droughts and floods. The country is extremely sensitive to the effects of climate change, and the resulting natural disasters present a threat to Somalia's long-term development, food security, and poverty reduction. Every year, droughts are followed by floods in Somalia, causing severe loss of life and property and delaying the country's economic and social progress. While floods are limited in scope due to the spread of major river systems, drought is the most common natural hazard that has negative consequences across multiple sectors and affects more people than any other sort of disaster.

6. Conclusions

According to my research, the Somali people are completely aware of natural disasters such as droughts and floods, and they are self-sufficient in dealing with the consequences of these disasters. Most foreign humanitarian agencies especially UN-agencies and the Federal Government of Somalia are often offer little assistance to people who are affected the droughts and floods in Jowhar district Middle-Shabelle region, Somalia. All of these issues arise as a result of their contributions to society by their hands, which is the leading source of deforestation and environmental deterioration.

Furthermore, the Somali government has not fully created environmental laws to protect and conserve the environment, and the majority of laws, rules, acts, and regulations are not used or administered effectively. This indicates that

people are to be courageous to harm the environment, because they are not afraid of breaking any laws, rules and regulations.

We also discovered that the Somali government is not yet financially prepared to deal with these crises, and that there are no strategic plans in the central government or even state administrations to prevent or at least control these disasters from causing extreme harm to the community and the environment.

People who do activities that are destructive to the environment simply to make money from the trees they cut down are obviously a problem to the country. The government should do either one of two things. The first option is to look to the government for alternative sources of income, second to reinforce environmental protection laws in order to prevent excessive deforestation.

If these two things are currently difficult, people should be educated and environmental institutions should be established to educate people about the deforestation and degradation and conserve their natural resources, or at the very least to start a campaign to plant trees in the same way that they are cutting down trees.

7. Recommendations

Once a forested land with trees and wildlife my home country today appears to be deserted only because we ignored the environment, witnessing a pastoralist with hundreds of animals totally engaged in destruction just to make some money. These people only need to be educated about the value of trees and forests in order to become part of the solution rather than the problem. Strict measures must be implemented across the country, with no mercy granted to anyone who cuts down trees or contributes to environmental deterioration.

Drought is common in large portions of the country, resulting in significant economic losses and humanitarian misery. Meteorological drought strikes Somalia nearly every two years, beginning in particular areas and gradually spreading to the rest of the country due to seasonal shifts and rising dryness. Its recurrence results in animal and agricultural losses, contributing considerably to the country's ongoing challenge of food insecurity, which causes immense hardship to the affected communities.

Floods, on the other hand, are a common occurrence in Somalia, notably along the Juba and Shabelle Rivers in the country's south. Floods are most common during the Gu and Dyer seasons, when rainfall exceeds usual. Hundreds of thousands of animals are killed each year by torrential rains and high wind speeds. Villages, homes and structures are also destroyed by such powerful storms, causing anguish and misery to already vulnerable communities. Climate events will have a particularly negative influence on Somalia's land-based resources sectors, such as forestry, agriculture, livestock, water management, and natural ecosystems.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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