Hazard Early Warning Systems in Botswana: A Social Work Perspective

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ABSTRACT

The study aims at exploring hazard early warning systems in Botswana, their significance and the need for enhanced mechanisms to reduce the risk of disasters. Early warning systems prompt people to act in order to mitigate or prevent hazards from becoming disasters. They are essential to empower populations to respond and appropriately in order to reduce the risk of death, injury, loss of property or damage. Botswana is prone to various natural and man-made hazards such as drought, floods, windstorms, animal diseases, pest infestations and HIV and AIDS (Maripe, 2011). Between 1980 and 2010, the country experienced 14 natural disaster events which killed a total number of 686 people and affected 1,340,496. During the same reporting period, averages of 22 people were killed per year, 43,242 people were affected, and the number affected continues to increase over the years (UNISDR, 2011). In 2009, Botswana received heavy rainfall (100mm) with the most affected areas being Dukwi, Sua, Mmatshumu, Lephephe and Mosetse. The rationale for the present study arose from a realization that disasters are increasing in number and severity. Disaster is that part of ecological propensity which causes major "human hardship with significant discomfort" rather than expected. It is vital to note that the structure and functioning of early warning systems vary from one kind of hazard to the other in order to fit the population group/country that is at risk.
Keywords: Early warning systems, hazards, Botswana

INTRODUCTION

Drought is one of the major international constraints affecting food security and livelihoods of more than 2 billion people who reside in dry areas which constitute 41 per cent of the global land surface. Drought is defined as "a deficiency of precipitation over an extended period of time resulting in water scarcity" (UNISDR, 2011). Researchers must, therefore, strive to develop strategies to address the challenges experienced by people living in drought prone areas. Solh and Van (2014) argue that "coping with drought and water scarcity is critical to addressing major developmental challenges such as poverty, hunger, environmental degradation, and social conflict".

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Despite the fact that drought cannot be prevented, developing relevant strategies and preparedness programmes could help communities to better prepare to cope with the situation. This would entail developing resilient systems, improving drought recovery mechanisms and mitigating the impacts of drought. Drought preparedness strategies include geographical shift of agricultural systems, climate proofing rainfall based systems, developing efficient irrigation systems and expanding intermediate rain-fed irrigation techniques. Many countries, regions, and communities currently manage drought risk through reactive and crisis-driven approaches which reduce their viability and increase the negative effects of such natural disasters (WMO, 2006; UNISDR, 2011).

Botswana is a landlocked country in southern Africa. It lies roughly between latitudes 18 and 27ºS and longitudes 20 and 29ºE, a region covered by approximately 582,000 square kilometres with a population of more than 2 million people (CSO, 2011). The landscape is flat to gently; the Kalahari Desert, located in the southwest, covers nearly 70 percent of the country, with remaining areas being primarily tropical grassland and savanna. Botswana's climate is mainly semi-arid to arid because of its average position under the descending limb of the Hadley cell circulation (Batisani and Yamal, 2010). Almost all rainfall occurs during the summer months (November to March). In early summer, the interior thermal low and most northeasterly flow deepen, allowing upper westerly waves to bring isolated rainfall. In mid to late summer, tropical easterly systems and continental troughs edge into the country (Matarira and Jury, 1992). During these periods, most rainfall occurs in spells of 24 days with some heavy showers accounting for the bulk of the rainfall (Bhalotra, 1987). This climatic environment means that the presence or absence of specific weather systems make the difference between a wet or dry year (Matarira and Jury, 1992) thereby making Botswana prone to weather hazards, including floods, drought and veld fires.

Due to the intensity of the rainfall, flash floods are commonly experienced in different localities, although widespread flooding on a national scale sometimes occurs. For example, the combination of a tropical low in early February 2000 and a tropical depression later that month resulted in floods that ravaged the southern Africa sub-region, including Botswana, causing extensive damage to infrastructure and property (Botswana Government, 2002). Floods and drought are the most frequent natural disasters in Botswana; and they continue to cause socio-economic losses for the society. Therefore, there is need for early warning systems to be put in place in order to prevent or mitigate such potentially dangerous natural phenomena.

IMPACT OF DROUGHT AND FLOODS IN BOTSWANA

The rainfall pattern impacts the lives of Batswana in several ways. There have been severe floods and droughts in the past resulting in a great deal of human suffering. Rivers were subjected to many random influences such as rainfall

extremes, giving rise to flooding or drought (Hall and Dracup, 1970). The 1983/84 drought cost the Botswana Government US$ M51939 to mitigate its impact of drought (CSO, 2001). Most Batswana still depend on agriculture (commercial and subsistence) for both food and income and rainfall deficiency affects crop and livestock production. During the 1985 drought, there was a reduction of 87% in crop production (CSO, 2000). Moreover, the cattle birth rate is positively correlated to rainfall (Clark and Quin, 1949; Frisch and Vercoe, 1977; Frisch and Vercoe, 1984; King, 1983). Both the surface water and groundwater resources depend on rainfall for recharge. During the 1995 floods, areas severely affected were Palapye, Serowe, Mahalapye, and Botetiwith fatalities recorded in all. In five veterinary districts, 128 families were affected. They lost 26 head of cattle, 1 139 goats, 20 sheep, 90 donkeys and 3 535 chickens (CSO, 2000). Other floods in 2000, though relatively severe caused less damage.

DIMENSIONS OF DROUGHT IN BOTSWANA

Botswana is a drought prone country. Reasons for this are the semi-arid environment with its relatively low and variable supply of resources required by the society. There is high and steadily growing demand for such resources as a result of rising activity levels in the rural areas and also changes (or the lack thereof) in land use of systems and environmental resource management (Tsheko, 2003). Drought is more than just an unavoidable instance of climatic mishap occurring frequently in semiarid regions. Low rainfall becomes a drought when it leads to a shortage of food stuffs for which society has a demand (Sandford, 1977). In the context of Botswana's socio-economic structure, the two most crucial rainfall dependent commodities are cereals and grazing for its human and cattle population. Drought is defined as a period in which moisture availability falls below the current requirements of some or all of an area's resident communities and below their ability to sustain the deficit without damage, disruption or excessive costs (Hewitt and Burton, 1971). The groups that are vulnerable to drought in Botswana are:

A. Households which are:

1. Female headed with relatively low access to jobs, remittances or pensions;
2. Those with high economic dependency ratios consisting of few adults and many children as well as disabled and elderly members; and
3. Displaced families.

B. Age groups consisting of:

1. Children from birth to five years of age;
2. Children of primary school age;
3. Street children; and
4. The elderly with insufficient land, family support or state aid.

C. Employment groups:

1. The unemployed;
2. Seasonal workers on farms; and
3. Casual labourers in both urban and rural areas.

D. People who live in:

1. Remote areas with inadequate transport networks;
2. Water scarce areas;
3. Infertile and/or land scarce areas where the type/amount of available land is unable to support the population (Thompson, 1993).

Two distinct outcomes of drought have been identified as:

1. Reduced household income leading to a decline in food entitlements:
   - loss of income for the poorest households reduces their ability to obtain food;
   - rural households are particularly susceptible to the effects of drought as rain-fed agricultural activities contribute to household incomes.
2. The second outcome is capital losses whereby survival strategies of drought wracked households lead to the disposal of property, especially productive assets such as drought animals. Drought may have wide ranging effects on health including insufficient nutrition, infectious diseases and forest fires causing air pollution, particularly in low income communities.

DROUGHT MANAGEMENT

Drought management is a significant consideration for communities and individuals living in drought prone areas. There are several activities related to preparedness and recovery that could be carried out before and after the occurrence of drought. In order to respond in a positive manner the following should be planned; public information and education campaigns, emergency conservation programmes, restrictions on nonessential use of water, improvements in water systems, emergency sources of supply (for example, emergency interconnections and drilling new wells), management of available water resources. Increased emphasis can and should be placed on drought mitigation and preparedness, as well as prediction and early warning capabilities, if society is to reduce the economic and environmental damage associated with drought and its personal hardships. This will require interdisciplinary cooperation and a collaborative effort with policy makers at all levels.

FLOODS/RAINS

Floods in Botswana are caused by a number of factors. The most common are storm surges from sudden and heavy rains and overflow of dams and rivers resulting in spillage. The 1999/2000 floods which were sudden, caused by heavy rains, and covered a vast area of the country, are still regarded as the worst in Botswana's

known history. Furthermore in 2009 the country experienced another massive disaster when the Chobe and Northwest districts were engulfed in floods. The Okavango and Chobe rivers were overflowing into low lying plains that had been dormant for years (Mosate, 2010). The occurrence of heavy rains in the central region of Botswana in June 2009 caused seven districts to flood and affected a total of 620 families or 3100 individuals. The afflicted households were in mud dwellings that collapsed in the heavy rain, leaving families in need of emergency shelter, blankets, and food. Approximately 3 789 persons were affected in the flood-ravaged Ngamiland District, located in the northwest corner of the country. Between 7 and 10 June 2009, heavy rains flooded the seven districts of Serowe/ Palapye, Kweneng, Tutume, Boteti, North-west, Mahalapye and Bobirwa in central Botswana. The Southern African Development Community (SADCs) Regional Remote Sensing Unit confirms that the Department of Meteorology registered rainfall figures of more than 100mm in 24hours in that area.

The average annual rainfall for most of Botswana is less than 50mm (IFRC, 2009). Making reference to the National Disaster Management Office (NDMO), Mosate (2010) states that the floods in 2010 were worse than those of 2009 and the situation was compounded by the fact that the natural reservoirs were relatively full from the 2009 floods. However despite experiencing heavier floods in 2010 as compared to 2009 fewer families were displaced due to effective disaster risk reduction interventions which had been put in place. These measures included the allocation of plots on higher ground to previously affected families, and the building of more than 91 structures by the NDMO in the Okavango Sub District for some survivors. In January 2013 heavy rains caused extensive flooding in the central region of Botswana. At least 842 families (4210 persons) were affected, including 300 families that were displaced and 125 refugee families who were accommodated in tents in Dukwi camps. The torrential rains destroyed homes and roads, flooded dams and fields, and destroyed livestock and livelihoods. By 20th February, the flood waters had started to recede and people had gone back to their homes; however many were still in tents while they rebuilt their traditional mud houses (IFRC, 2013).

FLOOD WARNINGS

Theoretically, flood warnings can be viewed in terms of a system involving a complex array of interconnected components. Warning processes and responses involve at least the following steps: detection and estimation of hydro-meteorological conditions by either official or unofficial sources; collation and evaluation of hydro meteorological information; decisions on who should be warned about the flood danger, and in what way; transmission of warning messages through available communication channels; response to the warning message by the public and feedback from evaluation and action in relation to the warning of those affected (Thiemig, Roo and Gadain, 2011).

However, in order to be appropriate, this ideal flood warning system must be tailored to the individual region, with careful attention to climatic, economic, social, and political constraints. Hence, a warning system should integrate social factors that affect public response to the warnings. Understanding the processes of the system within a social context is essential to understanding its effectiveness.

EFFECTS OF FLOODS

Floods have significant social consequences for communities and individuals in general and Botswana is no exception. The impact of flooding includes loss of human lives, damage to property, destruction of crops, loss of livestock, and deterioration of health conditions owing to waterborne and other communicable diseases (Haines, Kovats, Campbell – Lendrum and Corvalan, 2006). Roads and bridges are damaged and movement of people from home to work is disrupted. Some economic activities come to a standstill: people are forced to vacate their homes and relocate to temporary shelter and normal life is interrupted. Damage to infrastructure also causes long term impacts, such as disruptions to supplies of clean water, wastewater treatment, electricity, transport, communication, education and health care. Communities can be left vulnerable, both socially and economically (Queensland government, 2004-2014; Apan *et al.* 2010)

Floods may also traumatize victims and their families for long periods of time. The loss of loved ones has deep impacts, especially on children and the surviving spouse. Displacement from one's home, loss of property, and disruption to business and social affairs can lead to continuing stress. For some people, the psychological impacts can be long lasting while for others they may be short term depending on the variations on the people's coping mechanisms and support within the social environment. Stress is a relational concept that reflects an imbalance between environmental demands and individual and social resources to cope with those demands. It is further argued that the effect of stressors results from the perceptions and responses to the stressors by the people involved (Israel and Schurman, 1990).

According to the Logistics Officer in the National Disaster Management Office, the flooding of the Okavango River in 2009 left more than 800 families displaced (Mosate, 2010). In 2010, 170 families were relocated to higher ground (Mosate, 2010). The floods that occurred in 2009 left private and government facilities, including water treatment plants, schools, and community halls, submerged. Roads and bridges were also destroyed and communities were cut off from the outside world. According to Mosate (2010) the villages that were affected by the floods in 2010 were Mohembo East, Nxamasere, Ikoga, Kauxi, Etsha 13, Eretsha, Tubu and Jao. Those people that were displaced were settled in safe, higher ground areas (Maripe, 2011). As the flooding occurred after most people had harvested their crops, the impact on the availability of food and livelihood was lower than it might have been. Out of these villages, Etsha, is

reported to have been the hardest hit by the floods as 94 households were affected. The families were assisted by the District Disaster Management Committee (DDMC) in Gumare. In Tubu, residents and pupils were left stranded as they were unable to access the school and the clinic as the floods had cut off the access road to the village.

FLOOD MANAGEMENT

The vulnerability to floods is expected to rise in the future due to climate change and the steady increase of population as well as urbanization (Kundzewicz, 2008). In Africa, the occurrence of severe flood events has increased noticeably over recent years, affecting millions of people, hampering economic development in the region, and exerting enormous pressure on the affected countries (EM-DAT 2010: Dartmouth Flood Observatory, 2010). Therefore, considerable effort has been exerted with regard to the mitigation of flood-induced damages in Africa over the last decade. It has been agreed that effective flood forecasting and early warning systems are an essential part of flood risk management as they provide additional preparation time prior to a flood event (Thiemig, Roo and Gadain, 2011). At present, there are a number of initiatives in place to extend flood forecasting and warning through continental or global-scale early warning systems. The European Flood Alert System (EFAS) – an advanced prototype of a continental flood alert system – is an example of such initiatives. EFAS uses several deterministic and ensemble weather forecasts to produce probabilistic flood alerts with lead times of up to 15 days (Thielen, Bartholmes and Ramos, 2009).

Systems such as EFAS may have potential for application in Africa. This is facilitated by the large-scale approach of the EFAS-underlying hydrological model LISFLOOD (Thielen *et al.* 2009), through its ability to cope with a limited amount of input data, the increased lead time of up to 15 days and its clear, concise and unambiguous visualization and decision support products. Such a continental system could facilitate flood management on a national level and also improve the coordination of international aid. For these reasons, the development of this type of system for Africa has recently gained increased attention in the political and scientific environment (European Union, 2007).

EARLY WARNING SYSTEMS

The United Nations International Strategy for Disaster Reduction (UNISDR, 2011) asserts that early warning information systems must be people and location centered and they should integrate four (4) elements, namely: knowledge of the risk faced, technical monitoring and warning service, dissemination of the meaningful warning to those at risk, and public awareness and preparedness. Furthermore, failure in any one of these elements can mean failure of the whole system. Based on past disaster experience of communities in Botswana, it is evident that early warnings play a vital role in the safety and resilience of people to disasters. Through the

1990s improved access to and greater effectiveness of early warning systems led to the accomplishment of the IDNDR objectives including the reduction of loss of life, property damage, and social and economic disruption (Apan, Keogh, Thomas, Mushtaq and Baddiley, 2010). This was achieved through concerted international action, especially in developing countries. From the beginning of the 1990s, it has been recognized by the United Nations Organization and professionals that early warning systems need to bring scientific and technical abilities of hazard identification and forecasting together with effective communication, the commitment of public policy, and the understanding and participation of local communities. Early warning systems are an important means of reducing disaster losses (Kuppers and Zschau, 2003). To be effective, such systems need to actively involve the communities at risk, facilitate public education on awareness of risks, effectively disseminate messages and warnings and ensure that there is constant preparedness. United Nations (2005-2015) clearly spells out the need to have early warning systems whose warnings are timely and understandable to those at risk including guidance on how to act upon receiving warning.

Damage caused by disaster can be effectively contained if relevant warnings are given and communicated to disaster management departments, decision making officials, and all those who might be affected by animminent disaster or tragic event. If the correct decisions are made and carried out to ensure that everyone is aware of and prepared for the event, the outcome will be more positive. Preparation includes emergency evacuation of people and variables and training the population in actions to be taken when facing a disaster, for example, hiding, self-protection, and first aids skills. Disaster management committees in China have established their specific monitoring and early warning systems, which have been evaluated overtime. Each of these four networks consists of the following 4 (four) component parts:

1. The network for observation of natural hazards, relevant elements, and phenomena;
2. The telecommunications system for real time collection, transmission, and exchange of the observation data;
3. The system for data processing, analysis and diagnosis, modelling, and formulation of forecasts or warnings, and
4. The system for services, including the transmission and dissemination of such forecasts or warnings.

The early warning process has three inter-related stages (Smith, 1996):

1. Evaluation/forecasting (observation and prediction) is based on scientific expertise and advanced technologies such as mathematical modeling, and remote sensing. A large amount of effort and many resources should be invested in this stage, resulting in significant advances in some areas of forecasting. This is the scientific and technical dimension of an early warning system.

2. Warning/dissemination is where forecasts are turned into messages and transmitted by appropriate agencies as recommendations for action. There should be considerable investment in this stage as well. In particular, rapid advances in communications technology have greatly improved the speed in which warnings are transmitted. Early warning requires institutional and political characteristics.
3. Response is where warnings are turned into actions. The actors in this process are more numerous and diverse. They include officials at the national and local level, non-governmental organizations (NGOs), communities and individuals. This stage sees the institutional and political aspects of early warning broadening out and the early warning process acquiring an essentially social dimension where the 'human factor' of risk perception and decision making plays a crucial role. Internationally, it has not received as much investment as the first two stages.

Key elements in the success of an early warning system should be appreciated by countries such as Botswana.

(i) Forecasts must be accurate in predicting the location, time, and severity of a hazardous event.
(ii) Warnings must be disseminated in time for populations at risk to ensure safety.

Early warning could be more effective if the threatened population is made aware of the hazards they face and communication based approaches in disaster preparedness are put into practice. There is pressing need to accurately predict hazards and reduce the devastating effects of disasters. Early warning is an important activity within the general scope of disaster preparedness. Early warning is issued only after detecting the forthcoming hazard based on careful analysis of geological, meteorological, and atmospheric interactions and processes. Monitoring and predicting hazards involves scientific and technical skills, knowledge, and expertise. Issuing alerts involves communicating the forecast by translating the findings into terms understandable by the general public. Comai and Tena (2007) argue that "an early warning system sets the framework for a systematic process of gathering and analyzing data, based on several indicators defined by the organization and prepared after reviewing the different key actors in a specific environment".

THE GENERAL BENEFITS OF EARLY WARNINGS

Early warning saves lives and property. As a result people are more likely to evacuate to safety and take precautionary measures without undue resistance and delays. Early warnings enable individuals and groups to arrange their lives in relation to the hazards within their environment. Mozambique, which has suffered severely from seven major floods caused by hurricanes and tropical cyclones and droughts since 1980, has drastically reduced the loss of lives and property by

establishing early warning systems. Mozambique flood forecasting is coordinated by the National Directorate of Water, the National Institute of Meteorology, and National Disaster Management Institute. It provides forecasts of flood risk, detects and monitors flooding, and puts out flood warnings paving the way for a coordinated response (Muianga, 2007). Thus it is vital to invest in early warning systems to save lives and help protect property. Timely warnings, effective communication, and appropriate response will permit a country's economy to rebound more effectively from hazards. Hellmuth (2007) argues that reducing uncertainty caused by vulnerability to climate variation could have a direct, positive effect on people's livelihoods.

It is a known fact that countries (even those that are afflicted by poverty) are capable of reducing the death toll, moving food to avert a famine despite drought, and providing early warning systems to reduce death from storms and floods. However, in general, the evidence suggests that more is spent on relief than on prevention and that this is a public preference despite the evidence that indicates investment in prevention is more valuable than spending on relief (Healy and Malhotra, 2009).

Early warnings give people time to flee from a flash flood; enable local authorities to evacuate or shelter large numbers of people in advance; provide information on the occurrence of a public health hazard; and enable a faster response to problems of food and water insecurity. Warnings issued well before an event also enable people to protect property and infrastructure. In general, the longer the lead time, the greater amount of protection that can be ensured.

ROLE OF SOCIAL WORK

Social work as a multi-faceted profession plays a vital role in disaster risk management and/or problems that emerge from disasters such as drought, heavy rain, and floods. Social workers can be *inter alia* counsellors, educators, policy makers, and coordinators. They play a potentially key role in disaster recovery by facilitating community development, restoring livelihoods, providing psychosocial support, and building capacity in local communities. The social work profession has long been involved with disaster relief, both through the profession's roots in the provision of wartime relief and its concern with the physical environment of people. Beginning with the US Civil War and continuing with the formal role of social workers in Vet Centers in USA, social workers have helped treat the trauma resulting from wartime disaster deployment (Pryce J. and Pryce D., 2000).

Just as prevention is part of the mission of the social work profession, disaster social work is concerned with intervention in the social and physical environments of individuals and groups as a means of preventing serious long-term social and physical and mental health problems after disaster events (Rogge, 2003). Individuals, families, and communities suffer trauma and debilitation in every dimension of their daily lives from the loss of life and health, community

infrastructure, property, jobs, personal belongings, and social ties (Dukfa, 1988; Zakour, 1996). For social workers, the focal point of disaster management involvement should be to minimize risks, maximize resources, and streamline administrative processes for vulnerable populations (Karanci and Aksit, 2000; Zakour, 2000). In social work research, disasters are seen as a type of collective stress situation, in which many individuals fail to have their needs met through societal processes (Barton, 1969). Disasters are distinguished from other types of collective stress because; first and foremost disasters are crisis situations (Quarantelli, 1998). Social work intervenes in disaster management in different ways that affect individuals, families, organizations, and communities. Hence, social work practice could take the form of clinical, group and community practice, or social policy and planning (Tan, 2009). Areas of concern for social work in disaster situations include coping with trauma, stress, resource mobilization for disadvantaged and vulnerable groups, and coordination of various intervention systems (Pyles, 2007).

The profession of social work could play a vital role in enhancing community participation by using its methods and techniques, devoted to enhancing human well-being in helping to meet the basic human needs of all people, with particular attention to the needs and empowerment of those who are most vulnerable, oppressed, and or living in poverty (Mathbor, 2007). There is also a need to build capacity in the social work profession for the integration of social, economic, and environmental dimensions in policy and practice, and to develop curricula to better prepare social workers for the challenges ahead.

CONCLUSION AND RECOMMENDATIONS

It should be the responsibility of the social work profession to reduce the risk of disasters occasioned by drought and floods and the impact on vulnerable populations in Botswana and worldwide. This will require the application of appropriate comprehensive interventions that will aim at improving the well-being of individuals, families, and communities and build resiliency. In summary social work functions can be to: provide support for individuals and families; link individual's needs and resources and help the clients to access resources; prevent severe physical and mental problems; prevent individuals, families, groups, organizations, communities from breaking down; intervene to change micro and macro systems to improve clients' well-being.

Social work as a profession should play a vital role in mitigating and managing disasters at individual, family, and community level and become a key player in disaster recovery plan. Social workers should work with community members to identify areas that are prone to flood and drought risks as well as groups within the community that are the most susceptible in this regard. They should map the capacities, vulnerabilities and factors that promote vulnerability

in order to define community interventions geared towards reducing the impact of disasters. In addition, to establish community action teams that will conduct community education and awareness, design early warning codes, establish response systems, monitor the changing patterns of hazards and risks, and compile information on the successes and failures of interventions for good practice.

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