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Housing Vulnerability, Resilience and Adaptation Strategies to Flood Hazard: A Study of Shiroro Town in Niger State, North Central Nigeria

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Abstract

This study explores housing vulnerability and resilience to flood in Shiroro, a rural community in Niger State, North Central Nigeria. It exposes the flood challenge and coping strategies that typifies communities in river plane and dam water ways. The research method employed is qualitative, descriptive and analytical. Among the research instruments used were questionnaires and focused group discussion to probe into the menace of flood in the community. The findings indicate that the people use mostly local technology and expertise in dealing with the challenge. Many of the coping strategies are rudimentary and require little or no skills to put in place. The study noted that because the flood challenge will not go away, a comprehensive flood risk assessment should be put in place as a first step in dealing with the problem.

Keywords: adaptation, flood, resilience, river plain, vulnerability

1. Introduction

Flood is a global hazard. It transcends national and international borders, leaving in its trail, widespread destruction to life and property. No part of the globe is spared of this menace. Flood originating from one country can travel several thousands of kilometers to cause damage elsewhere. As a result of this, countries have to cope with not only flood from within their borders but also from outside.

Though the destructive impact of flood is felt in all sectors, its impact on housing is very disturbing. This is because a house is often a family's most prized possession. It is often the first serious investment by a family. However, it is immobile and cannot get out of the way of approaching flood. When flood takes its toll on housing on a large-scale, an equally large scale displacement of persons occurs.

This paper seeks to explore flood threat in Shiroro town, extent of the disaster risk, the town's vulnerability, resilience and adaptation strategies to flood threat in the area of domestic architecture. It is an exploratory study that probes into individual, family and communal adjustments in their continuous struggle against a common adversary that instead of going away, is increasing in intensity and spread.

1.1 Objectives of the study are:

i. To analyze the flood risk Shiroro town faces

ii. To undertake an assessment of the adequacy or otherwise of responses to the threat.

iii. To undertake a vulnerability and capacities assessment of the identified most vulnerable settlement in the town.

iv. To highlight the plight of the community and bring their condition to the knowledge of the authorities.

2.0 Literature Review

2.1 Theoretical Concepts

2.1.1 Hazard

The United Nations International Strategy for Disaster Reduction (UNISDR 2004a,b, 2005a,b; 2007a,b) defined a hazard as a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic destruction or environmental degradation. This definition

throws up hazard as a physical event whose origin could be from natural or human processes. Therefore hazards could be classified based on their origin.

Hazards originating from human processes are classified either as technological hazards or social violence (Hewitt, 1997). Technological hazard is accidental failures of design or management relating to large scale structures, transport systems or industrial processes that may cause the loss of life, injury, property or environmental damage on a large scale (Smith, 2005). On the other hand, social violence includes the weapons used (firearms, nuclear gas, biological, chemical warfare) during the type of violence (war, terrorism, subversion, sabotage, genocide, coup) by whom (armed forces, governments, terrorist groups, rebels) and how they are carried out (Hewitt 1997).

National hazards are classified according to the sphere of the earth they occur. These include the atmosphere, hydrosphere, lithosphere, cryosphere and biosphere. Table 1.1 shows a classification of hazards with natural origins, their types, physical forms and events. Flood hazard falls under the hydrosphere family as can be seen in the table.

Table 1.1: Classification of hazards with natural origins

Earth System's Sphere	Hazard Type	Physical Forms or Events
Atmosphere	Atmospheric Hazards: Temperature, fog, rain, strong winds, lighting, hail, snowfall, freezing rain (glaze)	Thunder/hailstorms, tornadoes, rain and wind storms, tropical cyclones, blizzards, glaze storms.
Hydrosphere	Hydrological hazards: Runoff (overland, stream) snow on the ground, ground water, freeze-thaw, sea ice, icebergs.	Floods (of different types), glacier advance and 'surges', ice-infested waters.
Hazards of the type originating from either the atmosphere or hydrosphere are commonly referred to as hydro meteorological hazards (see UNISDR, 2004a)		
Lithosphere And Cryosphere	Geological/Geomorphological hazards: Seismicity, volcanoes, tsunami (seismic sea wave), earth/rock materials (quickclay, quicksand), mass movements, radioactivity, geothermal heat.	Earthquakes, volcanic eruptions, rockslides, rock avalanches, debris and mud flows, submarine slides, subsidence, domestic radon gas hazards.
Biosphere	Biological and disease hazards (processes of organic origin or those conveyed by biological vectors [UNISDR, 2004a]): Viruses (e.g. measles, HIV), bacteria (e.g. pneumonia), protozoa (e.g. giardia, malaria), fungal (e.g. pneumocystas), algae, plants ('weeds), insects ('pests'), animals ('pests')	Disease outbreaks/epidemics: Bubonic plague, yellow fever, influenza pandemics, sexually transmitted diseases, 'red tide' (toxic algal bloom), plant infestations, 'invasions', insect plagues/infestations, locust/grasshopper plagues, rat infestations, shellfish poisonings.

Source: Hewitt 1997

As earlier noted, a hazard is a physical phenomenon. Therefore in discussing a hazard, its location, intensity, frequency and probability of occurrence are considered. Hewitt, (1997) further classified hazard into its spatial dimension (area/ extent or reach of coverage), temporal dimension (rate of onset, how fast or slowly it occurs its duration and frequency) and compound parameters.

Apart from the natural and manmade hazards already noted, Smith, (2004) added a third group he called "NA-Tech" hazards. He explained that this is a hybrid of the natural and technological hazards. He further argued that these environmental hazards are created when natural hazards are heavily influenced by technology and the failures thereof. These na-tech hazards or context hazards result from global environmental change (international air pollution and resultant oxygen change, environmental degradation, land pressure, urbanization).

Mustapha, (2005), noted that various physical, social and technological factors intersect to make flood hazard a "hybrid hazard." Furthermore, he argues that a flood hazard analysis cannot only consider the natural physical parameters, but should also consider the hazardscape.

2.1.2 Disaster Risk and Vulnerability

Disaster connotes loss of a huge proportion, normally caused by a hazard. Risk refers to the probability of a hazard occurring and creating loss (Smith, 2004). It is the chance (within a time frame) of an adverse event with specific consequences. Disaster risk therefore refers to the probability of harmful consequences, or experienced losses resulting from the interaction between natural or human induced hazard with the physical, environmental, social and economic vulnerabilities of society (UNISDR, 2004a and 2005a).

Vulnerability refers to the inherent conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of a community to the impact of hazard (UNISDR 2004a). Wisner et al (2004) noted that a disaster cannot occur if it exists but there is no vulnerability or if vulnerability exists but no hazard. O'Brien et al (2006) argues that risk to a human population is determined by the frequency of a hazard event, its intensity and people's vulnerability. UNISDR (2004a and 2005a) sums up their relationship with this equation.

Disaster Risk (DR) = Hazard (H) and vulnerability (V).

2.1.3 Coping and Adaptation.

These refer to disaster reduction strategies. Burton et al (2006) saw coping as either adaptation (biological or cultural adaptations) or adjustments (incidental and purposeful). In any of the above, coping or adaptation to climate change in this case manifested through flood involves some form of adjustments to flood disaster risk. Coping or coping strategies to flood risk therefore allude to a stressful situation being ameliorated.

Satterthwaite et al, (2007) sees adaptation as actual adjustments made from a range of possible choices. These range of possible choices are all geared towards mitigating the severity of disaster and they come under the term preparedness planning.

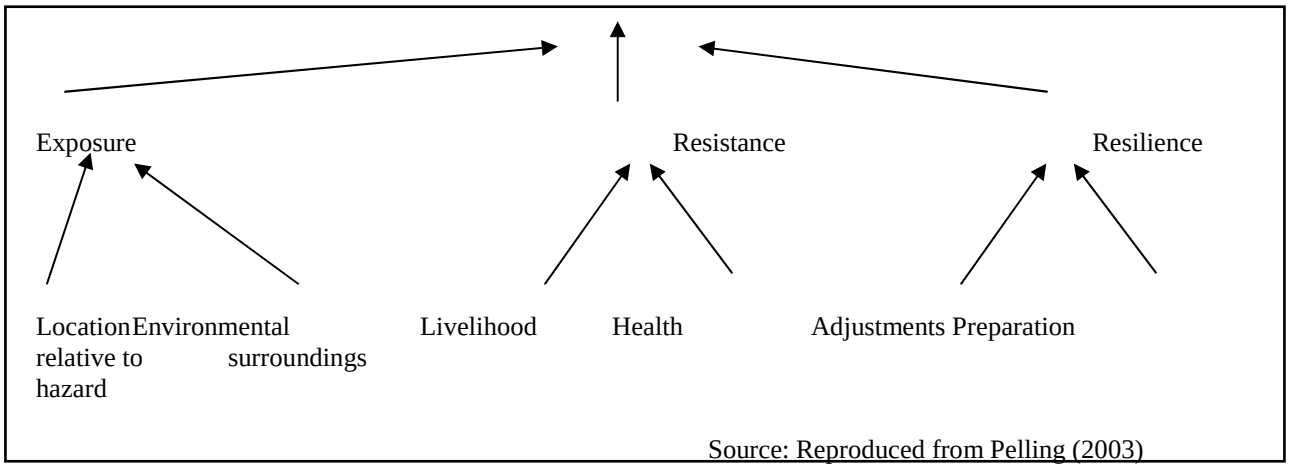
Preparedness planning comprises of a variety of measures that include emergency planning, early warning and specific actions taken to reduce risk (Asian Disaster Preparedness Centre ADPC 2005). Preparedness in this case involves flood response and emergency planning, flood forecasting and early warning and review of plans. Public awareness of flood risk is also an important component of preparedness.

2.1.4 Exposure, Resistance and Adjustments

Pelling, (2003) building on the work of Blaikie et al, (1994) divided vulnerability into three components: exposure, resistance and resilience. He further postulated that each of these components is made up of two products viz:-

- Exposure is the product of physical location and the character of the surrounding built and natural environment.
- Resistance is the product of economic, psychological and physical health and their system of maintenance and represents the capacity of an individual or group of people to withstand the impact of a hazard.
- Resilience to hazard is the ability of an actor to cope with or adapt to hazard stress. It is a product of the degree of planned preparedness undertaken in the light of potential hazard and of spontaneous or premeditated adjustments made in response to felt hazard, including relief and rescue see fig 2.1

Figure 2.1:Pelling's Human Vulnerability Framework Human Vulnerability



Source: Reproduced from Pelling (2003)

2.2 The Concept of Housing.

Housing as a concept goes beyond shelter. It includes all the social services and utilities that go to make a community or neighbourhood a liveable environment. The shelter alone is only a part of a bigger assemblage of interrelated elements. Housing in turn is part of a large assemblage: a city, a settlement or a built environment.

Several concept of housing exit, but the focus here is riverine community housing concept. Here a variant of mixed use housing concept where the house serves several purposes is mostly employed. It is a unique variant of mixed use concept, defined by water as both the source of livelihood and the harbinger of death.

A riverine community is often spatially and socially integrated. The community live a life of unity and their relationship is governed by specific social practices connected by proximity. Due to huge deficit in modern infrastructure, the community depends on nature for sustenance.

2.3 The Concept of Flood.

Flood is too much water in the wrong place, whether it is an inundated city or a single drain.

Flooding is the unusual presence of water on land to an intensity which has an effect on normal activities. Flooding arise mainly due to overflowing rivers and heavy rainfall over a short duration. An unusual inflow of sea water onto land is called ocean flooding. Ocean flooding can be caused by storms such as hurricanes (storm surge), high tides (tide flooding), seismic events or large landslides (sometimes also called tsunami).

Many definitions of floods have been made by various writers. (Olujimi, 2007) defined a flood is an overflow of water that submerges land. The European Union (EU) Floods Directive defines a flood as a covering by water of land not normally covered by water (Ologunorisa, 2004). In the sense of "flowing water", the word may also be applied to the inflow of the tide. Flooding may result from the volume of water within a body of water, such as a river or lake, which overflows or breaks levees, with the result that some of the water escapes its usual boundaries, or may be due to accumulation of rainwater on saturated ground in an area (Olujimi, 2007). While the size of a lake or other body of water will vary with seasonal changes in precipitation and snow melt, it is not a significant flood unless such escapes of water endanger land areas used by man like a village, city or other inhabited area.

2.4 Climate Change and Flood.

Climate change refers to the noticeable changes in global climate patterns in the last century. The causative factor is the increase in the quantity of green house gases in the atmosphere. This increase has caused more heat than before to be trapped in the earth's atmosphere, making it hotter than before. From historical temperature readings, every year on the average gets hotter than before (Adger, 2012). This increase in the near surface temperature of the Earth is called global warming.

One of the consequences of this global warming is seen in the world's water bodies. The rise in temperature has led to huge icebergs in the arctic regions melting (glacier melt in the polar regions of Antarctica) filling seas and rivers they flow into. As a result, sea levels rise with its attendant consequences which include fiercer weather, increased frequency and intensity of storms, hurricanes and heavy downpour.

All these lead to flood. This is the connection between climate change and flood. It means that the more extreme the weather gets, the more flood that will be experienced. Flood is transnational as it travels from one country to another, destroying on its journey farmlands, property, infrastructure, residences, people and livestock. This flood which are transcontinental and caused by glacial melt is called Galactic flood. (Okereke 2012).

2.5 Housing Settlements in Flood Prone Areas.

Due to huge supply deficit of urban land, people tend to settle on any available urban land despite the risks or hazards. As time went by and with rapid urbanization, even very difficult terrains in urban areas are built on by people. These difficult and risky terrains include flood plains. Therefore historically, Nigerian flood plains have always attracted settlement and today, they are no less in demand to meet the needs of urban expansion, posing risks to these relatively heavily populated settlements.

In the Northern part of Nigeria, the population is mostly agrarian. Those involved in the fishing sectors of the agrarian industry naturally settled along river banks and tributaries which are naturally flood prone. Also due to desertification, the segment of the population involved in livestock rearing necessarily have to live along river banks so that they can find enough water for their flocks. Again to facilitate movement of agricultural produce from the farms to the towns by boats and canoes, people were also attracted to settle along flood plains.

Another strong motivation to building along river flood plain is peoples desire for the pleasant view of the river from their homes. This desire to enjoy the rivers and live near them accounts for the some of the world's most valuable real estates being found in cities and towns along river flood plains.

Perhaps the strongest attraction to settlements along flood plains especially in Nigeria is peoples' strong affinity to flood plains in a claimed reverence to their ancestral heritage. This emotional attachment to ancestral areas of habitation is fueled by the cultural/religious attachment to ancestors, deities and sacred places including sacred lands. Hence all entreaties to such persons on the risk of settling in these risky areas pales into insignificance when juxtaposed by their strong emotional attachment to these areas.

3.0 Research Methodology

3.1 Type of Research

The research employs qualitative methods that draw from both primary and secondary sources. These methods are used to asses housing and flood hazard at both macro (settlement) and micro (household) scale. The methods were also used to access household flood vulnerability and resilience inputs that are undertaken in response to the risk.

The flood hazard during the flooding season was experienced in different physical forms by residents. These different physical forms were described during a focus group discussion with community leaders and the people. Transect works through the nooks and crannies of the community provided more insight and additional perspectives. Site observations afforded the researcher with on the spot the opportunity to see what the people were trying to say during the discussions. Photographs were taken to document these realities.

3.2 Methodology.

The research methodology involved the following sequence of steps:

Step i: Assessment of the river flood plain community's history of flood challenges.

Step ii: Assessment of the damage on the community during the 2012 Nigerian flood.

Step iii: Assessment of the settlements flood vulnerability.

Step iv: Assessment of households floods vulnerability and resilience.

Step v: Determining house hold risk levels.

3.3 Fieldwork

Fieldwork for this study was carried out on 24th September, 2013 by a team comprising of the author, two senior research assistants and two junior research assistants. The senior research assistant were carefully chosen as a result of their rich experience on research while the junior assistant were chosen due to their familiarity with the geographical location of the research areas, the language and culture of the people.

The means of transport used were motor vehicles, boats and motorcycles. These were alternated as the field situation required.

4.0 The Study Area.

The study area is Shiroro town in Lakpma Local Government Area of Niger State. The town is located on latitude 9.96° North and Longitude 6.84° East. It is about 60 kilometers east of Minna, the capital city of Niger State.

Shiroro town lies on the bank of Shiroro river, a 12.8 kilometer stretch of running water. Shiroro River is a tributary of river Kaduna, River Kaduna itself is a tributary of river Niger. A unique feature of Shiroro town is the presence of the Shiroro Dam which powers the Shiroro Hydro Electric Station, a 600 mega watts installed capacity station. Both the Shiroro River and the dam water channel converge. The extent of flooding of Shiroro Community when the river Shiroro bursts its banks (which often occurs) is serious. It is devastating when one or two of the four spill ways of the dam is opened (as also occasionally happens). It is noteworthy that in the history of the dam, the four spill ways have never been opened at the same time. It is feared that the entire Shiroro Community may be submerged in the ensuing flooding.

5.0 Discussions of Findings,

5.1 Flood Risk Reduction Strategies in Shiroro Town

Flood risk reduction strategies in Shiroro town can be classified into two:-

Structural and nonstructural. Structural measures involve building of physical structures to avoid flooding of the houses or part thereof. Non structural measures are the peoples behavioural responses to the threat of flood. Unfortunately, while attention through structural and non structural measures are focused towards protecting individual dwellings, little or nothing is being done to avoid flooding of the flood plain where the flood risk originates. It appears as if the people have concluded that the flood risk cannot go away and have resolved to live with it.

One interesting finding is the communal participation in selecting viable structural solutions to the flood risk. After each flooding session (which takes place every rainy season or when the dam's spillways are opened), a communal task force goes round to assess the viability of the resilience measures earlier put in place. Those measures that did not measure up to the flood are discarded while those that served their purpose are continued in the flood risk challenge.

Predictably, it was discovered that the vulnerability of the dwellings decreases with increasing distance from the river channel. This much was also evident from the 2012 flood when dwellings nearer the river experienced more flood damage than those further off. This was same on both sides of the river channel. Also terrain elevations were a major factor. Houses whose terrain levels in relation to the river bed were high did not experience much flooding even when they were close to the river bed.

5.2 Structural Measures

The focus of the structural measure is the use of local technology and expertise. In these measures, no real planning goes into their implementation. They involve such actions that are rudimentary and require little or no technical skills and can be achieved using very basic resources (financial, technological and human resources). They are simply additions that result from impulsive responses to flood risk.

i. **Bye-Pass Channels and Floodways**.

This involves using open channels to divert water elsewhere. These diversion systems serve two purposes: While diverting water away from the houses, they channel the water towards water reservoirs or wetland areas for wetland cultivation. The stored water could be used to water their livestock or domestic purpose.

Though this measure is very effective in controlling flood risk, it has sever limitations. First, flood channels are limited by topography. Secondly households living in low lying lands towards the end of the diverted water become vulnerable to flooding. Thirdly, often the diverted water over flows the banks of the channel and flood households and farmlands on both sides of the channel. Another very sever limitation to this protection system is that it becomes extremely vulnerable to larger than normal floods and the water easily burst the banks of the channels.

ii. **Flood Proofing**

Flood proofing involves adjusting or modifying the design of individual structures to reduce flood damages. Various flood proofing measures were observed:-

- **Elevation**: Raising the building above the flood by short mud piles (especially their granaries)
- **Land Fill**: Filling up an areas of land with sand to create an elevated platform upon which to erect building.
- **Flood walls**: Using sandcrete mortar to plaster mud walls to protect the mud walls from soaking water.
- **Dry Flood Proofing**: Sealing the property to prevent flood water from entering using water proof sheets, shields, sand bags and other materials that prevent water from entering.
- **Concrete Apron around mud wall bases**: This was found particularly helpful in keeping flood water away from wall bases that otherwise would soak and seep into the building.
- **Extended Roof Eaves**:Extended roof over hangs were particularly helpful in keeping out rain water from the mud walls thereby keeping water off the walls.

Limitations of Flood Proofing

Interactions with the community revealed a lot of limitations and disadvantages with flood proofing. First, when the flood water is fast moving or violent as is often the case, most flood proofing measures fail. Secondly, they complained about the labour involved with some flood proofing measures like landfill where they have to go and fetch the right type of sand from afar and transport it on their heads. Again land fill flood proofing may divert flood water causing flooding elsewhere. The conclusion was that flood proofing helps only in mild, low level and non violent flood.

iii. Demolition.

This involves demolishing a damaged property and rebuilding it more securely on the same site or on a safer location.

5.3 Non Structural Measures

The non structural measures aim to keep people and their property away from floods

i Maintenance of a watershed.

A watershed is an area of land that drains water to a stream river or lake. It is normally an elevated area higher than adjoining lands, normally dry as it is well drained. Such a watershed is kept and maintained by the Shiroro Community.

By a communal agreement, farming is prohibited on this land. It is a communal land and belongs to nobody in particular. In times of extreme weather conditions (sever flooding) the entire community and their livestock by common consent assembly on this watershed, awaiting the receding of the flood water. When this happens, they can go back to the houses, salvage whatever is salvageable, pick up the pieces of their lives and wait for another flood.

ii. Relocation

Even though this also involves temporarily moving away from the flooded area, it is different from moving to a watershed as this one involves moving upland and building temporary homes in the new place, staying there for days, even weeks if need be, waiting for the flood waters to recede.

iii. Mobile Chicken House:

As part of non structural measure, some of their chicken houses are not fixed on the ground. When there is a flood threat, they are easily picked up and taken to a safer place, sometimes on the roof of their houses.

iv. Closure of School:

As part of measures to avert losses due to flood, communal schools are often closed during threat of flood and reopened when the threat ceases to exist.

Plate I: Bye-Pass Channel and Floodway
Source: Authors' Field Work 2013

Plate II: Raising the building above flood level with short mud piles
Source: Authors' Field Work 2013

Plate III: Filling the land with sand to create elevated plat form for building
Source: Authors' Field Work 2013

Plate VII: Extended roof eaves
Source: Authors' Field Work 2013

Plate IV: Plastering mud wall with sandcrete mortar
Source: Authors' Field Work 2013

Plate VIII: Watershed at the background
Source: Authors' Field Work 2013

Plate V: Dry flood proofing with waterproof sheet
Source: Authors' Field Work 2013

Plate IX: Chicken houses hung on the eaves of roof
Source: Authors' Field Work 2013

Plate VI: Concrete Apron around mud wall bases
Source: Authors' Field Work 2013

Plate X: Closure of school
Source: Authors' Field Work 2013

6.0 Conclusion and Recommendation

6.1 Conclusion.

The research area of this study, Shiroro town presents an typical example of the nature of flood risk and flood damages faced by riverine communities and communities along dam water channel. Here both the Shiroro river and the Shiroro dam combine to present the town flooding hazardcape challenges of ponding, over land surface run off, seepage, riverine/stream flooding, wetland flooding, storm water run-off and rain water leakage. Though the main challenge is the conventional flooding caused by the river over flooding its banks and dam water discharge, those other forms relatively overlooked for their insignificance in terms of scale (leakage, ponding, seapage) often pose major discomfort and interruptions to households and they are the ones that occur more frequently.

The findings showed that residents implemented different measures to their dwellings that assisted in reducing the impact of the flood. Most of the measures were purpose made additions to their already built dwelling being threatened by flood. The findings further confirm that building flood resilience dwellings is preferred by the people to relocation. This is because as they put it, their livelihood revolves around the water: farming, fishing, transport and ancestral history.

6.2 Recommendations.

The flood challenge in Shiroro town is an ever present threat that will not go away. Instead, climate change and poor management of the country's inland water ways will exacerbate it. It therefore requires an integrated broad based approach to manage. Government, the community, individuals and other stake holders like the dam authorities must be involved.

A comprehensive flood risk assessment should be the starting point. Conceptualization of this assessment must be broad based to include not only the physical dimensions of the threat, but also the social and economic parameters. In this way, an all inclusive assessment that will cover all areas of the challenge will emerge.

The findings of this risk assessment should inform mitigation, preparedness, response and resilience strategies. These strategies will involve both physical and nonphysical measures that consider local techniques as well as social adjustments that include local and appropriate social protection mechanisms.

Risk reduction should follow risk assessment. Since floods cannot be eliminated, their impacts can be reduced through appropriate planning and engineering solutions. In the case of Shiroro Community, better waterway management and improved dam management will certainly reduce the flood risk.

Particularly important here is information and warning from the dam authorities. Impending release of water information channels should be improved so that early warnings reach the district heads and community leaders for instant dissemination to all in a clear language. District heads during the focused group discussion complained that warning messages either reached them late, was often ambiguous or did not reach them at all. Therefore warnings about dam water release should be communicated to the local community in a timely and appropriate manner.

It is recommended here that ward councilors, ward committee members, community leaders, religious leaders and residents association heads be appointed information point persons. These point persons should then communicate the message to their broader community via town criers or runners that can go door to door with the information.

A communal joint operations task force (JOTF) should be set up. This should be a rapid response task force that is capable of co-ordinating responses to any perceived flood threat. Due to poverty, many households may be unable to respond appropriately to a flood threat. This taskforce should be able to assist vulnerable households to respond as appropriate.

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