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Appraisal of Knowledge, Perceptions and Adaptation to Flood Risks in the Downstream Section of River Niger Flood Plain in Mokwa Local Government Area of Niger State

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Abstract

Flood is a well-known phenomenon in the flood plain of River Niger that has continues to pose serious multiple threats to the inhabitants. Despite the risk involved, the communities continue to occupy the area using their creative set of profound local knowledge, perceptions and adaptive initiatives, because of its economic benefits. However, existing approaches to flood risk reduction and management by stakeholders at local levels over the years have not produced the desired results. This is partly because of the conventional conceptualization by the stakeholders that has overlooked and ignored local knowledge, perceptions and adaptive initiatives in the management of flood plain areas. This neglect is partly due to the lack of real evidence base to understand the importance of local knowledge, perceptions and adaptive initiatives of flood plain communities. Hence, the search to identify this evidence base to understand the importance of this initiatives of flood plain communities has prompted the need for this study. The study however, identify and appraises the community's knowledge, perceptions and adaptation initiatives with a view to understanding it importance to flood risk management for safer floodplain habitation. In order to achieve this, the research adopted mixed methods (quantitative and qualitative) for data collection. There are 46 settlements with 26,851persons in area. Nine (9) settlements were selected using purposive sampling and 392 respondents with 15 interviews and 9 FGDs participants were used. The respondents include the household heads while interviews and FGDs involves village heads, members of Community associations, elderly community members, religious leaders, lead farmers and youth representatives. The participants were selected systematically in consultation with Village Heads. The findings indicated that communities have a good deal of knowledge and experience regarding local risk and hazards in the floodplain area and have developed forecasting techniques to predict flood occurrence and adaptive initiatives to manage the conditions at the household and community levels. Significant variations in residents' perceptions of risk and what makes them vulnerable in the floodplain have developed between geographical locations in the rural setting (i.e. farmers and fisher men), and among different socio-economic groups (i.e. age, income and employment characteristics). Recommendations highlighted the need for integration of the diversity of the identified local knowledge and adaptive initiatives with the scientific or conventional knowledge. The Government and Community Based organizations (CBOs) dealing with flood disasters in the flood plain area should focus on preparedness by enhancing local adaptive capacities on protection measures in anticipation of future flood events. Flood warning activities tailored to local social contexts will be instrumental in reducing risk and strengthening capacity of the affected communities to respond more effectively to flood emergencies.

Keywords*: Flood risk, Vulnerability, Local knowledge, Perception, Adaptation Initiatives*

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Background to the Study

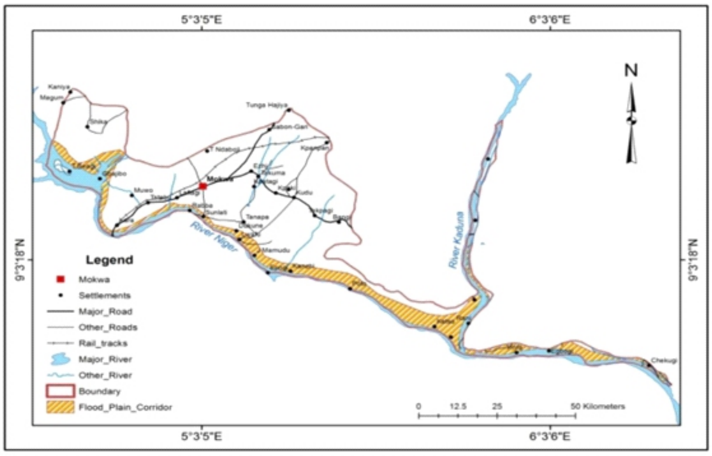
Flood is a well-known phenomenon in the flood plain of River Niger that has continues to pose serious multiple threats to the inhabitants (Flew, et al., 2004; Adeoye, et al., 2009; Aderogba, 2012; Onwuemele, 2012; Ikhuoria, et al., 2012; Kellens, et al., 2013; UNISDR, 2016). Despite the risk involved, the communities continue to occupy the flood plain area because of its economic benefits using their creative set of profound local knowledge, perceptions and adaptive initiatives (Oyebande, 1995; Abdullahi, 2004; Abdullahi, 2014). These communities have devised a creative set of strategies and complex adjustments that have allowed them to live in hazard-prone areas and they possess invaluable knowledge and perceptions that has helped them to prepare and adapt to crises caused by flood hazards (Cuny, 1991; Hiwasaki, et al., 2014). This knowledge system which is referred to as local knowledge is essential and its application in the face of hazards and other threats is referred to as an "adaptation measures" or "coping strategies" (Twigg, 2004).

However, existing approaches to flood risk reduction and management by stakeholders at local levels over the years have not produced the desired results. This is partly because of the conventional conceptualization by the stakeholders that has overlooked and ignored local knowledge, perceptions and adaptive initiatives in the management of flood plain areas. This neglect is partly due to the lack of real evidence base to understand the importance of local knowledge, perceptions and adaptive initiatives of flood plain communities. The current study, is an attempt to identify and understand how local communities used the knowledge and perceptions to lived and adapt to high flood risks and associated water-induced hazards in the flood plain of River Niger in Niger State.

The Study Area

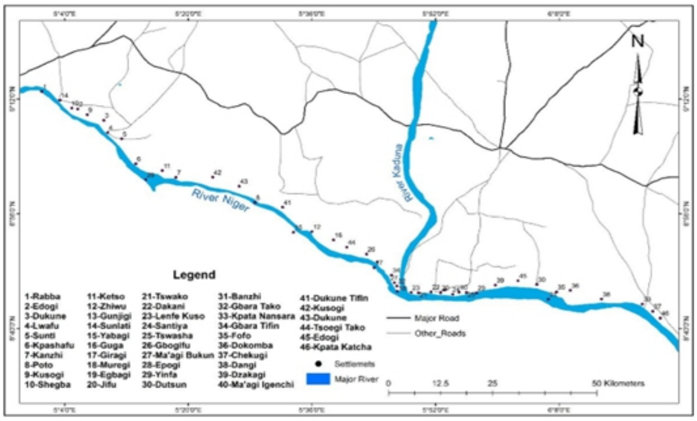
This study was carried out along the flood plain corridor downstream section of River Niger in Mokwa Local Government area of Niger State. The area lies between 8° 50' N and 9° 15' N and 5°3'5" E and 6°3'6" E on topography of between 50-100 meters above sea level with a slope gradient of 0-1%. (Figures 1). This area is divided into three (3) geographic areas/zones based on the report of committee on resettlement scheme carried out in the year 2000 in the area by Niger State Government which also corresponded with three (3) political wards existing in the area. They include: Jaagi, Muregi and Gbara areas/zones) (Figure 1 & 2 and Table 1). However, there are forty-six (46) settlements scattered within the zones with a total population of eighteen thousand five hundred and forty (18,540) according to 2006 population census and twenty-six thousand eight hundred and fifty-one (26,851) projected to 2021 at the annual growth rate of 2.5%.

Figure 1: River Niger Flood Plain area in Mokwa local Government of Niger State.



Source: Google Earth & Field Survey (2016)

Figure 2: Distribution of Settlements within the downstream section of River Niger flood plain area in Mokwa Local Government area of Niger State.



Source: Google Earth (2016) & Field Survey

Table 1: Existing Settlements with their population in three geographic areas.

JA'AG AREA/ZONE					MUREGI AREA/ZONE				GBARA AREA/ZONE		
S/N	EXISTING SETTLEMENT	POPULATION AS AT 2006	PROJECTED POPULATION, 2021	S/N	EXISTING SETTLEMENT	POPULATION AS AT 2006	PROJECTED POPULATION, 2021	S/N	EXISTING SETTLEMENT	POPULATION AS AT 2006	PROJECTED POPULATION, 2021
1	Rabba Kede	811	1,175	18	Muregi	718	1,040	32	Gbara Tako	381	552
2	Edogi	228	330	19	Egbagi	493	714	33	Kpata Nansara	491	711
3	Dukune	305	442	20	Jiffu	498	721	34	Gbara Tifin	492	713
4	Lwafu	784	1,135	21	Tswako	164	238	35	Fofo	418	605
5	Sunti	298	432	22	Dakani	358	518	36	Dokomba	408	591
6	Kpashafu	503	728	23	Lenfa Kuso	494	715	37	Chekugi	422	611
7	Kanzhi	303	439	24	Santiya	279	404	38	Dangi	888	1,286
8	Poto	372	539	25	Tswasha	180	261	39	Dzakagi	290	470
9	Kusogi	463	671	26	Gbogifu	330	478	40	Ma'agi Igenchi	595	862
10	Shegba	196	284	27	Ma'agi Bukun	373	540	41	Dukune Tiffin	305	442
11	Ketso	573	830	28	Epogi	361	523	42	Kusogi II	463	671
12	Zhiwu	265	384	29	Yinfa	367	532	43	Dukune	563	815
13	Gunjigi	86	125	30	Dutsun	407	589	44	Tsoegi Tako	429	621
14	Sunlati	451	653	31	Banzhi	233	337	45	Edogi	312	452
11	Yabagi	431	624					46	Kpata Katcha	505	731
16	Guga	277	401								
17	Giragi	277	401								
						TOTAL					
			EXISTING SETTLEMENT				**46**				
			POPULATION AS AT 2006				**18,540**				
			PROJECTED POPULATION, 2021				**26,851**				

Source: 2006 Population Census and projection to 2021

Field Work and Data Collection Methods

The study employed quantitative and qualitative methods (mixed methods) to engage the communities in appraising the knowledge, perceptions and adaptation on flood risk. There are 46 settlements with 26,851persons in area. Nine (9) settlements were selected using purposive sampling and 392 respondents with 15 interviews and 9 FGDs participants were used. The criteria used for the selection of the settlements was based on the vulnerability of each settlement to flood which was determined using (Flood Vulnerability Index (FVI)) formula developed by Connor & Hiroki (2005). The approach used component variables that were derived from the communities. These variables are grouped under four components, that includes: Climate, Environment, Socio-economic activities and Adaptation Strategies (Table 2, 3 & 4). The respondents include the household heads while interviews and FGDs involves village heads, members of Community associations, elderly community members, religious leaders, lead farmers and youth representatives. The participants were selected systematically in consultation with Village Heads.

Table 2: Components variables for flood vulnerability index (FVI)

Components	Indicators	ABB.
Climate	Amount of rainfall	M_1
	Average slope	M_2
Environment	Area coverage	M_3
	Population in flood area	M_4
Socio-economic activities	Damage of properties per year	M_5
	Literacy rate	M_6
Adaptation Strategies	Invest amount of building structures	M_7

Source: Connor & Hiroki, (2005)

The weights of the indicators were presented with the following equation:

$$FVI = C + E + S - M$$

$$FVI = C + E + S - M \text{ -------------------------1}$$

Where

$F = Flood$

$V = Vulnerability$

$I = Index$

and

$C + E + S - M$

$C = Climate\ component$

$E = Environmental\ component$

$S = Socio - economic\ component$

$M = Adaptation\ Measure$

$FVI = C + E + S - M$

$C + E + S - M - FVI$

$C + E + S + MFVI$

$C + E + S = MFVI$

$C + E + S / M = MFVI/M$

$$\boldsymbol{FVI = C + E + S / M}$$

$$FVI = \frac{(3 * m1) + (3 * m2 + m3) + (m4 - m5 + m6)}{m7}$$

The results are presented on (Table 3) below.

Table 3: Flood Vulnerability Index for the Settlements (FVI)

SELECTED SETTLEMENT	ANNUAL RAINFALL FOR ZONES (MM) (M1)	SLOPE COVERAGE PER SETTLEMENT (M2)	AREA COVERAGE PER SETTLEMENT (KM2) (M3)	PROJECTED POPULATION PER SETTLEMENT (M4)	DAMAGE TO PROPERTIES PER YEAR (₦) (M5)	LEVEL OF LITERACY (%) (M6)	AMOUNT INVEST ON BUILDING PROPERTIES (M7)	FVI (%)
JAAGI ZONE/AREA								
Rabba Kede	1486.7	0.61	301	1,175	53	31	117	
Edogi	1486.7	0.73	601	330	42	47	101	53.4
Dukune	1486.7	0.69	705	442	39	39	288	19.5
Lwafu	1486.7	0.75	913	1,135	25	72	320	20.5
Sunti	**1486.7**	**0.71**	**710**	**432**	**48**	**41**	**91**	**63.1**
Kpashafu	1486.7	0.63	501	728	33	38	104	54.9
Kanzhi	1486.7	0.70	522	439	29	49	99	14.4
Poto	1486.7	0.68	611	539	44	71	113	49.9
Kusogi	**1486.7**	**0.58**	**531.01.**	**671**	**59**	**66**	**180**	**31.5**
Shegba	1486.7	0.74	813	284	37	52	110	50.6
Ketso	1486.7	0.63	320.50	830	61	33	115	46.3
Zhiwu	1486.7	0.55	435	384	55	38	133	39.5
Gunjigi	1486.7	0.77	394	125	59	68	97	51.4
Sunlati	**1486.7**	**0.62**	**672**	**653**	**49**	**53**	**118**	**11.2**
Yabagi	1486.7	0.59	589	624	30	48	114	49.9
Guga	1486.7	0.66	639	401	17	59	413	13.4
Giragi	1486.7	0.57	478	401	23	46	119	45.0
MUREGI ZONE/AREA								
Muregi	**1486.7**	**0.78**	**810**	**1,040**	**22**	**51**	**171**	**37.0**
Egbagi	1486.7	0.69	711	714	38	59	149	34.9
Jiffu	**1486.7**	**0.75**	**586**	**721**	**19**	**44**	**169**	**34.4**
Tswako	1486.7	0.58	712	238	40	55	133	39.8
Dakani	1486.7	0.63	689	518	77	46	121	46.5

Source: Connor & Hiroki (2005)

Table 4: Selected Settlements

GEOGRAPHICAL/ ADMINISTRATIE ZONES	NO. OF SETTLEMENT PER ZONE	PROJECTED POPULATION PER ZONE	SELECTED SETTLEMENT PER ZONE	POPULATION PER SELECTED SETTLEMENT	FVI	LOCATION OF SELECTED SETTLEMENTS	
						LATITUDE (N)	LONGITUDE (E)
			Sunlati	653	11.2	090^{0} 07’ 517”	0050^{0} 10’ 572”
			Sunti	432	63.1	090^{0} 04’ 337”	0050^{0} 13’ 040”
Jaagi	17	9,627	Kusogi	671	31.5	090^{0} 06’ 314”	0050^{0} 16’ 513”
			Muregi	1,040	37.0	080^{0} 52’ 122”	0050^{0} 48’ 861”
			Gbogifu	478	63.8	080^{0} 47’ 382”	0050^{0} 45’ 980”
Muregi	14	7,709	Jifu	721	34.4	080^{0} 47’ 168”	0050^{0} 45’ 999”
			Fofo	552	71.6	080^{0} 44’ 225”	0060^{0} 11’ 040”
			Epogi	713	12.4	080^{0} 44’ 519”	0060^{0} 14’ 917”
Gbara	15	9,515	Kpata/ Katcha	731	31.8	080^{0} 44’ 136”	0060^{0} 18’ 873”
Total	**46**	**26,851**	**09**	**6,495**			

Source: Field Survey 2021

A Sample size of 400 persons were selected for questionnaires administration based on Krejcie & Morgan (2006), Sample Size Determination and 392 were questionnaires were returned.

Results and Discussions

The study identified what constitutes the local knowledge and the signs that are used to identify risk within the environment. Local knowledge composed of local early warning systems which are grouped into five knowledge categories: (i) phenomenological knowledge (human physical sensation such as hearing, seeing and feeling), (ii) ecological knowledge (flora, fauna and non-human related behaviours), (iii) riverine knowledge (behaviour and observations of running water bodies), (iv) meteorological knowledge (meteorological phenomena such as winds, rainfall and air temperature), and (v) celestial knowledge (behaviours of celestial bodies). The community generally depend on their behaviours through experiences to identify early signs of flood as summarized by the participants during interviews and Focus Group Discussions (FGDs) as presented on (Table 5).

Table 5: Local Knowledge on early warning signs on flooding

Categories of Local Knowledge	Example Signs
Phenomenological	• Elderly community members feeling pain in certain body parts. • Villagers unable to sleep due to increased temperatures
Ecological	**Fauna**
	➢ Behaviours of certain animals. • Increased number of ants in the villages. • Animals (e.g., hippos' crocodiles) migrating from the rivers to the fields and villages. • Birds producing a specific sounds (e.g., trumpet bird)
	Flora
	• Tamarind tree producing an increased number of flowers. • Increased production of fruits of the mango tree. • Plenty of bamboo growing next to river banks
Phenomenological	• Rainfall intensity. • Strong winds. • Rainfall duration. • Hot temperatures
Celestial	• Halo around the moon. • Occurrence of orion star. • Full moon
Riverine	• Sounds of waters in the rivers increasing. • Colours of waters getting dirty and muddy. • Rate of water level increase

Source: Interviews & FGDs, 2016

Behaviours of Certain Animals

Certain animals' actions/behaviours are used to foretell flooding by research participants stem from their close relationship with their surrounding environment, and they are embedded in their livelihoods and everyday existence. For instance, farmers have reported the observation of different animal species in the fields; whereas fisher men have identified an increased number of specific fish species as a sign of upcoming floods. some of the reported animal species includes:

i. Frog calls uninterrupted f imply heavy showers and probable flooding.

ii. If there are no fish or few fish in the early raining season, there will be floods, etc (FGD, October,2016).

These folk beliefs are shared primarily during community gatherings, such as religious ceremonies, funerals, and during meetings of community groups indicating a more formal dissemination practice. In some instances, the local chiefs and disaster committees organized special community meetings in order to share the signs and provide advice for household heads in the areas.

Knowledge on Movement of River

They have an idea of how soon a flood wave will come and how severe it can become by observing the aspect of the rising waters and the current in the flow and, accordingly, prepare to endure the floods from their houses or to leave their residence for safer places if required. Changes in the river constitution were considered important indicators of eminent flooding. Bursting of river banks due to heavy rain in the area or runoff was reported as one of the main causes of flooding in the study area. As one respondent in the FGD put it;

> *"When the amount of water flowing in the river increases alarmingly, we know there is a possibility that it will flood and therefore, appropriate action will be taken" (FGD, October, 2016).*

Change in the colour of the river water was another sign of approaching floods mentioned by the respondents. As described by one of the respondents;

> " *When the river turns a dirty brown with a lot of debris, we know the floods are Fast approaching and will be here in less than 24 hours. These are the deadly flash floods that come without warning sweeping everything on their path including people, animals, crops, trees, furniture etc*".

Knowledge of Weather Pattern

Long experience of living in flood-prone areas has equipped villagers with the knowledge and intelligence to read the nature of weather and anticipate rain and floods by observing natural phenomena. Seeing grey and black clouds in the sky means rain in the next couple of hours, dark clouds on the horizon and lack of visibility of the distant hills warns them about the possibility of rain in the upstream and consequent floods in a matter of three to four hours in the area. This involves predicting probability of future flood events by watching for changes in the rain pattern. Heavy rain in these areas accompanied by strong winds blowing from the river towards the hills was considered by half (50.5%) of the respondents to be signal of the approach of flood. Heavy rains in the area was believed by nearly (38.1%) to be clear signs of impeding flash floods usually experienced as a result of the ensuing runoff. If heavy rain was accompanied by lightning and thunder on the river, it was a signal that it will definitely flood. High temperatures during the wet season were also mentioned as another sign of heavy rainfall. An inquiring into the Sources of community information on flood forecasting revealed that 54.6% of respondents through the surveyed had knowledge of flood occurrence with 45.4% that does not have because of experience. Further inquiry for the source of information revealed that majority of respondents got the knowledge through personal observations.

Communities' Perceptions to flood Severity

Participants demonstrated a high level of understanding of flood dynamics, by detailing the ways in which water reach and spread throughout the villages. From their responses (FGDs), they usually have a measured and marked most visible houses or objects which they constantly monitor at the onset of rain each year that informs them of decision to take at a particular stage of water entering their settlements. A measurement of an object up to ankle (human body) is equivalent to less than 1 feet and less than 20cm in metric system. This constitutes a 'practical' approach as their local experiences and perception toward flood risk (Table 7).

Table 7: Community-based reference for flood severity and its approximate equivalence in feet and metric system

Community-based reference level in correlation to a person's body parts	Its equivalence in feet	Equivalence in metric system
Ankle	< 1 foot	< 20cm
Knee	1-2 feet	40 – 60cm
Waist	< 3 feet	70 – 90cm
Chest	> 3<4 feet	80 – 100cm
Above chest	> 4 < 5feet	110 – 130cm

Source: Field Survey and FGDs, 2016

From the FGDs and interviews it was revealed that severity of flood is usually measured (in days or weeks) according to the marked and measured references and the duration of flooding and the time that flood waters may remain. Based on their experiences, the participants characterized the threat posed by flooding with progressive depth and duration and the disruption to their normal activities and life as presented in (Figure 4). As noted in the diagram, the transition from one situation to the next may present some fuzziness in time and water depth. The transition will depend among others on the way in which flooding is taking place, the moment at which it stops and moreover the effectiveness of the adaptive strategies at hand. Some households, for instance, may find they can '*manage*' a 60 cm flood level (above *Knee* depth) for four days as long as it stops raining on the second day and the flood starts receding.

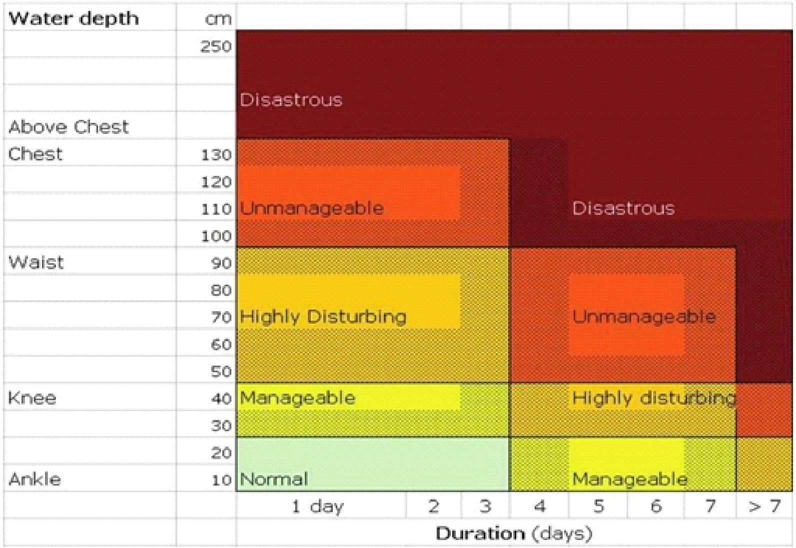


Figure 3: Summary of the Communities' perceptions to flood severity
Source: Field Survey and FGDs, 2016

Communities' Adaptive Initiatives

As revealed during the FGDs and interview activities carried out as part of this study revealed that in these communities' numerous adaptive strategies existed to deal with the disruption created by flooding (Table 8). The main aim of these strategies is to avoid or decrease the disruption and damage of the most important aspects of people's everyday life such as their own safety, the safety of their residence and valuables for livelihood activities.

While some of these strategies were found to be temporary and practice just for survival during the event or in the aftermath, some others have become permanently integrated in their daily life. Some of the adaptive strategies have the aim to reduce the impact of a possible flood (e.g. raising a house). Some others are more related to adapting with the negative impacts of a flood. These are strategies to deal with the reduction of resources. Decreasing the food intake, pawning or selling valuables, borrowing money at high interest rates increase the poverty and marginality of the people in these communities. Related to that was the subdivision of adaptive strategies that are executed before, during or after the occurrence of a flood. Adaptive strategies are also chosen depending on the way how a flood is evolving. The timing at which households have to start implementing adaptive strategies is an indicator for their overall vulnerability. For instance, households that do not have the resources for elevating their house need to adapt coping strategies already at very low water levels (*ankle* level).

Table 8: Adaptive Strategies employed by the Community at different Stages of Flood

BEFORE FLOODING		
Technological/Structural	**Economic**	**Social**
Long term: 1. Build a secure place under the roof to put their valuable properties more than one floor. 2. Reinforce pillars. 3. Construct house using the concrete material (wall and floor). 4. Ask in advance for temporary refuge at relatives or friends in case of flooding.	**Long term:** 1. Buy stocks to avoid scarcity and increasing prices. 2. Store basic non-perishable food items (rice, sugar, salt, canned goods). 3. Collect/store wood for fire and cooking. 4. Look for additional sources of income.	**Long term:** 1. Cleaning the house and surroundings together. 2. Discuss with other households about the action plan to adapt with flood.
Short term: 1. Put sand bags in front of the house to barrier the water	**Short term:** 1. Prepare the cooking Equipment. 2. Prepare baby's stuffs(clothes, blankets, etc.), light and battery	**Short term:** 1. Check the water depth at the designated areas. 2. Move properties to relatives or neighbours house
DURING FLOODING		
1. Evacuate personal goods to the higher place. 2. Evacuate the children, women, and elderly. 3. Tie a rope in dangerous places to help people during evacuation.	1. look for jobs in flood-free areas to meet family needs. 2. Bring enough food to evacuation place	1. Prevent kids from going out/playing amidst flood waters.
AFTER FLOODING		
1. Reconstruct damage houses by family members to avoid cost of labour. .	1. Look for alternative job. 2. Swap labour for food (in farms). 3. Borrow money from relatives, friends' 4. Ask for livelihood to community members.	1. Source relief materials. 2. From government 3. Solicit support from relatives, friends, or Government. 4. Participate in community recovering activities.

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