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The *Gablilo* Phenomenon: Local interpretations of on-coming flood events and forms of preparedness adopted by Families in the Nyando River Basin of Western Kenya

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Abstract; Gablilo Olil* (Gablilo is dark) and *Gablilo Oliero* (Gablilo is hanging overhead) are pronunciations which bear heavy meanings to the people of Nyando River Basin of Western Kenya. Unbeknown to many weather experts and humanitarian agencies that support flood victims in western Kenya, the local community in the Nyando River Basin seems to have developed local forms of interpreting on-coming flood events long before the disaster arrives. While much highlight has been directed at the sufferings experienced by the victims during flood disasters, little attention has been given to forms preparedness adopted by the people to enable them to cope with their miseries over time. This article explored how the local community interpret the on-coming weather events and the consequent forms of preparedness they adopt to enable them cope with such disasters in the Nyando River Basin of western Kenya. Through a descriptive design, a sample size of 324 households was involved in providing quantitative data while qualitative information was gathered from community leaders and health workers, as well as the interior ministry officials from the area. Dark clouds hanging over the Nandi escapement for approximately three days, locally described as *Gablilo*, and movement of the wind from Lake Victoria towards the mountains are interpreted as clear signs of pending floods. Many other local forms of predicting on-coming weather are also discussed. Interventions addressing flood disasters should consider local forms of interpreting and predicting weather events.

Keywords: **Climate Change; Flood Disaster; Gablilo; Nyando River Basin; On-coming Weather events.**

1. INTRODUCTION

Indigenous communities across different contexts have often deployed local weather forecasting mechanisms to predict on-coming climate change events such on-set of rainfal and droughts (Radeny et al, 2019). According to United Nations Environmental Programme (UNEP, 2008), prediction of on-coming weather conditions have been phenomenal in informing adoption of appropriate adaptation measures to address extreme weather events especially in the developing economies such as the Sub Saharan Africa. Traditional ecological knowledge has therefore remained part of a valuable social resilience toolkit that is heavily relied upon by many indigenous communities for developing adaptive measures to natural disasters (Nyong, Adesina & Osman, 2007). This is because traditional societies have over a long period of time built up knowledge about environmental changes and have consequently developed elaborate strategies to recognize and cope with these variations (Lantz & Turner, 2003; Lefale, 2010; Egeru, 2012). In the context of global climate change, traditional and indigenous peoples have valuable lessons to offer about successful and unsuccessful adaptations to change, lessons which could be vital in responding to extreme weather events such as flood disaster (Alemayehu & Hizekeal, 2022). Radeny et al (2019), however, lament that despite the significance of indigenous knowledge (IK) weather forecasting, there is lack of adequate documentation on its benefits especially with how it arouses preparedness towards ensuing flood disasters.

Commonly referred to as place-based knowledge accumulated across generations within numerous specific cultural contexts, the value of IK weather forecasting stems from long periods of observation, interaction, and experimentation with species, and ecosystem processes (Jessen, Ban, Claxton & Darimont, 2022). According to Ziervogel and Opere (2010), IK weather forecasting inbuilt in many African cultures utilise different indicators to predict future weather conditions. For instance, farmers, pastoralists, and indigenous experts in East Africa observe local weather phenomena and behavior of living organisms including appearances and behavior of certain insects, animals, and plants (Kagunyu et al, 2016). Direction of wind and types of clouds are also used as indicators for forecasting local weather conditions such as on-set, cessation, intensity and distribution of rainfall as well as occurrence and magnitude of drought and flood events (Alemayehu & Hizekeal, 2022). Indeed, a number of previous studies in East Africa indicate that indigenous weather forecasts are used for making crop and livestock production decisions, conserve the environment, and deal with other natural disasters in Uganda and Ethiopia (Egeru, 2012; Ayal et al, 2015). Similarly, communities in parts of Tanzania have largely relied on IK to forecast weather through observation and monitoring the behavior of animals, birds, plants, and insects (Acharya, 2011; Kijazi et al, 2013). In Kenya, agro-pastoralists have relied on environmental indicators such as movements of migratory birds including the white quails (*Tsisindu*) and the eagle (*Esikhokhotole*) to predict rainfall variability (Speranza et al, 2010; Misiani et al, 2021). Whereas, IK weather forecasting appears to be crucial in supporting efforts to mitigate climate change impacts in many communities in Africa, how it has informed preparedness towards flood in regions hardest hit by the disaster has received little attention.

The Eastern Africa countries are probably the hardest hit region in Africa accounting for 41% of flood disaster events, followed by West Africa (24%) and North Africa at 14% (Lukamba, 2010). Some of the worst flood events have occurred in Kenya, whereby between 1990 and 2014, the percentage loss attributed to flood disasters was 71.9 % compared to drought (17.5%) and landslides (7%), according to Huho and Kosonei (2014). Flood disaster severity in Kenya is perhaps symbolised by its impacts in the Nyando River Basin, where the cost of annual relief and rehabilitation is approximately Kshs 57 million or US$ 600,000, constituting 71% of the national disaster relief (Okayo et al, 2015). According to Ochieng, Otieno and Ang'awa (2017), annual disaster in the Nyando River Basin affects Muhoroni, Nyakach, and Nyando Sub Counties of western Kenya. It is estimated that over 85% of households living in areas considered as high-risk zones in the Nyando Basin report damage to their houses annually (Nyakundi, Mogere, Mwanzo & Yitambe, 2010).

The severity of flood disaster discussed in the preceding paragraph illustrates miseries facing majority of the families especially those living in the Nyando River Basin. It is against this background that a deeper understanding of the effectiveness of indigenous forms of predicting on-coming weather conditions was sought by the researchers. The ancient Luo community, which dominate the Nyando River Basin, had different traditional ways of predicting weather based on analyses of changes in the environment. For instance, among the fishermen in Lake Victoria, continuous crying of *Kwasi* (African fish eagles) or its sudden flight in the middle of the Lake meant a sudden change in wind direction and strong wind, which is dangerous for fishing boats as they may capsize (Onyango et al, 2021). Similarly, the arrival of large flocks of common swallows (*Hirundo rustica*) circling the sky which was an indication of the start of the rains. Conversely, late arrival of emergent lake flies moving from west to east over Lake Victoria signaled the late arrival of rains and poor rainfall (Obiero, Klemet-N'Guessan, Migeni & Achieng, 2023). The aforementioned studies tend to shed light on how local forms of predicting weather patterns have been relied upon even by the Luo community in western Kenya to anticipate on-coming climate events. However, how the IK weather prediction has aided the Nyando River Basin community members in designing and building response mechanisms to flood disaster has not been highlighted. This paper was set to explore local interpretations of on-coming flood events and forms of preparedness adopted by families in the Nyando River Basin of Western Kenya.

2. MATERIALS AND METHORDS

2.1 Research Design

Cross-sectional descriptive survey design with mixed-methods approach was utilised in this study. This design utilised both quantitative and qualitative methods of data collection and analysis (Poth & Munce, 2020). This approach enabled the researchers to use quantitative methods to measure particular features the research phenomenon and qualitative methods for other facets, as proposed by Dawadi, Shrestha and Giri (2021). In addition, this research work gained from concurrent triangulation of data accorded through this approach especially during interpretation of the results.

2.2 Study Area

This study was carried out in western part of Kenya, in the Nyando River Basin. This basin runs across Nyando, Muhoroni and Nyakach Sub-counties of Kisumu County. Straddling the equator bound by longitudes 34°45' 0' E and 35° 21' E, the Nyando River Basin covers an area of 3500km^2 in Kisumu County with a poverty level standing at 60%, way above the national level of 33.4% (Masese, Neyole & Ombachi, 2016; Onyuro, 2020). Flood disaster occurring in the Basin affects 75% of the households in the area, representing 53% of the national flood disaster victims in Kenya, and absorbing approximately 71% of the national disaster relief in Kenya (Okayo, Odera & Omuterema, 2015).

Nyando River remains the historical source of the frequent flooding in the area, responsible for flood return frequency of between 3 and 7 years with an average magnitude of 400 m^3/sec (Opere, 2013). Approximately 15,000–20,000 hectares of land in this area is often susceptible to floods (Opere, 2013). This affects over 5,000 people every year during April-June (long) and October-November (short) rainy season (Masese et al, 2016).

2.3 Study population and Sample

The study targeted 1, 728 households (Muhoroni=482; Nyando=1, 246) which have frequently been predisposed to floods each year (Onyuro, 2020). Target population also included officers from the Ministry of Interior (the chiefs and their assistants), Community Based Organizations (CBOs) operating in the study area, local community health workers, and local disaster committee members.

Sample size of the study was computed using Taro Yamane's formula (Yamane, 1976) as:

$$n = \frac{N}{1 + N(e)2}$$

(N = target population; n = sample size; e = significance level at 0.05). Based on the formula, the sample size of the study was:

$n = \frac{1728}{1+1728(0.05)2} = 324$

2.4 Instrumentation, Validity and Reliability

Closed and open-ended questionnaire was administered on the sampled household heads to collect both qualitative and quantitative data. This allowed for spontaneous responses including one-on-one interviews with the household heads, a fact emphasized by Hyman and Sierra (2016). Multiple rating scales were utilised to quantify constructs of respondents' opinions with regards local interpretations of on-coming weather events and the consequent measures or preparedness adopted by the families in the study area, as: 6 - Very Frequently (VF); 5 - Frequently (F); 4 - Sometimes (S); 3 – Occasionally (O); 2 - Very Rarely; 1- Never (N). Subedi (2016) recommends this approach because it makes the responses to be easily quantifiable and subjective to computation of mathematical analysis. Interview schedule was also used to collect data from officers from the ministry on interior (the chiefs and their assistants) and Community Based Organizations (CBOs) operating in the study area, while Focus Group Discussions (FGDs) were conducted with local community health workers and community elders.

Content validity index (CVI) was used to enhance the validity of the study instruments. This was achieved by involving ratings of four experts who analysed the extent to which constructs of the study variables are measured by the question items as Dawadi, Shrestha and Giri (2021) highlights. For this study, the formula propounded by Davis (Davis, 1992) based on a 4-point ordinal scale of 1 (for not relevant) to 4 (for highly relevant) for measuring Item Content Validity Index (I-CVI) was adopted as:

I-CVI = (agreed item)/ (number of expert)

The calculated rating of the four experts generated a CVI of 0.88. This was considered to be highly relevant by the researchers.

For instrument reliability, the study employed split-half method using pilot study data from randomly selected 32 households. Reliability index using Cronbach's Alpha coefficient was computed with the aid of a computer package (SPSS version 23). The study used the threshold of 0.7 and above as a pointer to a satisfactory reliability (Nunnally, 1978).

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2.5 Data Analysis and Presentation

Data obtained using questionnaire was analysed via descriptive statistics with the aid of SPSS version 23. Descriptive statistics enabled generation of frequencies and percentages which was essential for interpretation of quantitative results. Similarly, thematic analysis was used to analyse qualitative data obtained from open ended questions in the questionnaire, interviews and Focus Group Discussions.

3. ETHICAL CONSIDERATIONS

For ethical considerations, an assent form was designed and signed by the sampled household heads. For purposes of confidentiality, participants were asked not to exclude their identities from the research instruments. In addition, the researchers obtained clearance to conduct the field study from Maseno University Scientific and Ethics Review Committee (MUSERC) and the National Commission for Science, Technology and Innovation (NACOSTI)

4. RESULTS

Questionnaire was administered on 324 household heads (Male = 51.9%; Female= 48.1%) The average of the respondents was 31 - 40 (37.3%) and 41 – 50 years (30.6%). For education level, 44.1% had primary level of education, while 34.3% had secondary level of education. Majority (79%) of the sampled respondents were married while 17.6% were widowed and 3.4% were single. Most households (37%) had between three and four members, while 35.5% had a size of 5 – 6 members. Similarly, most of the household heads (38%) had a monthly income level of below Kshs. 5, 000.00, while 29.9% had a monthly income level of between Kshs. 5, 100.00 and Kshs. 10, 000.00.

4.1 Local Forms of predicting on-coming Floods

The study enquired from the sampled community members the local forms or ways of predicting the on-coming flood event mostly relied upon and the reasons as to why they think or believe so. Table 1 presents the responses with regards to the most effective ways of predicting floods in the study area.

Table 1: Local ways for Predicting Floods

Reliable sources of information for flood prediction	Frequency	Percent
Radio announcements	57	17.6
Movement of clouds	103	31.8
Blowing of wind	124	38.3
Behaviour of some birds/domestic animals	28	8.6
Radio	12	3.7
Total	**324**	**100**

Blowing of wind (38.3%; n=124) and movement of clouds (31.8%; n=103) as revealed in Table 1 are considered as the most effective ways of predicting on-coming floods in the study area. This observation was also reflected in the qualitative data from FGDs with selected elders from the study area. A male FGD participant stated:

Local people understand very well that when the wind blows from the Lake towards the Highlands, it is going to collect rain. And when it is carrying rainfall when it is blowing back from. Similarly, appearance of heavy-dark clouds over the Nandi Highlands is a precise indication of on-set of heavy rainfall (male FGD participant).

The sentiment of the male FGD participant indicates that the community of Nyando River are able to read changes in the environment in terms of movements of wind and clouds which help them to predict the anticipated weather including floods. A good explanation of why movement of wind is believed to be causing heavy rains and floods emerged in one of the FGDs with community elders, where a female elder said:

Dry winds moving towards Nandi Mountains and white clouds hanging over the *Nandi Hills* signifies that the rains are nearing. Such winds and clouds are often on a rains-collection mission. Within two weeks' time, the winds will start blowing back from the mountains and the clouds will come back, this time darker- heavy with rainfall - to our areas (female FGD participant).

As highlighted by the female elder discussant, three natural features in the environment around the Nyando River Basin are believed to be responsible for heavy rainfal and floods in the area. These are movement of the wind and appearance of clouds. These two are often interpreted with regards to how they appear around the Nandi Hill. It appears that the people of

Nyando River Basin understands that the Nandi Hill has a lot to do with eventual floods happening in the area based on interaction of wind and cloud with the escarpment.

The researchers additionally enquired about the traditional mechanism widely used for predicting the on-set or arrival of floods. Quantitative results obtained are tabulated in Table 2.

Table 2: Traditional Mechanisms for Predicting On-set of Floods

Cultural mechanisms for predicting flood on-set	Frequency	Percent
Croaking of Frogs	79	24.4
Movement of clouds	103	31.8
Blowing of wind	124	38.3
Behaviour of some birds/domestic animals	28	8.6
Total	**324**	**100**

Table 2 illustrates that blowing of wind (38.3%; n=124), movement of clouds (31.8%; n=103) and croaking of frogs (24.4%; n=79) are the traditional mechanisms relied upon to predict the on-set of floods in the area. The qualitative data collected during interviews with the interior ministry officials also reinforced the findings regarding the interpretation of on-set of floods based on movement of wind and clouds. A male officer from the office of the area Assistant chief who is also a member of the Nyando community stated:

The mentioning of Gablilo in the mouths of Nyando residents sends shivers across their spines. This is because it signals the impending flood event. These people are always aware when the flood is about to occur. Movement of wind towards the Mountain especially in the afternoon signifies an impending heavy rain on the Hill. Similarly, appearance of dark clouds and fierce lightening over the Nandi Hill, locally referred as Gablilo, and known even by children, is an indication that floods will occur anytime even without rainfall in the area.

Floods in the Nyando River Basin, based on the sentiment of the interior ministry official, are associated with the weather patterns between the area and Nandi Hills escarpment. Consequent to the weather patterns in the two areas, actions of some amphibians especially frogs also emerged to be following the above-mentioned ecological interactions. During FGDs with selected community elders, an explanation of how croaking of frogs was interpreted as a sign of on-set of floods was highlighted. A male FGD participant stated:

Movement of the wind towards the Hill and the subsequent appearance of dark clouds will often orchestrate croaking of frogs especially near streams, rivers and other water bodies in the area. This is because the frogs appear to 'smell' the nearing of floods hence they 'cry-out' to their colleagues to come out and remove their eggs away from the path of the impending water overflow which could sweep the eggs away. Continuous croaking of the frogs over the night indicates that around mid-morning the following day, the 'visitor' will arrive (the flood will hit the area) (male FGD participant).

This man's views suggest that the people of this area have identified specific indicators based on observation of changes in the local environment to predict future weather events. These findings seem to suggest that the people of Nyando River Basin understand and are well aware of when the floods are going to hit them.

4.2 Preparedness informed by Prediction of On-coming Floods

Having established the forms of indigenous knowledge (IK) of weather prediction by the people of Nyando River Basin in regards to the on-set of flood events, the researchers proceeded to explore the forms of preparedness adopted by the community in mitigating the ensuing disaster. Table 3 summarises the forms of preparedness adopted to combat the impacts of on-coming flood disaster.

Table 3: Preparedness based on Traditional Prediction of On-coming Floods

Preparedness for On-coming Flood Disasters	Frequency	Percent
Goyo Ndiri (Constructing ridges)	106	32.7
Channeling (*Yawo Ofula*)	78	24.1
Moving property to safer grounds	124	38.3
Preservation of foodstuffs & firewood	16	4.9
Total	**324**	**100**

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Table 3 highlights that the immediate actions that the people of Nyando River Basin take in realising that floods are arriving involve moving their property to safer grounds (38.3%; n=124), *Goyo Ndiri* or constructing ridges (32.7%; n=106), and *Yawo Ofula* or making channels to enable water to flow easily or passes by faster (24.1%; n=78). These are the forms of preparedness that the local people of this area have often deployed to respond to the anticipated flood events. These preparedness mechanisms were also highlighted in the qualitative data obtained through FGDs where a male elder explained:

The on-set of rainfall often sets forth activities such as *Goyo Ndiri* (constructing ridges) around our homes, as well as channels on specific spots on the compound to enable easy flow of water. Similarly, we also start *migrating* or evacuating some property as well as children and elderly members of the family to places situated on higher grounds or evacuation centres. In addition, we also start preserving some foodstuffs as well as firewood for use during the flood events.

The explanation provided by the male discussant highlights that the people of the area have specific actions that they often take to prepare for the on-coming or anticipated flood event. These include activities aimed at controlling the overflowing water, salvaging properties and vulnerable family members, and preserving goods to be used during the disaster.

Further analysis was also carried out on post disaster activities which ensures recovery by the victims of the flood events. Table 4 presents post-flood disaster opportunities available in the study area.

Table 4: Post-flood Disaster Recovery Activities

Post- Flood Disaster Activities	Frequency	Percent	Description of Gains
Fishing	96	29.6	Availability of indigenous fish species such as mud fish and cat fish
Maize/Sorghum Vegetable farming	81	25	Bumper harvest of maize, sorghum, and Kienyeji vegetables
Rice farming	127	39.2	Bumper harvest of rice
Other Activities	20	6.2	Large deposits of sand, etc
Total	**324**	**100**	**100**

Table 4 illustrates that rice farming (n=127; 39.2%), fishing (n=96; 29.6%), and vegetable farming (n=81; 25%) are major post-disaster activities that are relied upon for post-disaster recovery by people of the study area. Despite of the losses and social disturbance that these people often face due to flood disasters, there are activities which enable them to "bounce back" from the miseries. Qualitative data from FGDs aptly captured these activities, where one female community health worker stated:

The floods often bring deposits of fertile soil which help us in producing bumper harvests especially local vegetable such as *Osuga*, *Ododo*, *Bo* and *Dek*, and green maize and sorghum. Bumper harvest of rice often follows after the flood events. Floods leave behind fertile soils that has helped in the production of rice even without manure or applying chemical fertilizers. In addition, flooded areas normally leave behind caves where fish such as *Kamongo* reside, thereby giving the villagers large catches of fish to survive on.

Part of the abilities of the people of this area to tolerate the flood disasters, as emphasised by the female community health worker, is their capacity to turn these adversities to benefits: they capitalize on the floods to produce more food for consumption and even for sale.

5. DISCUSSIONS

This study has found that there is a close connection between rainfall patterns in the study area and the weather patterns around Nandi Hills. Winds moving over the Nandi Hills send a message of impending weather changes to the people of Nyando River Basin. Similarly, wind and cloud coming from the Nandi Hills signify the on-set of rainfall to the community in the study area, guided by the movement of clouds and winds. Relying on the movement of wind to interpret on-coming weather patterns as revealed in the study had also been revealed in previous research among the Luo fishermen along Kenya's Lake Victoria, which included part of the current study, by Onyango et al (2021). Onyango and colleagues showed that the fisher folk community in the area refer to a certain strong wind coming from the southwest as "*Ogingo*" which brings waterspouts known locally known as "*Nyakoi*". Among these fishermen, "*Tarai*" is also another strong wind from

the east while "*Ombalo*" is a strong wind from the south (Onyango et al, 2021). Similarly, "*Kus*" is the name given to a strong wind which produces gusts that come suddenly from different directions. The interpretations by these fishermen in regards to interpretation of the on-coming weather conditions seems to be akin to the understanding accorded to movement of wind by the people of Nyando River basin as revealed in the current study.

The research findings with regards to prediction of on-coming weather based on movement of wind revealed in this study concurs with previous study done in different countries such as Uganda by Okonya and Kroschel (2013). In their work, Okonya and colleague revealed that presence of red clouds in the morning and winds blowing west to the east are predictors of rain in the following days. In Ethiopia, Kidemu et al (2020) established that circulation of wind and appearance of cloud cover are important indicators of impending weather-disaster risks relied upon by rural farmers. Dube and Munsaka (2018) in Zimbabwe as well as Praveen et al (2018) in India have also established that local communities in these contexts often rely on movement of wind to predict the on-set of rainfall. In the same vein, the people of Nyando River Basin seem to have utilised these indigenous patterns of predicting on-coming weather conditions to build adaptive capacities and to mitigate impacts of flood disasters in the area which in turn seem to have enabled them to sustain themselves.

The Nyando Basin community, as revealed in this study has been interpreting the movement of cloud over the Nandi Hills, commonly known as *Gablilo*, to predict the on-set of flood disasters in their villages. This study shows that movement of dark clouds commonly referred to as *Gablilo* have been most effective in guiding the households in the area to prepare and cope with on-coming flood disasters over the years. This gives the notion that the people of Nyando Basin would definitely know the type of weather to expect (whether floods or not) in a few days' time based on appearance of certain types of clouds. Likewise, to findings in a previous study by Powell (2016) among fishermen in the shores of Lake Victoria which showed that appearance of big white clouds with dark edges signifies dangerous gusts of wind, *Gablilo* sends shivers among the spines of Nyando Basin villagers due the foreseen flood disaster. Residents of this area have been found to put up remedial measures in preparation of the expected disaster by digging channels around homes to control the water, they move their property and vulnerable family members to safety, as well as preserving goods including foodstuffs for use during flood event. These revelations concur with findings in a study done in the same area by Masese et al (2016) which also established that the first actions normally taken by flood disaster victims is the evacuation of property to safer places. In a context away from the study area, a past study in Nepal by Sharma et al (2022) showed that families in flood prone areas often construct wooden fences around their houses and refill their compounds using soil to protect them from flooding water. Besides this, they also move their children and property to safer location, particularly to their relatives' houses. The families also store food (garlic, onions) by suspending them from the ceiling. These are actions or steps which ensure that life continues post-disaster that have been adopted even by the people of Nyando River Basin of western Kenya.

6. CONCLUSIONS

The study concludes that people of Nyando often employ traditional sources of climate information for predicting the on-set of rainfall. These include movement of dark clouds, blowing of the wind, and the behaviour of frogs, wild birds and domestic animals. The study specifically concludes that appearance of dark clouds over the Nandi escarpment locally known as *Gablilo* is a precise indication of an on-coming flood disaster in the area. It is also concluded that appearance of Gablilo instigates various measures of mitigating the impacts of impending floods. These measures include evacuation, *goyo Ndiri* (putting up ridges) and *yawo ofula or kiewo* (channelling).

7. RECOMMENDATIONS

The study reveals that appearance of dark clouds over the Nandi escarpment is clear a sign of the on-set of floods in the area and in turn households in the study area would embark on activities such as evacuation, dyking and chanelling among others. The study therefore recommends that mitigating flood disasters among the households of Nyando River Basin should start from the Nandi Hills towards downstream, with measures such as dam construction on waterways feeding into Nyando River given high priorities. In addition, further exploration should be done to gain an understanding on the extent to which existing policy interventions guiding flood disaster are aligned to local interpretation for predicting weather patterns and how this has influenced response to flood events in the Nyando River Basin of western Kenya.

8. SUGGESTIONS FOR FURTHER RESERCH

Critical examination on the general challenges facing the integration of local knowledge and scientific knowledge in climate change adaptation and disaster preparedness mechanisms.

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