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Another tool in the box: Epidemiological forecasting of floods

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Floods have been recorded as the most frequent type of natural disaster, constituting 47% of all occurrences and impacting about 2.3 billion individuals globally [1]. In 2019, floods accounted for 43.5% of all deaths due to natural disasters [2]. Floods can have long-lasting detrimental effects on human socio-economic conditions, including public health issues, crop and livestock losses, creating large-scale unemployment, disrupting livelihood activities and wreaking havoc on natural ecosystems. In addition, floods caused extensive damage to infrastructure, and put extra strain on meagre public resources of the developing regions they frequently occur in. The full scope of the destruction caused by floods is often only realized once the waters have receded and the true extent of the devastation is revealed [1, 2].

Impacts of floods on crops and livestock

Crops and livestock, along with the people who depend on them for their livelihoods, can be profoundly affected by floods. When crop fields are inundated with water, the resulting crop losses induce household food insecurity [3]. Moreover, flood waters may cause soil erosion, reducing soil health and yields for subsequent crops. Furthermore, flood water may transport pollutants into crop fields; contaminate the soil and render it unfit for many agricultural activities.

Livestock is similarly negatively impacted by floods. Flood waters can wash away fencing and expose livestock to predators. Additionally, the hazardous conditions created by flooding can be difficult for livestock to navigate leading to their downing. Livestock can suffer from stress and health problems due to prolonged exposure to wet conditions and inability to access pasture. This results in decreased productivity, mortalities and socio-economic losses for livestock farmers. Further, floods hinder the transportation of goods. Thus, supply of agricultural inputs and implements to farmers, and the transportation of agricultural produce to markets, is curtailed for the period. The impact of floods on agriculture can be extensive and persistent while having severe consequences on agricultural dependent communities [4, 5].

Flood Impacts on human health

The healthcare system faces significant hurdles when it comes to floods and their impact. Their effects on health can be categorized in two - direct and indirect. Direct impacts result from floods ponding leading to fatalities, injuries caused by debris, environmental contamination or hypothermia while indirect consequences stem from water-related disturbances to natural surroundings and physical environment such as communicable diseases, obesity-linked issues, famine-driven ailments, and illnesses arising due to displacement of populations [6, 7]. The World Health Organization (WHO) reported that in the 2010s, floods affected more than 20 million people, many of whom were homeless, and resulted in the closure or damage of over 400 of the approximately 3,000 clinics and hospitals in the affected regions. This limited the availability of essential healthcare services for those affected, and at least 8

million people required immediate humanitarian aid. The floods also caused significant damage to infrastructure, including roads, bridges, and water supply systems, further compounding the crisis.

Floods can have a significant impact on public health by spreading waterborne diseases, promoting the growth of disease-carrying insects, and disrupting access to essential health services. In the aftermath of flood, contaminated water can cause outbreaks of gastrointestinal illnesses such as cholera, typhoid fever, and dysentery. Floods can also lead to an increase in mosquito-borne diseases such as malaria and dengue fever. In resource limited settings, the impact of floods on communities can be devastating, as the areas are already vulnerable with low resilience due to lack of adequate resources to mitigate the risks posed by floods. In Sub-Saharan Africa (SSA), a combination of factors such as poverty, poor infrastructure, and lack of access to essential services worsen the effects of floods, leading to significant loss of life and property. Furthermore, the region is also grappling with limited capacities for disaster risk reduction, early warning systems, and effective response mechanisms. This can result in a slow and inadequate response, leading to further losses and suffering.

Addressing flood-related disasters requires a holistic and integrated approach that involves all stakeholders and addresses the root causes of vulnerability. Only then can the impact of floods on communities be reduced and their capacity to face such disasters in the future enhanced. Epidemiology and the tools available from this discipline can contribute to adapting and mitigating flood hazards and disasters in several ways, for instance, through epidemiological forecasts.

Epidemiological forecasts as a tool for flood mitigation

Epidemiological forecasts aim to explicitly quantify the probability of different future trajectories of a pandemic [8]. They are important tools in predicting the potential impact of future pandemics. Epidemiologists use data collected from previous instances of extreme events such as floods, droughts and extreme temperatures to create models that predict how severe the next flood might be, how long it will last, and what areas are most at risk. By accurately forecasting meteorological extreme events such as floods, and epidemiological events such as pandemics, governments can design and implement proactive disaster reduction and mitigation plans and allocate resources optimally. In the past, climate experts and epidemiologists have tended to work in silos, and missed out on synergies that result from the cross fertilization of collaborative modeling.

By using a multi- stakeholder approach, epidemiological forecasts can aid in creating awareness on disaster risk for crop and livestock farmers and public health and strategizing on mitigation measures to reduce floods. In cases where mitigation is not feasible, adaptation measures to reduce the severity of the impacts

could be formulated. This may include measures such as; distributing clean drinking water, providing access to safe sanitation facilities, controlling populations of disease-carrying insects and delivering essential health services to communities cut off by floods. When instituting these measures, it is important to provide early warnings, while taking into account urbanization patterns and land use planning in response to urban flooding [9]. Inarguably, epidemiological forecasts are one but an important tool in the box of approaches to flood disaster mitigation and adaptation.

What else can be done?

It's important to note that addressing floods is a complex challenge that requires a multi-faceted approach and cooperation among different stakeholders collaborating at different scales. Other measures include;

- Prepare for floods: Individuals and communities can take steps to prepare for floods by creating emergency plans, preparing an emergency supply kit, and elevating critical items in homes and businesses. It is important for public health officials to be prepared for the potential health impacts of floods and to have plans in place for responding to outbreaks of disease.

- Improve land use planning: Land use planning can help reduce the risk of floods by avoiding development in areas that are prone to floods and preserving natural floodplains.

- Strengthen building codes: Governments can enforce building codes that require new structures to be built to withstand floods, as well as retrofitting existing structures to make them more resilient.

- Implement flood warning systems: Flood warning systems, such as early warning systems and flood forecasts, can help reduce the impact of floods by providing communities with advance notice of incoming floods.

- Improve drainage systems: Governments can invest in improving drainage systems and infrastructure to reduce the risk of floods.

- Increase public awareness: Increasing public awareness about the dangers of floods and the steps individuals can take to prepare and protect themselves can help reduce the impact of floods.

- Climate adaptation measures: As the frequency and intensity of floods is expected to increase due to climate change, it is important for governments to implement adaptation measures such as improving coastal defenses and investing in water management infrastructure.

Declarations
Author Disclosure statement
The authors declare that there are no conflicts of interest

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