

Paper:

Assessing Rural Communities Concerns for Improved Climate Change Adaptation Strategies in Northern Ghana

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Northern Ghana is becoming vulnerable to risks induced by climate change. There is an urgent need to improve communities' ability to cope by implementing risk-preventive measures at the household and community levels. However, studies have shown that the existing risk communication system often fails to encourage the people to implement risk-preventive measures because community concerns are not seriously taken in the adaptation planning and management process. The present study systematically examines community concerns about existing risks and possible adaptation strategies by conducting group meetings in four rural communities in the Wa West District. Results show that local communities consider drought or water scarcity to be the most severe risk from climate change because it is directly affecting their livelihood, which is mainly rain-fed subsistence agriculture. As their livelihood is increasingly affected by drought, the local communities are becoming more exposed to floods and other natural calamities. Presently, the climate change adaptation strategies of the local communities are weak and ineffective. It is found that improved irrigation facilitated by rainwater harvesting, watershed management, and seasonal weather forecasting are the preferred adaptation strategies. Though a high level of intention to adopt non-structural preventive measures is observed, local communities report that a lack of knowledge and insufficient financial resources are major impediments to their implementation.

Keywords: concern assessment, climate change adaptation, Northern Ghana

1. Background: Climate Change Risks in Northern Ghana

Northern Ghana, as it is located in West Africa, is considered part of the region most vulnerable to climate variability [1]. It is projected that this region will experi-

ence changes in growing seasons and indices of drought, altered rainfall patterns, and higher temperatures, all of which will highly affect livelihood options. The majority of the population in Northern Ghana lives in abject poverty, their livelihoods revolving around rain-fed subsistence agriculture [2]. Ghana, particularly the northern part of the country, has experienced about a 1°C rise in temperature over the past three decades and a 20% reduction in rainfall [3]. Furthermore, statistical analyses of rainfall patterns in the last 60 years have shown that the onset of the rainy season has shifted from April to May, and dry spells during the rainy season have increased [4]. It is forecast that in Ghana, including Northern Ghana, the temperature will rise by 0.6°C by 2020, 2.0°C by 2050, and 3.9°C by 2080, whereas decreased rainfall patterns of 2.8%, 10.9%, and 18.6% will be experienced during the same periods [5]. Climate models for the region project that between 2030 and 2039 the rainy season might start as late as June or even later in Northern Ghana [6]. These future predictions of warming and drying, together with greater variability, will lead to increased intensity and frequency of extreme droughts and floods. In the past 10 years, Northern Ghana has experienced two catastrophic floods, in 2007 and again in 2008. A conservative estimate by the Ministry of Food and Agriculture (MoFA) reveals that 70,500 hectares of land and 50,000 people in Northern Ghana were directly and indirectly affected by the 2007 flood [7]. The death toll from the 2007 flood was 20, but the impact of the flood resulted in the displacement of vulnerable persons and the destruction of key infrastructure, food stocks, and livelihoods throughout the region [7, 8]. In 2008, more than 325,000 people were directly affected, needing external livelihood support [8]. Reports and studies on climate change in Ghana indicate that climate change will ominously aggravate water scarcity and droughts. Because of climate change, rivers, ponds, and streams are drying up, groundwater layers are shrinking and availability of potable water is decreasing [3]. From 1982 to 1983, Ghana experienced a particularly severe drought, followed by a less severe one in 2004.

Though there have been a very limited number of studies done on the impact of climate change in Northern Ghana, these studies have revealed that increasing climate change is directly impacting the communities' livelihoods, which are predominately based on rain-fed subsistence agriculture [2, 9]. Therefore, communities' survivability itself is at risk. In a study on food security and climate change impacts in Northern Ghana, Akudugu et al. [9] showed climate change causes crop yields to decline as a result of erratic rainfall, and it eventually has an increasing negative impact on the people's general welfare. The same study also reported that food insecurity, emigration, and hunger months have become regular phenomena in Northern Ghana as the climate has changed. This region of Africa is also characterized by limited social, political, technical, and other resources to draw upon to combat problems of scarcity and poverty, and these limitations constrain the people's ability to adapt to changing conditions [7]. Therefore, reducing climate change risks should be considered the primordial policy goal for the local government. As the climate change risks are unavoidable, adaptation at the local level is considered to be an imperative to protect the livelihood of the poor [1]. In support of this view of local adaptation, studies have shown local communities are not passive recipients; significant local initiatives against climate change risks are already evident in many parts of Northern Ghana. Laube et al. [2] in their study in Northern Ghana mentioned several such household strategies, including crop diversification by replacing crops that have long growth periods, such as millet or guinea corn, with other types that mature faster, or the application of green manure from legumes and paddy rice cultivation to adapt to low soil moisture and declining soil fertility. Moreover, there exists a rich local knowledge base to use to fight against emergency situations. For example, there is knowledge of local rain corridors, of the color of clouds, and of changes in the cries of birds, etc. to forecast weather [8]. The social implementation of climate change adaptation strategies at the community level demands adequate knowledge and understanding of the level of vulnerability, knowledge, and capacity of the community and their priorities and needs [10]. It was reported that proposed climate change adaptation strategies and programs for this region, such as the Individual Country National Adaptation Programme of Action and National Communication Reports to the United Nations Framework Convention on Climate Change, have failed to become implementable because they are very often generic and lacking micro level understanding of the issue; they do not take communities' concerns, needs, and visions into the adaptation process [11]. Therefore, to enhance the community's local adaptation capacity, it is instrumental to have a deep understanding of the community's concerns and needs. The present study will systematically examine the concerns of communities affected by climate change in the Wa-West District of Ghana to deepen understanding of communities' perceived risks, adaptation orientations, and major constraints, which when taken all together may help to formu-

late socially implementable strategies to reduce climate change risks. The next section, Section 2, will provide the importance and definition of concern assessment, and Section 3 will describe the tools and methods used in this paper to collect primary data on community concern assessment. The last two sections of the paper will provide results, including community concerns about floods and drinking water risks as well as possible mitigation strategies. The results obtained from the field will be compared with existing literatures on climate change adaptation in Ghana, particularly in Northern Ghana. The study findings will facilitate the formulation of socially implementable climate change adaptation strategies in Northern Ghana, and the process may be replicable in similar places.

2. The Significance of Concerns Assessment in Climate Change Induced Risk Management

In recent times, studies on climate change and disaster risk have pointed out that public involvement in the planning and management process is vital to the establishment of resilient communities [12, 13]. As the researchers and planners are advocating public participation, knowing communities' concerns has become a prerequisite and primordial task, as suggested not only by climate change and disaster management studies [14, 15] but also by environmental planning and risk management studies [16, 17]. Before providing an elaborate discussion on the definition and concept of a community's concern assessment, we will argue why the importance of concerns assessment is getting admiration in climate change adaptation studies, as detailed below.

There is a growing consensus among researchers that top-down, engineering-based measures are not enough to reduce climate change induced risks; there is a need to encourage households to adopt non-structural preventive measures, such as evacuation planning, crop diversification, and water harvesting [18]. However, it is often reported in climate change and disaster management studies that the implementation of non-structural measures at the community level remains low because the conventional risk communication strategies are ineffective [19]. The conventional risk communication system fails to understand that it is not only information that influences individuals' adaptation behavior; how individuals interpret the information also matters [18]. Therefore, an effective risk community plan should be well aware of a community's concerns, needs, and priorities. For example, in many parts of Africa, programs have been initiated by the local government and civil society to develop timely seasonal forecasts to encourage rural communities to shift away from intensive maize towards more drought tolerant seeds. It is often reported that it is difficult to convince the people to follow the recommendations [20, 21], and such efforts are much more effective and implementable when participatory risk communication strategies are practiced [22].

The second important reason behind community concerns assessment is that studies have shown that stakeholders often vary in terms of risk perception and planning options [23]. Diverse and conflicting ideas among stakeholders in climate change adaptation and disaster management are frequently reported. A study by Patt and Schroter [23] on the perceptions of residents and policy makers in a flood affected area in Mozambique showed that the policy makers rated the risk of flooding higher than did the residents and at the same time were less sensitive to the potential costs of the mitigation measures they asked residents to engage in. In technical risk models, risk is often seen as the product of the magnitude and likelihood of harm, but the subjective evaluation of risk diverges from the objective results of formal risk analysis. "Risk is all about thoughts, beliefs, and constructs" [24]. It is often argued that such differences arise, on the one hand, from uncertainties in the factual knowledge base and, on the other hand, from ambiguities in problem framing [17]. Therefore, considering these diverse and sometimes conflicting views among stakeholders, researchers and policy makers argue that climate change and disaster risk problems should be dealt with using "universally correct solutions," but the goal should be to generate "socially viable solutions" that are acceptable to as many stakeholders as possible at the specific sites and time [25]. Climate change risks are uncertain and complex, and so the management process should be more participatory and anticipatory. Therefore, learning community concerns is essential to knowing why there are different perspectives and how to tackle them constructively.

Concern assessment is a systematic analysis of the associations and perceived consequences (benefits and risks) that stakeholders, individuals, groups, or different cultures may associate with a hazard or cause of a hazard [16]. The significance of concern assessment in risk management and risk governance is to ensure the decision makers account for how the risk is viewed when values, perceptions, and emotions come into play. Concern assessment includes socioeconomic impacts, economic benefits, and public concerns. The International Risk Governance Council [16] has proposed that concern assessment respond to such questions as the following: a) What are the public's concerns and perceptions?; b) What is the social response to the risk?; c) Is there the possibility of political mobilization or potential conflict?; and d) Are risk managers likely to face controversial responses arising from differences in stakeholders' objectives and values, or from inequities in the distribution of benefit and risks? Pahl-Wostl [17] suggested that incorporating knowing community concerns (through social learning) into the decision making process in risk management would enable and enhance the following management capacities: being aware of each other's goals and perspectives, identifying shared problems, understanding stakeholders' mutual interdependencies, resolving conflicts and learning to work together, building trust, and building formal and informal relationships.

Considering the critical importance of the adoption of

preventive measures by local communities for improved climate change adaptation, this study attempts to examine local communities' concerns on climate change risk and its adaptation strategies or response mechanisms in Northern Ghana. The component of risk perception includes individuals' perceptions of risk probability, risk severity or vulnerability, and their anxiety [26]. It is generally predicted that high risk perception leads to higher likelihood of disaster preparedness [18]. On the other hand, coping capacity or response orientation is a process or course of preparedness in which individuals look forward to finding the best possible options, actions, and measures that could minimize the losses and damages from existing or imminent risks [26]. The coping aspect focuses more on the usefulness of the preventive measures and individuals' skills and knowledge to put them into practice.

3. Methods

The study was based on primary data obtained from group discussions in communities affected by climate change in the Wa-West District in Ghana (see **Table 1** and **Fig. 1**). The Wa-West District is one of nine districts in the Upper West Region of North Ghana. Being a part of the north, the entire district, particularly the rural areas, are highly susceptible to climate change risks. We conducted surveys in four village communities, including Chiatanga, Bankpama, Zoawayili, and Baleofili. We selected these four communities for the following reasons. First, they were identified by the research team of the local university, the University for Development Studies (UDS), as highly affected village communities in the region. As these communities were poor, they lacked the socioeconomic resources and political will to mobilize and/or influence the local disaster management authorities to take the initiative in disaster mitigation. Moreover, unlike other nearby communities, these communities were well accessible and operationally convenient areas for organizing workshops, building rapport, and conducting site visits for primary data collection. Moreover, the local leaders had shown a keen interest in initiating activities to improve their community.

To accumulate local communities' concerns on climate change risks and household adaptation strategies, we organized group meetings in four villages (**Table 1**). Following the local tribal tradition, to conduct a meeting in each community, we first informed the chief of the community of our intention to hold a meeting, and, after we received the chief's consent, the date and place of the meeting was decided. It was the chief who decided the list of participants from the particular community and summoned them. In general, the participants of a group meeting included the chief of the tribal community, village wise men and elder council members, village assemblymen, and few general members of the community (see **Fig. 2**). Notably, except in Zowayili, women did not participate in any focus group meeting. During the focus group meetings, the opinions and views of the chief were considered

Table 1. List of case studies and description of survey methods.

Village studied	Location	Village population	Key informants	No. of participants/ key informants	Survey methods
Chiatanga	Along Black Volta River	359	Village chief, assemblymen, general members of the community	12	Group meeting, semi-structured interviews, observation, and photography.
Bankpama	Along Black Volta River	742	Community chief, assemblymen, general members of the community	7	
Zoawayili	Along Black Volta River	192	Community chief, assemblymen, village wise men, chief advisors, general members of the community and women’s group members	12	
Baleofiili	Little away from Black Volta River	742		20	

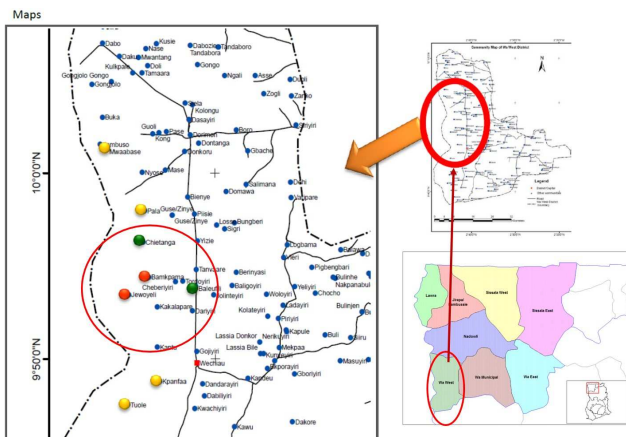


Fig. 1. Location of the study areas in Wa-West District.



Fig. 2. Group meeting with key informants including village chief in Baleofiili.

as the final verdict; however, other participants were allowed by the chief to share their concerns about existing risks and possible coping options. In the majority of the meetings, the number of participants was 7 to 10, excluding the researchers. However, in many cases, the number of participants was as high as 20. During the meetings, the leader of the research team first explained the aims and scope of the meeting, and then the discussion began in a structured manner, following the research objectives. The meeting was organized in the community and carried out in a semi-structured manner; that is, for every meeting there was a fixed number of questions. However, the participants were allowed to express their concerns freely and in an open-ended manner. Furthermore, in several occasions, questions were also asked to deepen the understanding of particular facts or concerns provided and expressed by respondents. On an average, the meetings lasted 2.5 hours. The village meeting was conducted in the local language, Wala. The fifth author of this paper acted as interpreter between the research group and the communities. The surveys were carried out in two phases, the first in June, 2013 and the second in November, 2013. The issues discussed in the group meetings were climate-change-induced risks and communities’ existing coping orientations. **Table 1** provides an outline of the survey process to understand the communities’ concerns about the impact of climate change the Wa-West District.

4. Results

Based on 8 group meetings, this study collected communities’ concerns on two different but mutually interdependent aspects: climate change risk perception and community coping orientation.

4.1. Nature and Magnitude of Climate Change Risks

Based on group meetings with all four communities, common rain calendars as perceived by the communities were drawn (**Fig. 3**). **Fig. 3(A)** shows that during normal times, the rainfall was concentrated in the period from April to October, and during the period of August, the rains used to reach their peak levels. Normally, the dry season continued from November to the end of March or the beginning of April (see **Fig. 4**). **Fig. 3(B)**, which is also drawn based on communities’ common understandings, shows that in the last 15 to 20 years, local communities have seen clear changes in the climate pattern. The wet season is now getting shorter; the onset of rain has shifted to June instead of the beginning of April. Moreover, in several years there was no rain observed until the end of July. Similar findings were reported by the study of Laube et al. [2] in Northern Ghana. Statistical

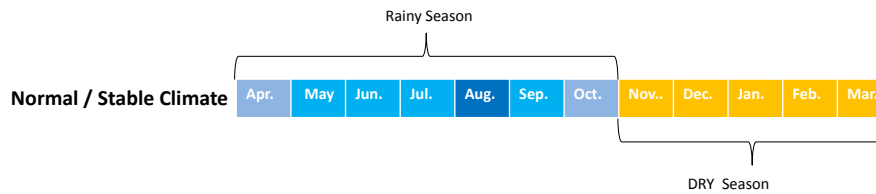


Figure 3.A : Norman Climate (Based on Community Reporting)

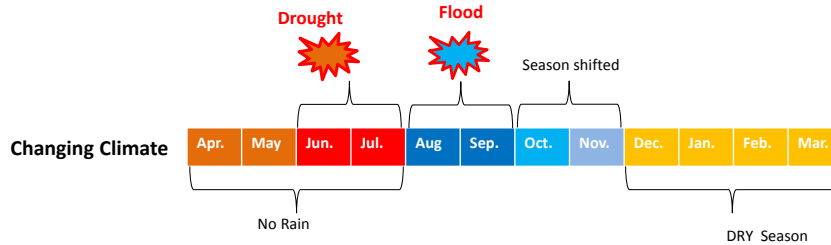


Figure 3.B : Changing Climate (Based on Community Reporting)

Indicators

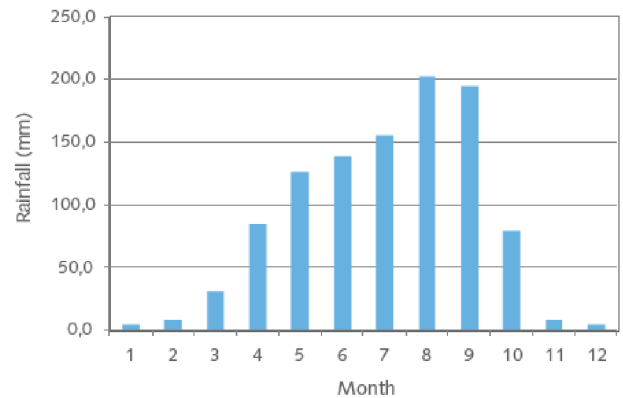


Fig. 3. Climate change pattern reported by local communities, Wa West District.

analyses of rainfall patterns over the last 60 years have shown that the onset of the rainy season has shifted from April to May, and the dry spell during the rainy season has lengthened [4]. Over the past three decades, there has been a 20% reduction in rainfall [3]. The immediate and concomitant consequence of this long dry season is water scarcity and drought, which brings more suffering and even starvation to these poverty stricken communities. According to the community, in the normal climate scenario, the dry season continues for a period of 5 to 5.5 months (see **Fig. 3(A)**), but it has extended to up to 6-7 months without a drop of rain (see **Fig. 3(B)**). Besides that, communities are now experiencing erratic and sometimes very intensive rains along with wind storms in August, which is immediately after the long dry spell. Consequently, the frequency of floods has also increased. Due to changing nature of the climate, communities such as Chiatanga and Baleofili have reported that they are experiencing drought and flooding in succession in a single year. This means the frequency of floods has increased, but the wet spell has gotten shorter and shorter while water scarcity has increased overall.

In summary, the following are the important concerns the communities expressed about climate change risks.

- i) Temperature has increased. The frequency of drought has increased. Drought or water scarcity is the most frequently observed phenomenon caused by climate change. Communities believe that they will experience more droughts in the future, and that situation will severely affect their livelihoods.
- ii) Rainfall has become erratic and sometimes very intensive. The total span of the wet season has shortened and total precipitation has decreased, but the frequency and severity of floods have increased.



Source: C. Rademacher-Schulz, and S. M. Endward, 2012 [27]

Fig. 4. Mean distribution of monthly rainfall 1953-2011 (Synoptic Weather Station – Wa, Upper West Region).

- iii) More, stronger winds have been observed. The frequency and severity of the winds have increased.
- iv) As a result of the expansion of agricultural land, bushfires, and the high demand for firewood, forest cover of the research area has been vanishing.

Based on the above concerns, the communities face two major risks: flood and drought. Next, each of the risks will be discussed.

4.1.1. Flood Risks

Table 2 shows that only one community has experienced floodwaters inside the settlement, namely Baleofili in 2010. None of the other communities could remember floodwaters entering their houses or settlement in the past

Table 2. Flood risks: nature and causes.

Village	Flood in settlement	Flood in agricultural land	Floodwater level (in feet)	Duration of flood (in months)	Time of water logging	Frequency of floods	Reasons for floods	Last flood observed
Chiatanga	Never	Yes	20	2	July to August	Once every 3 years	Dam across the Black Volta River and heavy rains	2007
Bankpama	Never	No	15	1	July	Never	N/A	N/A
Zoawayili	Never	A little	20	2	July to August	Once every 10 years	Heavy rain	2003
Baleofili	A little in 2010	Yes	10	1	July to August	Once every 3 years	Heavy Rain	2010

Table 3. Impacts of floods on villages.

Villages	Human loss and injury	Damage to buildings	Damage to household durable assets	Damage to household stocked foods	Crop loss	Livestock loss
Chiatanga	Not at all*	Very little**	Not at all	Very little	A Great Extent	Very little
Bankpama	Not at all	Not at all	Not at all	Not at all	Not at All	Not at All
Zoawayili	Not at all	Not at all	Not at all	Not at all	Very Little	Very little
Baleofili	Not at All	Very little**	Not at All	Very little**	Some Extent	Not at all

Note : Scale used for flood impacts : Totally, A great extent, Some extent, Very little, Not at all.
 *It was reported that a fisherman who used to live in close proximity to the river had lost his life.
 **Reported damage was mainly due to heavy rain falling on buildings made of mud.

Table 4. The relation between flood vulnerability and lack of livelihood security in upland areas, as explained by the chief of Chitanga.

Upland area		Lowland area (near river bank)	
Merits (benefits)	Demerits (Costs)	Merits (benefits)	Demerits (Costs)
No flood/ water logging	Lack of water source	Plenty of water	Heavy rain and river overflow
No irrigation facilities	No threat to life and property	Better irrigation source	Opening of dam water gate without prior notice
Infertile land	Preferred residential location	Fertile land	Threat to life and property
Lack of alternative employment		Source of income from agriculture	

20 to 30 years. There is also no record available at the district level on the flood of 2010. Baleofili, which is considered to have comparatively better socioeconomic capacities, had floodwaters inside people’s homes for less than 24 hours in 2010. Heavy rain caused this flood, which damaged mud buildings and crops stored in houses. No human loss or injury was ever reported (Table 3), except the death of a fisherman crossing the river during the rainy season in the village of Chiatanga.

Though floods in residential areas are reportedly uncommon, three out of four communities expressed concerns over floods in agricultural lands. Table 3 shows that the community of Chiatanga is the community most severely affected by flood, and the least affected is Bankpama. The last flood experienced in agricultural land was in 2010. In Chiatanga and Baleofili, floods are reported once every three years. Floods in farmlands often have a great impact on the livelihood of the community because the waters damage crops and kill livestock. Floods in agricultural lands severely affect Chiatanga, whereas the other three communities are less severely impacted. The community of Chiatanga considers that the floods are caused not only by heavy rains: recently the switch gate of the Bagare Dam has suddenly been opening without notice. This has brought a lot of suffering, crop

loss, and livestock loss. In regard to this, the Chief of the Chiatanga has explained that the causes of increased flood risks were closely associated with the increasing livelihood insecurity or risks in upland areas, as shown in Table 4. Nowadays, it is impractical and even suicidal for these tribal communities to depend solely on farming activities in upland areas for their livelihoods. Because of erratic rainfall, increasing temperatures, and the absence of any irrigation facilities, it is extremely hard to plough in upland areas. Moreover, due to increasing population, the pressure on land has increased, resulting in overexploitation of the land in upland areas. This in turn has caused the livelihoods of these self-sustaining agricultural tribal communities to be under great threat, forcing them to find alternative sources of livelihood in risky and fragile areas such as the riverside. Instead of seeking better ways to cultivate the upland areas, these agricultural communities have started cultivating the riversides. The riversides are more fertile because of river sedimentation and the easy access to water for irrigation, but they are susceptible to flooding.

It is notable that floods have caused enormous damage to agriculture, but the affected communities are reluctant to build embankments or levies on the river banks. This is because riverside lands are fertile because of river sed-

Table 5. Nature of water scarcity.

Villages	Lack of drinking water	Lack of water for irrigation or agriculture	Lack of water for live-stock rearing	Water borne disease
Chiatanga	Great extent	Absolutely	A great extent	Very little
Bankpama	Absolutely	Absolutely	A great extent	A great extent
Zoawayili	Absolutely	Absolutely	A great extent	Some extent
Baleofiili	Some extent	Some extent	Some extent	Very little

Note: Scale used for water scarcity: Absolutely, A great extent, Some extent, Very little, Not at all.

Table 6. Sources of drinking water facilities.

Communities	Borehole/ deep tube-well	Well	Natural steams	Pond in village	Access to pond outside village	River (access to river)	Rainwater harvesting
Chiatanga	0	0	Only in rainy season	0	Yes	Yes	Only in rainy season
Bankpama	0	1	Only in rainy season	0	Yes	Yes	Only in rainy season
Zoawayili	1	1	Only in rainy season	0	Yes	Yes	Only in rainy season
Baleofiili	1	2	Only in rainy season	1	Yes	Yes	Only in rainy season

imentation caused by floods. Moreover, the construction of levies would inhibit the communities' free access to river water. The chief of Chiatanga also suggested that adequate irrigation facilities in upland areas or alternative employment may reduce this risk by decreasing the number of people farming near the riverside. In summary, even knowing the floods could be catastrophic, the tribal communities, such as Chiatanga, welcome such natural calamities, as they keep their agricultural land fertile.

4.1.2. Water Scarcity and Drought Risks

Water scarcity or drought is reportedly the most severe climate change impact faced by the community. In **Table 5**, it is shown that due to climate change, all communities in the study area are facing water-related risks, such as water borne diseases and the lack of potable water and irrigation systems. Communities' concerns over water-related risks can be divided into two parts: drinking water risks and inadequate water for agriculture or irrigation.

4.1.3. Drinking Water Risks

All communities reported that they have a 100% drinking water problem, which means that they have inadequate drinking water resources, a dropping groundwater level in the dry season, poor drinking water quality, including muddiness, iron, and smell, water borne diseases, and remote access to drinking water sources. **Table 6** shows that, irrespective of the communities, the major source of drinking water is the river and ponds. Only two communities reported that they have a borehole, and only one community has a pond of its own (**Fig. 5**). In the present climate change context, communities are forced to alter their sources of drinking water throughout the year, as shown in **Fig. 6**. During the rainy season, the options are much more open; even using rainwater from rooftops is also observed. Traditional wells, hand pumps, and natural streams are also common sources of drinking water in the rainy season. Local wells and hand pumps or boreholes are functional only until January, that is, just a few



Fig. 5. A pond in Baleofiili.

months after the rainy season. Afterwards, local people have to depend on ponds and the river for drinking water. Furthermore, if rains do not come until May or June due to changing climate, the water scarcity reaches its highest level, and the communities have to travel a long distance every day to fetch drinking water. With the changing climate pattern, the scarcity of drinking water and inefficiency of the existing drinking water supply system become prominent.

Figure 7 shows that in the present climate change context, it is only for the 4 to 5 months from August to November that communities have plenty of drinking water because of rain. Though the communities have started recycling rainwater for drinking water and other purposes, they do not yet have any mechanism for storing rainwater for the dry season. Natural streams that are active during the rainy season become inactive if there is no rain. For the first few months just after the rainy season, communities also have access to safe drinking water because during this time boreholes and wells work well as the groundwater is replenished by rains. The situation gets difficult starting between January and March. From January onwards, boreholes become nonfunctional and traditional wells dry up because of the falling groundwater level. Moreover, there are not enough boreholes. Generally, one borehole services six to seven village communities. Therefore, to get a little water, the women of

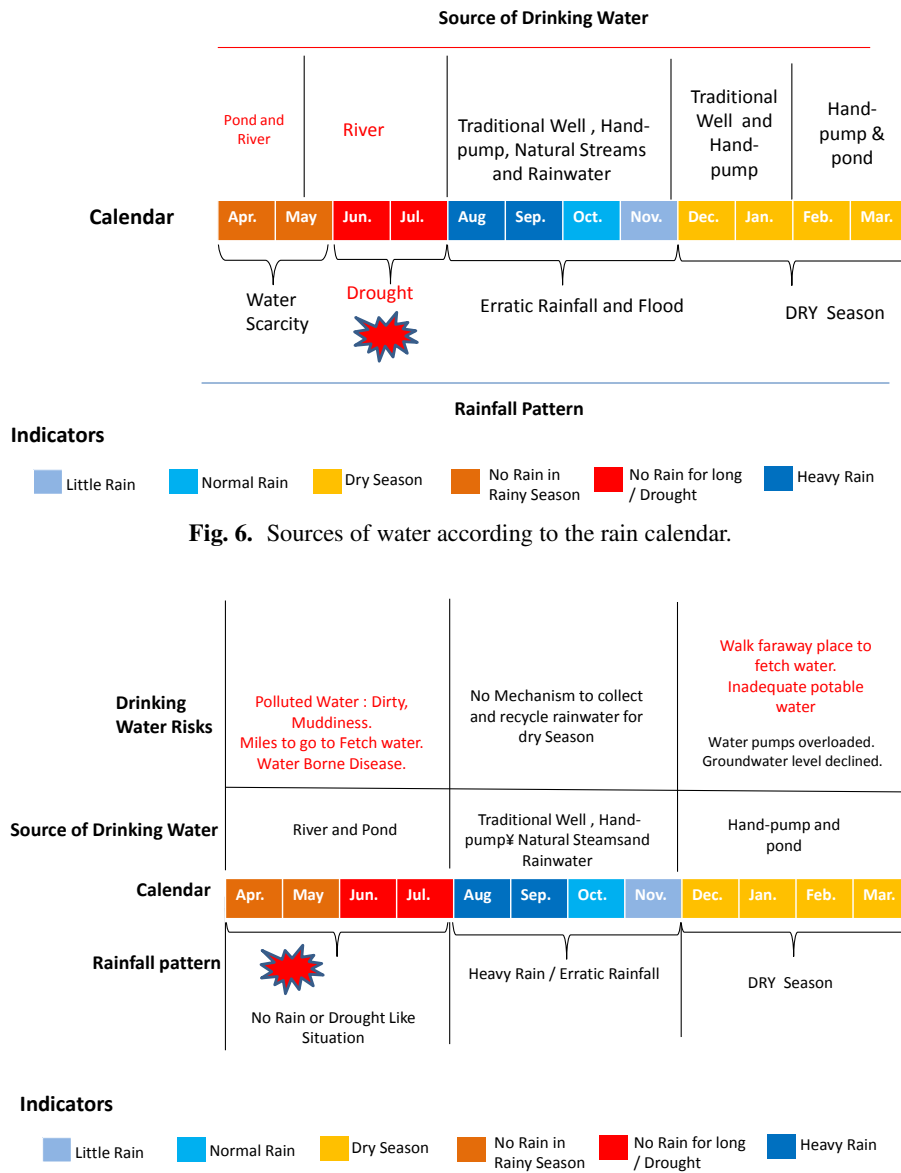


Fig. 6. Sources of water according to the rain calendar.

Fig. 7. Drinking water risks due to climate change.

the house have to travel long distances and wait in long lines for water from boreholes. Usually, before the climate changed, by the end of March the area used to have rains which replenished local water bodies. However, due to climate change, no rainfall can be observed until May or June. People have to satisfy their water requirement by traveling 6 to 10 km every day, and that is to get muddy, polluted, bad colored river water which often bears disease. Therefore, all individuals, irrespective of their gender, education and economic status, have expressed a deep need for a safe drinking water system.

4.1.4. Water Scarcity for Irrigation and Agriculture: Impact on Livelihoods.

Communities have reported that water scarcity or drought is accelerating their livelihood risks. As Fig. 8 shows, in former days, communities were usually engaged in agricultural activities from April to October, and whatever they produced was used to satisfy their own

needs during the dry season. Animal husbandry and sometimes forestry were considered as secondary occupations practiced during dry seasons. However, Fig. 9 shows that with the climate change impacts, this subsistence agriculture economy is under great threat. People cannot depend with certainty on agriculture for their livelihood. Because of erratic and decreasing rainfall and the lack of access to bodies of water, the traditional system of agriculture is under great threat. People do not have much water in upland areas, so they go to the riverside, but it is prone to floods. As a result, the crops produced are not adequate for the requirements of the communities. As farming provides the basis of the livelihoods of the local communities, several households are experiencing difficulty gaining enough income for basic amenities or education. Communities have indicated that the declining success of their crops has occasionally obliged them to keep what they could harvest for their household needs in lieu of selling them in the market, reducing household

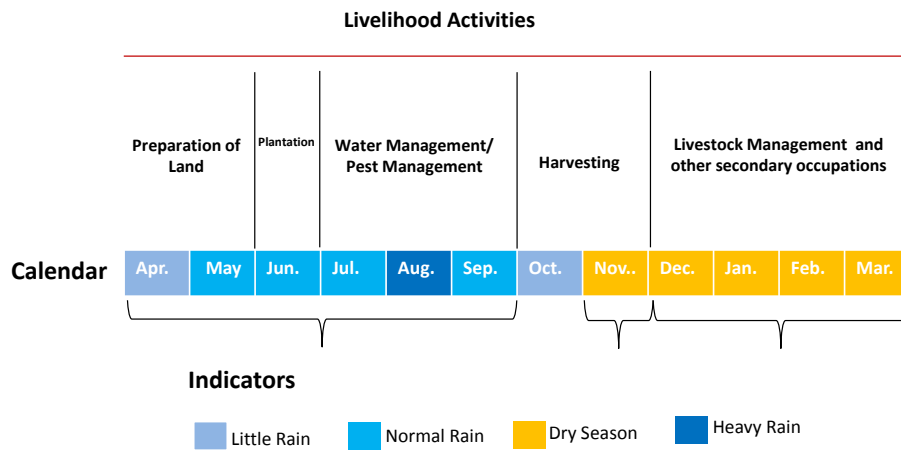


Fig. 8. Normal livelihood pattern and agricultural activities.

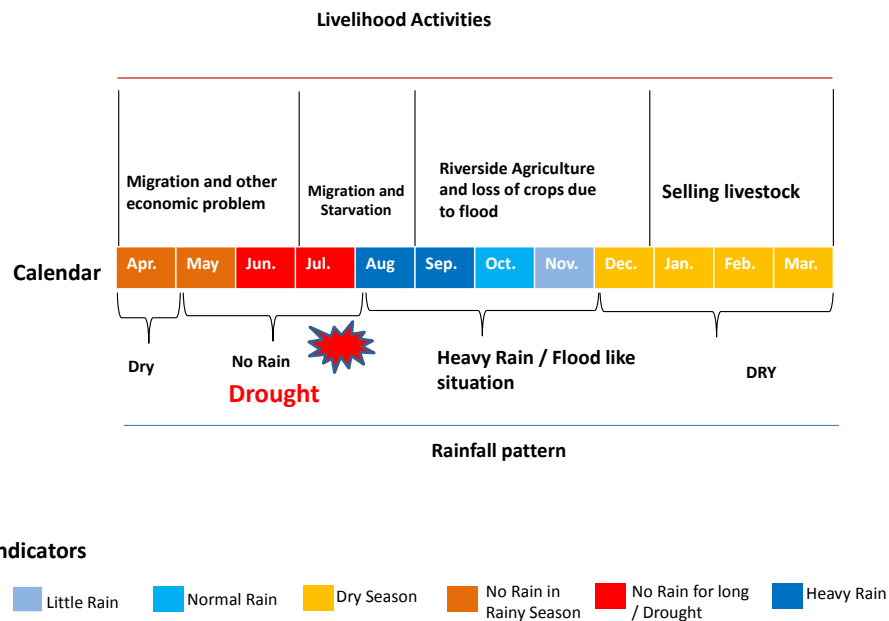


Fig. 9. Water scarcity and climate change impacts on agriculture and welfare.

income. In addition to that, practicing animal husbandry is becoming challenging because of a lack of water and pasture land. As a result, from January on, migration to nearby towns is observed. In extreme cases, if rains do not come by April or May, this drought brings starvation and disease.

4.2. Communities' Coping Orientations

The entire community has recognized that floods and droughts are recurring events and their impacts are severe, but to reduce the risks of climate change, there are not many coordinated and planned actions initiated at the community or household levels. Presently, there are almost no governmental or non-governmental organizations providing support to local communities to enhance their resilience against floods and droughts. Local communities have indicated that major impediments to implementing adaptation strategies are the lack of financial resources and knowledge. Communities have informed us that they

have barely any knowledge as to what they can do on their own, and any adaptation strategies they could foresee require considerable funding. Communities have, however, communicated that they have manpower, plenty of land, timber and sand, all of which can be mobilized for the implementation of preventive measures. During the group meetings, communities stated their preferred adaptation strategies and status of those adjustments, as follows (also see Table 7).

- i) Irrigation was the most preferred adaptation strategy among the communities. Access to irrigation would bring security in cultivation and provide more stable income for the families. Farmers currently use river water extracted mainly by manual means using buckets. A few farmers use shallow groundwater, which they access from dugouts.
- ii) Communities also listed wells and boreholes as preferred strategies. Communities contend that they spend a significant amount of time every day hauling

Table 7. Preferred adaptation strategies and their implementation constraints and opportunities.

Rakings of preferred adaptation strategies	Purposes	Major constraints	Opportunities and capacities	Observed initiatives
1. Irrigation facilities	To improve and secure farming	Lack of money and technology, erratic rainfall	Plenty of land and labor	Extracting river water by using buckets
2. Provision of boreholes and wells	To receive potable water and reduce water fetching time	Boreholes are expensive. Traditional wells dry up during summer	Rainwater harvesting	Collecting rainwater in plastic drums during rainy season
3. Seasonal weather forecasts	To prepare better for farming, e.g., site selection, crop selection, and water management	Lack of technology and dependency on external source	None	Traditional knowledge, such as color of river water and movements of birds
4. Drought tolerant crops	To secure agricultural production when water is scarce	Lack of technical assistants and external support	None	None
4. Alternative jobs (non-agricultural)	To secure livelihood through creating alternative income sources	Lack of specialized skills, knowledge, technology, and capital	Plenty of land and forests	Charcoal production and animal husbandry
4. Migration	To secure livelihood	Lack of education, skills, and professional networks	None	Seasonal migrations

water from distant sources, and the quality of the water is extremely bad. As a result, wells and boreholes were considered to be essential adaptation strategies during periods of drought. Communities complained of the unavailability of pipe boreholes, because wells often completely dry up during periods of drought. Rainwater harvesting can be observed only in the rainy season. During the rainy season, the majority of the households store rainwater in plastic drums for use for drinking and cooking. There is no mechanism developed to store and recycle rainwater for future use as people think large household size and the lack of financial resources prohibits them from harvesting rainwater for use as drinking water.

- iii) Communities also prefer to have seasonal forecasts to prepare better for the season, especially in order to know whether or not to go to the riverside for farming and also to decide the times for field preparation, seed sowing, and water management. Early warnings for evacuation did not receive much support. This is because evacuation would mean that they could save their lives, but they could not save their crops, which are the source of their livelihood. In contrast, seasonal forecasts could help them not only by telling them when to cultivate but also if the rivers may overflow their banks. It was also expressed that local knowledge related to seasonal predictions was gradually disappearing, and people could no longer rely on it.
- iv) Drought tolerant crops were another adaptation strategy preferred by communities.
- v) Opportunities for employment or work outside subsistence agriculture are scarce, limiting residents' ability to seek other sources of income. Residents increasingly turn to charcoal production as a means of gaining income, but the implications of that are bushfires and deforestation. Moreover, deforestation,

overgrazing, and bushfires have degrading effects on the already poor soils of the area.

- vi) Migration is not a preferred coping strategy but a commonly adopted one nonetheless. Farmers generally migrate to southern Ghana in search of work in the mining, plantation, and urban areas. Both permanent and seasonal migration are observed. Many migrants stay for a number of years in the south and later return to begin farming again in the homeland. Seasonal migration usually takes place during the dry season when agricultural production comes to a halt and the demand for labor is high in urban areas.

5. Discussion and Conclusions

As Northern Ghana is considered as one of the most vulnerable regions due to climate change, there is a growing need to enhance the ability of local communities to cope by encouraging them to adopt household- and community-level preventive measures. However, studies across the world on disaster and climate change risks inform us that the adoption of non-structural preventive measures by local communities remains elusive. It is considered that planners and policy makers often neglect community ideas, opinions, and views about risk and mitigation strategies. As a result, the concerns of communities are not reflected in climate change adaptation decisions. The concomitant results of this are that local communities have refused to adopt the proposed and desired preventive measures or actions, including crop alteration, watershed management, evacuation planning, crop conservation, etc. Therefore, community concern assessment is considered to be a critical step in the climate change risk governance process. Considering the importance of concern assessment, this study has systematically examined the concerns of four rural tribal communities affected by risks induced by climate change in Northern Ghana. We

used group meeting survey techniques to collect community concerns regarding risk and adaptation strategies.

Our findings suggest that local communities perceive the probability of extreme climate events and their level of vulnerability to be very high. Climate change studies indicate that generally high risk perception increases individuals' motivation or intention to adopt risk preventive technologies and measurements [18, 19]. Therefore, existing risk awareness can be utilized to promote the dissemination of risk preventive measures, such as diversifying crops, recycling rainwater, storing emergency food supplies, building houses on higher ground, etc., which are considered critical but very challenging tasks to implement across communities [26]. In the present study, drought or water scarcity is considered the major concern of risk by all communities. Communities have recognized that due to water scarcity, the risks to their livelihood are increasing, making the community unable to recover from disasters. The local economy is predominantly subsistence farming based on rain-fed agriculture. Fewer rainy days, the shifting of the onset of the rain, and erratic rainfall have all combined to make the return from cultivation in uplands uncertain and diminished. Therefore, such circumstances have forced the people to select more fragile and hazardous areas, such as lowland river basins, for cultivation, but these are prone to flooding. Therefore, in order to reduce the disaster risks of the communities, their livelihoods must be secured. Studies and reports on climate change in Asia have suggested that securing livelihoods is instrumental to reducing communities' increasing vulnerabilities in developing country contexts [28, 29]. Livelihood risks triggered by water scarcity or drought are generating new risks, such as bushfires and deforestation, as many households have increased charcoal production to supplement their low agricultural production. Similar findings were reported by Westerhoff and Smit [11] in a study on climate change in Ghana. As the people leave their vulnerable communities towards further vulnerabilities to maintain livelihoods, mainstreaming climate change adaptation into development would be an important policy option for the local governments [29]. Such realizations of securing livelihoods through mainstreaming climate change adaptation can be accomplished through programs such as alternative income generation programs that enhance the skills of vulnerable groups, through the local governments' providing a minimum wage and 100 days of job security to rural communities, and through business loans for long-term rehabilitation packages, which are already reportedly successful and effective in Bangladesh and other climate-affected agricultural regions [28]. Our study reveals that communities exposed to flood have no alternatives as the recurring droughts and low agricultural returns leave no options and force people to farm in flood-prone areas. Drinking water risk has also been identified as a major risk because the people have to travel long distances to fetch water, water that is contaminated and carries water borne diseases. Using dugouts and small scale dams to harvest rainwater have been reported to be effective, but the use of

these measures has been constrained by the lack of financial resources [2]. Farmers are vulnerable to unexpected events, such as flooding from extreme weather; seasonal variations, particularly in the timing and amount of rainfall; and long term trends, such as an increased mean temperature. Coping strategies are commonly in place to reduce vulnerabilities to seasonal variation. Such coping strategies include planting a mixture of crops and cultivars adapted to different moisture conditions, using landraces resistant to climate stresses, and conserving water [30, 31].

Not much coordinated and planned community adaptation strategy has been observed. Major adaptation strategies taken by the communities, which are basically reactive rather than proactive, have included migration, charcoal production, livestock selling, and risky riverside farming. The communities have mentioned that they intended to adopt innovative preventive measures but were unable to implement them because they lacked the requisite knowledge and financial resources. The most preferred adaptation strategies are irrigation facilities, boreholes for potable water, seasonal forecasting systems, and crop varieties. People also prefer rainwater harvesting as a potential mechanism for reducing drinking water risks, but it is not considered to be feasible or affordable because of large household sizes and tank construction costs. Communities have identified that the diffusion of innovative preventive measures to fight drought and flooding can be possible because all communities are endowed with many resources, including manpower, land, timber, stone, and sand. Some critical measures identified in this study are rainwater harvesting, water shed management, a seasonal weather forecast system, and drought preventive household actions. Improving communities' intentions and capacities to implement risk preventive measures in combination with the mobilization of local resources are imminent challenges for planners and researchers to reduce the climate change risks in the region.

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