ORIGINAL ARTICLE

Floods and health in Gambella region, Ethiopia: a qualitative assessment of the strengths and weaknesses of coping mechanisms

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Background: Floods are the most frequent and devastating type of natural disaster worldwide, causing unprecedented deaths, diseases, and destruction of property and crops. Flooding has a greater impact in developing countries due to lack of sufficient disaster management structures and a lack of economic resources.
Objective: This study was conducted with the aim of contributing to the knowledge base of development strategies that reduce flood-related health risks in developing countries. The study focused particularly on assessing the flood risks and health-related issues in the Gambella region of Ethiopia; with the intent of producing relevant information to assist with the improvements in the efficacy of the current flood coping strategies in the region.
Methods: Data were gathered through interviews with 14 officers from different government and non-governmental organizations and a questionnaire survey given to 35 flood victims in Itang woreda. A qualitative approach was applied and the data were analyzed using content analysis.
Results: It was found that flooding is a common problem in Gambella region. The findings also indicate that the flood frequency and magnitude has increased rapidly during the last decade. The increase in floods was driven mainly by climate change and changes in land use, specifically deforestation. The reported main impacts of flooding on human health in Gambella region were deaths, injuries, and diseases such as malaria and diarrhea. Another notable consequence of flooding was crop destruction and subsequent malnutrition.
Conclusions: Three weaknesses that were identified in the current coping strategies for flood-related health impacts in Gambella region were a lack of flood-specific policy, absence of risk assessment, and weak institutional capacity. This study recommends new policy approaches that will increase the effectiveness of the current flood coping strategies to sustainably address the impact of flooding on human health.

Keywords: *floods*; *health risks*; *coping mechanism*; *preparedness*; *capacity*; *impacts*

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Climate change may affect health in a number of different ways, one of which is flooding (1). Floods are recognized to be the most frequent and devastating type of natural disaster worldwide, accounting for 40% of all natural disasters (2, 3). Most floods occur in developing and tropical regions (2). Between the years 2000 and 2008, East Africa has experienced many episodes of flooding (4). Additionally, increased flood events have been observed throughout southern African countries (5).

The adverse health impacts of flooding are very complex (6). One of the health impacts of flooding is death. Deaths caused by flooding can occur in different ways and periods, but the most easily recognized ones are due to drowning and injuries obtained during the onset of flooding (7). Injuries can happen before, during, and after flooding. Injuries occur before flooding when people are trying to escape the approaching water. People also are injured during the onset of floods primarily when they are hit by an object in fast flowing

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water (8). Once the flood waters recede people can still be injured when they return to their homes and business areas and start to clean up the damage (8). In addition to the escalating probability of death and injuries, floods also cause an increase in the transmission of diarrheal disease. The incidence of diarrhea is linked to floods because flood waters often carry pathogens and pollutants that can contaminate food and water source (9). Diarrhea is not the only disease that results from flooding. Vector-borne diseases such as malaria also increase in the aftermath of floods. This is due to an increase in the habitats, such as stagnant pools, used by the vector population (9).

Furthermore, floods damage crops and inundate farmlands, which can lead to food shortages. Floods also damage property and displace those living in the flooded area (2). Malnutrition caused by inadequate supplies of food during a natural disaster and problems with distribution compounds the effects of disease (2). In addition, severe damage to hospitals, health centers, and other facilities has been reported in many countries following intense flooding (10). More importantly, health facilities may be inaccessible to those in need of medical attention due to the flooding (11). Above all, significant stress can also result from floods because of damage to property; disrupted livelihoods and loss of social networks (12).

Different coping strategies have been used to reduce the impact of floods on human health and property. Despite this effort, flood hazards continue to pose multiple risks to human health in many countries around the world, particularly in low-income countries. This indicates that the strategies currently used in low-income countries have failed to effectively resolve the problems caused by flooding. 'Flood coping strategies should be an ongoing process by which all concerned bodies plan for and try to reduce the impact of disaster before flood disaster happen, take the necessary reactive response during the flood event and take action after a flood disaster happens to return affected communities to a more normal condition'(11, 13). Continuing action at each phase plays a crucial role in reducing the health impact of flooding (14).

Aims and objectives

The aim of this study is to contribute to the development of strategies to reduce flood-related health risks in developing countries. The study focuses particularly on the assessment of flooding and the subsequent health impacts in Gambella region of Ethiopia. The specific research questions that the study strives to answer are:

1) What was the trend of flood events in the study area over the last decade?
2) Were there any health problem arising from the flooding?
3) What current efforts are being made to cope with floods?
4) What are the strengths and weaknesses of the coping strategies?
5) What changes are needed in current strategies from a sustainability perspective?
6) What are the general lessons learned that can be applied elsewhere?

Gambella region was chosen for three reasons: (1) the region is prone to floods; (2) no significant research has been done in the region; and (3) the region is one of the least developed in all aspects including human resource and infrastructures even when it is compared with other regions in Ethiopia (15).

Research in the field of coping with flood risks has largely focused on economics, livelihood, and agriculture; little attention has been given to health dimension of flooding (16, 17). The fact that this sector has received little attention underscores the necessity of this research.

Background to the study area

Ethiopia is one of the largest countries in East Africa, and its topography has made the country vulnerable to floods and the resulting destruction and damage to life, economics, livelihoods, infrastructure, services, and health systems (18). Gambella region is one of the regional states in Ethiopia that has been hit particularly hard by floods. It is located in the western part of the country bordered to the south by Sudan (Fig. 1). The region has an area of 25,800 km^2 with an estimated total population of 247,000 (19), divided into three administrative zones. The Gambella region contains eight woredas (districts) and the woredas are divided into 220 kebeles, which are the smallest administrative units.

Altitude in the Gambella region ranges from 1,000 to 2,000 m above mean sea level in the east, to 500–900 m in the center, and 300–500 m in the west (20), reflecting a progressive decline from east to west. The annual rainfall ranges between 800 and 1,200 mm, and some falls throughout the year, but with 85% between May and October. The average annual temperature in the region is 27.5°C (19).

Most of the people in Gambella region live along the river bank which makes them susceptible to yearly flooding. Excessive rains from Gambella region and surrounding regions cause rivers to overflow. There are many rivers in the region but the major rivers are the Baro, Akobo, Gilo, and Alwero which flow throughout the year, originating from the highlands. As a result, flooding is the most common natural disaster in the region. For example, in the last seven years the big rivers such as Baro, Akobo, Gilo, Alwero, Jikow, Gnandera, and Koikoye all overflowed each year, with the exception of 2002 (18). As a result, thousands of people were

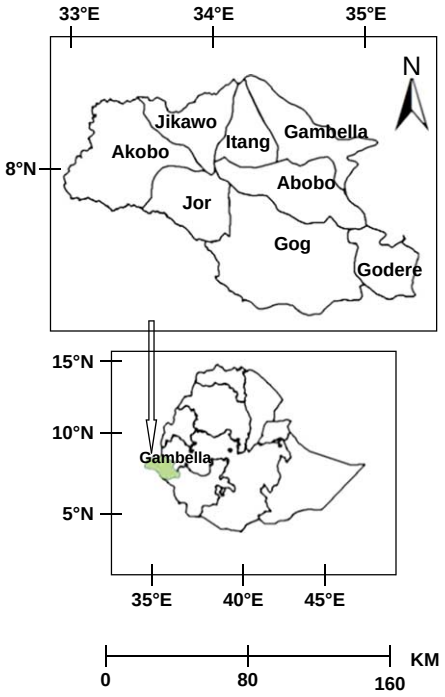

Fig. 1. Location of Gambella region in Ethiopia.
Recently some of the woredas in the Gambella region have been subdivided. The current number of woredas is 11. Currently, however, maps showing administrative boundaries of the recently repartitioned woredas are not available.

displaced, crops were damaged, and property destroyed (18). Furthermore, floods have often resulted in deaths, drowning, communicable diseases, and malnutrition and caused interruption of health services due to the damage to the health infrastructure (21).

Methods and materials

The disaster management model (13) was used as the analytical framework for this study. In the model the flood disaster management sequence is divided in to two phases (Fig. 2). The first phase is called the risk reduction phase and includes policy development, risk assessment, mitigation, and preparedness. Mitigation refers to the long-term activities undertaken prior to impact and the aim is to reduce the risk or occurrence and/or effect of a disaster (22). Preparedness is the step dealing with all the pre-disaster activities intended to increase the effectiveness of emergency response during a disaster. The second phase, called the recovery phase, includes the response and recovery measures (13). The response can include any activity undertaken immediately prior to and during an event to protect lives and properties (22). Recovery is a post-disaster activity with the aim of returning affected communities to more normal conditions. Therefore, in general the assessment focuses on policy development, risk assessment, mitigation, preparedness, responses, and recovery.

The disaster management model has been criticized 'for underplaying the dynamic and often undermining relationships between disasters and ongoing coping capacity that may create spirals rather than cycles of vulnerability' (23). However, for this study the model was an important blueprint for disaster management. The model is also an important tool in aiding the capture of a more holistic approach to risk assessment (23). Through the model it is possible to focus not only on the evaluation of responses aimed at addressing the impacts of flood on health but to also to assess the efforts that are in place to mitigate against flooding and its impacts on human health.

Data collection

Secondary and primary data were used in this study. The secondary data were gathered from several data sources including government reports, policy documents, health service reports, and disaster preparedness and prevention appeal reports. The primary data were collected with the aid of questionnaires and interviews with government departments and non-governmental organizations that are directly or indirectly involved in flood disaster management in the study area and also with the victims of flood disaster in Itang woreda in Gambella region.

As a first step, discussions were held with the regional administration officers in the Gambella region. The aim was to: (1) build an inventory of the government departments and NGOs in the region that directly or indirectly worked with flood disaster management for interviews; (2) identify the most flood-affected area in the region where interviews with flood victims would be concentrated; and (3) to get a general overview about flooding and flood health problems in the Gambella region. From this discussion the government departments and NGOs that were identified as working with directly or indirectly with flood disaster were broadly categorized as: (1) service providers in preventive and curative health (*Department of Health Education; Department of Environmental Health; Regional Surveillance Department; Federal Surveillance Department; Itang Health Centre; and Gambella Hospital*); (2) Water Resource Department; (3) Meteorological Agency; (4) Disaster prevention and preparedness agencies (*regional and federal level*); (5) Gambella Regional Administration; and (6) NGOs (*World Food Programme Gambella Region; United Nations Organisation for the Coordination of Humanitarian Affairs (UNOCHA) Gambella Region; and Eastern Gambella Betel Senodos Church*). Using the frequency and number of flood victims as indicators of severity of flood impact, the Itang woreda was selected as the case study area.

A total of 14 officers were interviewed, one from each of the government departments and NGOs identified above. The interviews with the officers were conducted using semi-structured questionnaires. The main themes

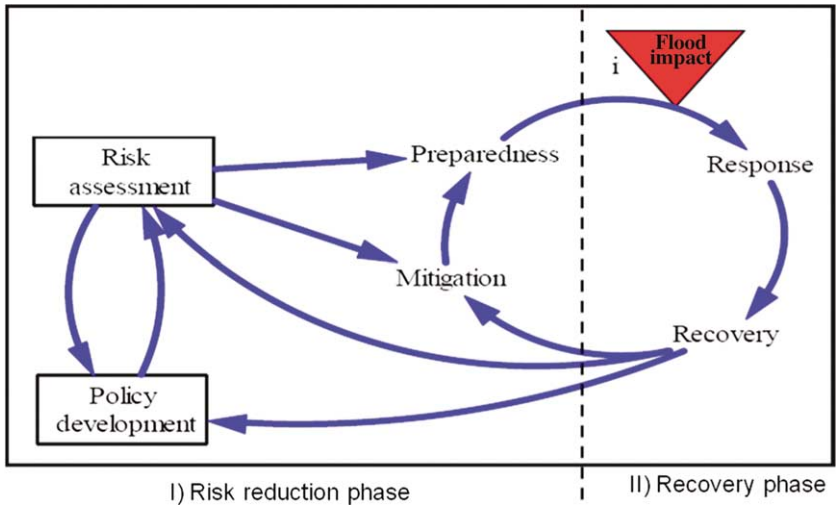

Fig. 2. Disaster Management Model (modified from Yesil (13)).

covered in the interview were: flood occurrence and frequency; flood events and trends over time; flood impacts; strategies for flood risk reduction; barriers to prevent flood induced health risks; and strategies for recovery. The principal researcher read the questions in an open manner, allowing for follow up questions where necessary. The answers were recorded in writing. The interviews were conducted after pre-arranging meeting appointments. The interviews were carried out between 14th January and 15th February 2008.

A questionnaire survey was conducted with 35 flood victims in Itang woreda. This number was selected on the basis of the resources available for the study. The interviewees were selected randomly. As in the case of the officials, the questionnaires were addressed in interview sessions. The interviews were conducted in Amharic and translated to English immediately after the interview. The main motivation of the interviews was to collect information on flooding and flood-related health problems including information on flood trends in the last decade, sanitation conditions, sources of water supply, and existence and use of mosquito bednets. Additionally, the questionnaire included the issue of resettlement, early warning, and emergency preparation. Oral consent was obtained to make sure that the purposes of the study were understood and accepted by all participants. The interview durations ranged between 30 and 60 minutes.

The flood victim respondents constituted 24 men and 11 women, whose age range was 20–57 years. The men dominated the interviews because in the region and Ethiopia in general the men are the heads of the households and whenever they are present are given the opportunity to talk on behalf of the household. Most of the female respondents represented household heads who were absent at the time of the interview; only a few of the women were household heads in single parent households. All the interviewees were farmers since the woreda is located in a very rural area. The education level for all the interviewees was low with only seven (six of whom were men) having attained primary school level. The rest had not attended school.

Data analysis

A qualitative approach was used in this study. The data were analyzed using content analysis. The collected data were read carefully and then put into data codes and categorized based on a list of themes prepared on the basis of the Yesil (13) analytical framework.

Results and discussion

Assessment of flooding and flood impact

According to majority of respondents among both the officials and flood victims, flooding has been a problem in the region for many years. However, they were all of the opinion that the flood frequency and magnitude has increased rapidly over the past decade. Also, the onset of the flooding used to be more predictable and allowed farmers to plan for sowing crops at the optimal time; hence harvesting has become erratic. Consequently, the unpredictable nature of the flooding, combined with increased frequency and magnitude, results in crop failure and unprecedented human health impacts. The reasons provided for the increased frequency and magnitude of the flood events were attributed to land-use change (*deforestation and over cultivation*) and also climate change. Four rivers were mentioned as main contributors to flood in the region (*Baro, Akobo, Gilo, and Alwero rivers*). The aforementioned rivers are the main rivers in the region (20).

Most respondents from the government departments attributed land-use change as the main contributing factor for increased frequency and magnitude of floods in Gambella region. Unplanned settlement and population

increases are the primary causes for the land use change. Before 1984, Gambella region was occupied by a few indigenous people in sparsely populated settlements (20). However, between 1983 and 1996, several thousands of people were relocated to the region (20). The impact of relocation was that more than 140,000 ha of natural forest were cleared and large-scale farming also increased in the region in order to meet the needs of the population. This led to increased run-off and high sediment yield which reduced the water holding capacity of rivers (24). Deforestation leads to higher run-off volumes which can result in flooding in low plain areas (6).

Climate change was mentioned by the water department and also by the meteorological department as another factor contributing to the increase of flooding in the region. The onset of the rainy season has been erratic and also the amount of rainfall has become unusually high. This is in line with findings (25) which show increases in the precipitation patterns for the study area and surrounding regions. Also the Intergovernmental Panel on Climate Change projection indicates an increase in precipitation and run-off in eastern African countries including Ethiopia (26).

The responses from the flood victims, government departments, and NGOs indicated that deaths, diseases and, crop destruction were the main impacts of flood in the region. The respondents unanimously reported that the flooding events in the study area always resulted in deaths. This finding is in line with the information from published literature that found death as one of the major impacts of flooding in Ethiopia and specifically the Gambella region (4, 21). Officially reported flood-related deaths have been increasing rapidly over the last five years (4). The number of flood deaths in Ethiopia has increased steadily from 199 in 2003 to 932 in 2006. Despite numbers from the database, this study argues that increases in flood deaths may not be an adequate indicator of increased flood events as postulated by respondents. This analysis is based on the argument that the acceptance of the officially reported cases is dependent on efficiency in the monitoring and reporting process. This efficiency can improve over time. However, possibilities that increased flooding could have contributed to the rise in the death rate cannot be overemphasized since other literature shows an increase in precipitation in the study area (25).

Diarrhea and malaria were the two main diseases that the flood victims and also the respondents from the health officials mentioned as the health problems arising from flooding in the region. Diarrhea outbreaks related to flooding are not only a problem of Gambella region, but also a problem in many parts of Ethiopia (27). The problem of diarrhea was aggravated in a temporary resettlement camp because of overcrowding and inadequate water and sanitation (28). Above all, the risks of a diarrhea outbreak was high when displaced people returned to their villages. This was because the floods destroyed protected springs, shallow wells, and boreholes (28). Health officials emphasized that malaria epidemics were a common phenomenon in many parts of Ethiopia following floods. This lends support to the Ethiopian Federal Disaster Prevention and Preparedness Agency, who reported high malaria incidence after floods due to increases in favorable mosquito breeding sites (18). Other studies also found a positive correlation between floods and the incidence of malaria (9).

The destruction of crops was mentioned by most respondents, particularly the flood victims and those from the disaster prevention and preparedness agencies, as a further impact of flooding. Floods damage crops and inundate farm land, which can lead to food shortages that may lead to malnutrition. For instance, the 2006 flood in the Gambella region caused damage to 1,650 ha of maize crops (29). There was also a 20% reduction in production, mainly resulting from water logging on the farmlands (29). Most of the people affected by this flood were very poor and considered highly vulnerable in terms of food security. Though it is difficult to relate flooding to nutritional status without undertaking prior surveys, it is likely that shortages of food caused by flooding in Ethiopia exacerbate existing malnutrition in the country. Malnutrition in Ethiopia, especially among children, is very high with 46% stunted and 11% wasted (18).

Assessment of flooding coping strategies

Policy development

According to the response from the Disaster Prevention and Preparedness Agency, flooding is not covered under the current disaster management policy. The reason was explained that in the past flooding was not a major problem compared to drought and other natural disasters. While drought affected several hundred thousands of people, floods had a negligible impact, and as a result it did not attract the attention of policymakers or government. However, more recently the frequency and magnitude of floods have increased, affecting large parts of the country and causing damage to property, loss of life, and impacting the health of the populations. The effect of floods is aggravated by the absence of flood policies, resulting in confusion in the event of floods. To reduce the impact of flooding which arises from fragmented effort and confusion, comprehensive flood-management policies are vital (30). It is also important to note that, to be effective, the flood disaster management policies should clearly state the responsibilities and roles of all stakeholders (31).

Risk assessment

Assessments of the risks of outbreaks of flood-related diseases and vulnerability were largely absent in the study area according to responses from regional surveillance

experts. Assessing risk and vulnerability can play a major role in identifying people and property that are at risk of flood hazards (31). Once the people and property at risk are identified, measures that will reduce their vulnerability through a reduction of health risks can be undertaken. To a large extent, the lack of risk assessments is tied to the absence of flood policies as discussed earlier. A lack of appropriate technology, data, and limited financial resources are also important contributors to the absence of such assessments. Flood risk assessment is now a sophisticated undertaking demanding new technology, computer models, remote sensing, and real time forecasting (32). The Gambella region by dint of its deprived nature lacks these tools. Additionally, most developing countries lack good quality data on which vulnerability and risk assessments can be based (33). For example, to determine vulnerability to epidemics, data need to be available on housing, living conditions, basic sanitation, and history of outbreaks (34). However, it is very difficult to find well-documented data on these issues for the Gambella region. We found only one risk assessment carried out only in Itang woreda, Gambella region. This study tried to identify the factors contributing to flooding and prepared a flood hazard zone map of the Itang area. It also assessed vulnerabilities of different elements at risk but the assessment focused only on a few land-use types, such as buildings and crops. Assessment of vulnerability should include many systems, infrastructure, and services which can be crucial for health care facilities (35). The assessment in Itang woreda could have been used as baseline data for implementing risk reduction if it had assessed all or most of the systems, infrastructure, and services at risk in the area.

Mitigation

The Gambella Regional Administration plans to reduce the effects of flooding on the population through relocating residents of flood-prone areas to safer regions on a voluntary basis. However, most of the flood-affected individuals responding from the Itang area said that they did not want to be resettled. The main reason they gave related to the benefit of cultivating land close to the riverbanks. Their agricultural system is highly dependent on flood-borne soil that is very rich in nutrients. The residents believe that living along the riverbank can help them to harvest twice a year, both during rainy season and in the period after flooding. Therefore, they fear that relocation may deny them the chance to produce an equivalent amount. Moreover, at the time of the study they were using traditional farming tools such as hoes. These tools may not be suitable for cultivating crops in a new settlement which may not be as productive as their current location. Contrary to the responses of flood victims, most officials that were interviewed agreed that relocation is a sustainable solution for the protection of lives and property because of the recurrent flooding problem. There remains a need to increase efforts to raise awareness of individuals in flood-prone areas about the future impact and consequences of flooding. Before implementing the resettlement program, it is very important to introduce new agricultural technology that is applicable to potential new locations, in order to create an increase in agricultural productivity for the new residents. Moreover, in order to attract residents to accept the relocation to safer areas, basic facilities, and social services including schools, health services, water supply, and irrigation should be guaranteed.

The literature is divided on the benefits of relocation. One side of the debate contends that, if properly applied, relocation is the best method for successful reduction of flood risk (36, 37). The other side of the debate is of the opinion that relocation will disrupt social networks and also could lead to serious health problems (38). Relocation of the whole community of vulnerable residents in Gambella could be an expensive proposition because the flood victims would have to be provided with houses and land. Additionally various social amenities would need to be installed (38). Given that previous resettlement programs in other parts of Ethiopia and in Gambella region were poorly planned and were not based on enough study (20), it is necessary for the Gambella Regional Administration to draw on the lessons from previous unsuccessful resettlement programs when planning future relocation strategies.

This study argues that relocation may not be a sustainable solution as it could be shifting a problem from one place to another or from one health problem to another. For example, poorly planned resettlement can result in huge loss of forests and other natural resources, causing a massive negative impact on environmental sustainability which in turn directly or indirectly affects human health. Therefore, the Gambella region could learn from other flood-prone countries such as Mozambique and Vietnam. In Vietnam, the flood policy encourages citizens to live with floods as a coping strategy for flood hazard. This ‘recognizes that flooding cannot be, nor should be, completely controlled and that efforts should also go into ensuring that communities can cope with, co-exist with and perhaps even exploit floods’ (39). This approach is also used in Mozambique to cope with flood hazards (40). To reduce the impact of floods, this policy emphasizes two main points: the importance of mitigation and preparedness, and response and recovery. These points include education, clear and simple early warning techniques, building escape roads and additional structural measures. However, there is a need to contextualize the Mozambican and Vietnamese cases when considering coping strategies for Gambella, in order to prevent unintended consequences.

Currently, structural measures against flooding are absent from the regional government of Gambella. According to responses from the Disaster Prevention and Preparedness Agency and the Gambella Regional Administration, the absence of structural measures was due to the high costs of construction of engineering measures such as dams and embankments. Some research argues that structural solutions are capital intensive, irrespective of how effective they may be, and so extensive coverage remains unachievable for many flood-prone developing countries (17). To institute structural measures the country needs assistance from external development partners. However, most of the time these donors are more responsive to emergency appeals (reactive) than to disaster reduction appeals (proactive) (13, 35). Typical of this trend, a number of NGOs are currently working in Gambella region, yet none of them are involved in proactive activities intended to mitigate the impact of floods. Most of the NGOs are actively involved in emergency responses in the aftermath of flooding. The lack of engineering measures such as dams and embankments could be viewed in a positive light from a sustainability perspective. These structures do not consider the impact on future generations and introduce intolerable instability in ecosystems (36). It can be further argued that they give a false sense of security which could lead to complacency and lack of vigilance on the part of flood-management agencies. However, not all structural measures are unsustainable. Small scale and distributed structural measures such as flood proofing, building codes, and extending permeable areas are some examples of sustainable structural measures (41).

Preparedness

The health service in Gambella region does not have any flood contingency plans, according to the responses from Gambella Hospital. No plans are in place to encourage the participation of volunteers or to train community health volunteers. All institutions, including health services, which the research followed cited limited human resources as a problem. The research findings show that no training was given to health professionals in Gambella region concerning flood hazard management and related issues, who would be better prepared if they had prior training on flood hazard management.

Training of hospital staff provides better understanding during disasters and improved skills (42). Furthermore it helps to discover insufficiencies in skills, judgment and information systems, and scarcity of resources (42). Therefore, it is necessary to strengthen the capacity of the health sector in the region, to help in coping with flood-related health risks. The government should allocate adequate resources to organize seminars, short courses, and training related to flood control and prevention. There are two approaches for providing training in flood disaster management for health professionals; either continuously at the institutional level or as part of academic training at undergraduate and graduate levels (34).

Coping mechanisms for flood health risks were also hampered by a lack of adequate health services and limited health professionals in the Gambella region, according to the responses from Gambella Hospital. For instance, the region only has the one hospital, catering for a population of 247,000, while Harari region with only 196,000 residents has five hospitals (43). There are many reasons why Gambella region has a less-developed health sector and a shortage of health professionals. Firstly, for a long time the region was politically marginalized by the central government (15). Secondly, a lack of security and instability in the region due to wars, continued violence, and ethnic conflicts has affected development activities in the region. Thirdly, its remoteness, harsh climate, and lack of basic facilities and infrastructure, such as steady electricity, safe water supplies, and means of communication does not make it an attractive place for health professionals to come and work (15). Moreover, Ethiopia generally suffers from limited numbers of health professionals.

The majority of the flood victim respondents did not have a latrine, mosquito bednet or safe water supply, and generally used water from unprotected rivers for drinking, cooking, bathing, and washing clothes. Open defecation and urination is a common practice in the area. The survey indicates that people did not have any information relating to the implication of these unhygienic practices in the event of flooding. Overall there were poor environmental health preparations for reducing morbidity and mortality during flooding.

Furthermore there is no effective early warning system in place in Gambella region. Most of the respondents in Itang woreda said they had not received any warning from the relevant institutions. The research found that the Department of Meteorology and the Department of Information, two key departments whose function is crucial to the success of early warning mechanisms, are not included in Early Warning Committee. The absence of early warning systems and other civil defense systems are major problems which hamper the preparedness of the government and other stakeholders to effectively tackle the problem of flooding and resultant health impacts.

Emergency response

The Disaster Prevention and Preparedness Agency's responses to emergencies in the Gambella region is hampered by a lack of boats, trained swimmers, life jackets, and shortages of medicine. Médécins Sans Frontières (MSF), a Swiss-based NGO, has played an important role in providing medicines to Itang Health Center. The process of buying medicine is bureaucratic and hampers the response efforts of the health services in

the region. The purchased medicine has to pass through many hierarchical channels and these delay the supply of medicines to affected populations.

'Water Maker' and 'Water Guard', tablets used to disinfect water, have been distributed to some flood-affected areas. However, according to the Environmental Health Officer in the region, the distribution of the disinfectant tablets did not cover all affected areas due to inaccessibility and an inadequate supply of tablets. In any case the disinfection was restricted to drinking water and did not take into account other domestic uses such cooking and bathing. 'Water Maker' and 'Water Guard' were donated by UNICEF. The flood-displaced people were forced to stay in temporary shelters such as schools and farm training centers. But these shelters lacked adequate basic sanitation facilities such as latrines and solid waste disposal containers. In response to this, there were some efforts by the Environmental Health Department and UNICEF to provide these people with basic sanitation facilities. UNICEF also provided some soap, pots, plastic plates, and blankets but not in sufficient quantities for all displaced people. The sanitation situation was exacerbated by overcrowding at the temporary facilities. The displaced people were living in overcrowded situations that increased the transmission of infectious diseases.

Recovery

Recovery efforts subsequent to flooding have been made in three main areas: rehabilitation of damaged water sources, psychological rehabilitation, and boosting food security within flood-affected communities. In the first instance, the focus has been to locate reservoirs and water sources at higher altitudes in anticipation of future hazards. Despite this effort, the allocated budget for the region does not allow any increase in the safe water supply coverage of the region. In the second instance, the thrust of recovery efforts centered on the provision of improved seeds and agricultural inputs to victims. Most farmers have little or no livelihood diversification. Therefore it is imperative that they are educated to embrace income diversification in order to decrease their risks. In the third instance, psychological rehabilitation has generally been pursued by churches such as Eastern Gambella Church, which mainly provides spiritual support to flood victims.

Conclusions and recommendations

The study has shown that flooding is a common problem in Gambella region. The findings also illustrate that the flood frequency and magnitude has increased rapidly in the last decade. The increase in flooding is a result of climate change as well as land-use change (particularly deforestation) following resettlement of people to the region from other drought-affected regions of Ethiopia. The main impacts of flooding on human health in the area are deaths, malaria, and diarrheal diseases. Another notable consequence of flooding is crop destruction and subsequent malnutrition. Despite these impacts, it was found that the current coping strategies against flood-related health risks in Gambella region show three major weaknesses: lack of flood-specific policy, little risk assessment, and weak institutional capacity. Due to these weaknesses, the management of flood events and their impacts on human health are often hampered. Therefore, it is imperative that the current weaknesses in the flood coping strategies are effectively tackled in order to sustainably address the impact of flooding on human health in the region. To achieve this, following recommendations are put forward:

1) A first priority is for the government to put in place policies that specifically address flooding and the management of flood-related impacts. In preparing such policies, government should encourage the participation of all stakeholders including flood-affected communities, NGOs, community-based organizations and religious leaders working in the area, together with governmental agencies and any other organization or individuals that are either affected or work with the flood-affected communities.
2) The government, while working with other stakeholders, should strive to strengthen institutional capacity in terms of training flood watch monitors and escape route wardens as a short-term measure. These volunteers can also be employed as first aid workers in the event of flooding. In the long term, qualified health professionals should be attracted to the area through the provision of incentives.
3) To reduce the health impacts of flooding, the government and other development partners should endeavor to provide a complete basic infrastructure including telecommunications, roads, and health facilities. All these are directly or indirectly important for flood disaster management, particularly for early warning, evacuation, and recovery.
4) Further research is needed in flood risk assessment in the region to aid in identifying systems at risk and for policy interventions.
5) It is essential to understand flood vulnerability at the household level, in terms of the coping strategies that they apply in dealing with flooding and flood health impacts, for inclusion in policy. Therefore, this study recommends further research on this subject area.

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