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Local knowledge and practices can help in drought prediction and extreme weather management

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Local knowledge and practices can help people in drought prediction and extreme weather management. The study was carried out to elicit and document local knowledge use in drought prediction and weather extremes management. Focus group discussions were used for this study. The appearance of certain insects, birds, animals and indication of weather are all seen as important signals of change with respect to timing and seasonality of natural phenomena that are well understood in traditional knowledge systems. The lying of pigeon on the ground by spreading its feathers is considered as the sign of drought. The sound of wild cat with *dhul* was also indicates the notice of drought. If the west sky appeared with bright red colour during sunset, that also warn the drought. Termites den and mound in dry soil was thought as the hint of immense drought and termites den and mound in wet soil was looked as the indication of immediate rainfall. People from Hindu families organized frog's marriage to end drought. They find that local knowledge and practices are very much useful in drought prediction and management.

Keywords: Drought, Local knowledge, Barind, Extreme weather patterns, Disaster, *Santal* people

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Drought can be defined as an environmental disaster and have drawn attention of environmentalists, ecologists, hydrologists, meteorologists, geologists and agricultural scientists[1]. Drought can be defined as a natural phenomenon resulting from a lack of water resources. Drought is the most complex natural hazard and it is a common disaster phenomenon for the North-West region. It is just like chronic disease. Drought is a relative term that can mean different things to people from different backgrounds and with different viewpoints. This is happening due to lack of continuous decline in rainfall in term of space and time. In Bangladesh, drought condition prevails for a prolonged, continuous period of dry weather along with abnormal insufficient rainfall. Indigenous knowledge defined as a body of knowledge built up by a group of people through generations of living in close contact with nature. According to scholars, indigenous knowledge has been defined as institutionalized local knowledge that has been assembled upon and passed on from one generation to the other by word of mouth[2,3]. Indigenous or local knowledge is used for the prediction of drought in the rural areas of Bangladesh. Beliefs like spirituality may control how resources are supervised and how enthusiastic people are to implement strategies[4]. Several folk literature related to weather, climate and agriculture (e.g. in the *Khanar Vachan*, proverbs told by a lady named *Khana* in the ancient times) have been documented traditional knowledge and practices in Bangladesh[5,6] .

Drought prediction plays a significant function in the scheduling and management of the water resource. Drought prediction must endow with information on drought severity, duration and location in utter time (initial and termination time points). To reduce the impact of drought and to improve drought preparedness and response it is quite essential to predict drought[7]. To monitor dryness and wetness on multiple time scales, Standardized Precipitation Index (SPI) has been used[8]. According to several researchers the SPI properly measures the dryness and wetness

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allowing comparison of climatic conditions of areas governed by different hydrological regimes[9-11]. Also different prediction models have been developed to predict drought as well[12]. Indigenous knowledge is espoused in this research how the local people use their local knowledge in predicting drought and managing weather extremes. The local weather and climate is assessed, predicted and interpreted by locally observed variables and experiences using combinations of plants, animals, insects and meteorological and astronomical indications. The local people are habituated with the use of local knowledge in drought prediction and extreme weather management by using their local knowledge. The objective of the study was to explore and document local knowledge systems that were applied in drought prediction and extreme weather patterns in the study area. Eventually how they use plants, animals and other meteorological indication in drought prediction and management of weather extreme. In many countries signs and animal's abnormal behavior are being studied before natural calamities for their scientific base and thus acceptability[13].

Methodology

The study was concentrated in six villages under six sub districts (one village from each sub district) in three districts from Barind Tracts which is situated at the North-West region of Bangladesh. Based on geographical settings, drought severity and ranking, three districts (Rajshahi, Chapainawabganj and Naogaon) were selected from North western region of Bangladesh[14]. According to the study of CEGIS, 2013, six Upazilas were selected based on drought severity ranking (two sub districts from each district). Finally Tanore (rank 2) and Godagari (rank 12) from Rajshahi district, Nachole (rank 3) and Shibganj (rank 9) from Chapainawabganj district and Niamatpur (rank 1) and Porsha (rank 4) from Naogaon district were selected for this study. Six Unions from six Upazila (each union from each upazila) were selected considering drought severity, production loss and affected livelihoods. The selected study areas are prone to drought and demonstrate extreme weather patterns. Data were collected using both primary and secondary data. Secondary data were collected using literature review. Primary data were collected through Focus Group Discussions (FGDs) and that were conducted at six villages. Thirteen FGDs were conducted to elicit local knowledge regarding drought and extreme weather patterns. One focus group discussions with male group and one FGD with the female group were conducted from each village. Each focus group comprised of between six and eight persons. Guided checklist was used to facilitate the session. Another FGD was carried out with the ethnic people (*Santal* people) to elicit their ways of drought prediction and management of extreme weather by using their inherent knowledge. Outcomes of the discussions were recorded and documented.

Results and discussion

Local knowledge used to predict drought and weather patterns

Natural disasters like drought is caused huge damage to the agricultural (crops, livestock, fisheries, horticulture) production and livelihoods in the study areas. The people of the study area were used local knowledge for the prediction of drought and weather extreme management. The local knowledge that were used to predict drought and weather patterns in the study area were described here. The respondents from the study area were mainly used key indications and symptoms based on animals behavior and few characteristic of weather parameter (Table 1). The respondents were mentioned that they can predict future drought by observing pigeon's lying with spreading feathers. In predicting drought, they were used few symbols, sound of wild animals, insects movement as the indicators. They were also mentioned that they use the sound of wild cat as the indicator of drought. The local people are being practiced the bright red colour of the sky during sun set as the sign of immediate drought. Peoples in the study areas were used sunny days as the indicator of drought too. Strong sunlight and high temperature give reflection of rays and local peoples were taken it as a drought prediction tool. The frequent lighting and thunder in the East sky at night was also used as the sign of drought. Peoples were used termites movement as the drought prediction device. It included both upward and downward movements. The upward movement as indicated the future drought whereas, the downward movement was directed no drought for few months. On the other hand, the appearance of black ants with eggs and grains were also indicated the end of drought. It was also considered as the hope of heavy rainfall when frogs start blaring or croaking. If a snail

Table 1 — Local knowledge used to predict drought and weather patterns

Predictors/signs	Descriptions
Pigeon feathers	Pigeon lying on the ground by spreading its feathers, the indication of drought.
Sound of wild cat	If the wild cat make sound with *Dhul/Mul* and people ask to the wild cat and response with *dhul* then drought may occur.
Ant's upward movement	If ant starts to move upward from down, rain may come.
Red colour in the west sky	If the sky shows bright red colour in the west sky during sunset, drought may come in the following year.
Sun light's kid	If sunny days show illusion like *roder bachha*, drought may occur.
Thunder in the east sky	If frequent thunder happen in the east sky at night. This indicates drought in the next year.
Abundance of termites	When large number termites found in the mound, drought is the immense issue for the year.
Visibility of black ant	Appearance of black ants and storing grain and eggs in safer places indicate that the rain follows for couple of days.
Hoppers fly	If hoppers fly randomly, drought may occur.
Dark clouds on the west sky	The appearance of dark clouds on the west, the immediate hail storm accompanied by thunder, lighting and *kalboishakh.*
Chirping of Fatik bird	The chirping of Fatik bird (common *lora*) during October to April is a sign of rainfall.
Rainbow	If rainbows come in the eastern sky, there would be chance of drought and if it comes in the western sky that indicates sure rain.

climbs on trees, earthworm crawls plenty in and around; Ants move to safer places, all these were taken as the indication of extreme weather followed by heavy rain. Peoples in the study areas were mentioned that when hoppers start fly around then drought is the immense issue. Swarming of worm over cow dung was taken as the sign of heavy rain. Rainbow can help peoples in predicting drought and extreme weathers. Even local people can predict cyclone and *Kalboishakhi* by observing dark clouds on the West sky during summer. These types of local knowledge and practices were widely used in the rural communities in the study sites. Older and illiterate people are very much fond of using local knowledge on prediction of drought and weather pattern. The knowledge that was applied by the local people to predict weather patterns and drought are linked to belief, myths and superstitions and their usefulness were not proven.

Both hydro-meteorological and biological signals were used by the ethnic people[15]. As per our study these types of signals were also used by the people in predicting drought. The local knowledge that is unique to every society. Indigenous knowledge is the fundamental for local level decision making tools in agriculture, natural resource management, economic activities, and host of other activities in rural societies[16,17]. The prior to emerging modern technologies, peoples were tried at their best to use nature indication to predict natural disasters and extreme weather event[18]. It is essentially important to tie indigenous knowledge into formal Disaster Risks Reduction (DRR) policies[19]. It is the time to integrate local knowledge systems with modern technologies can contribute lots in managing natural disasters of Bangladesh.

Local practices used to reduce drought impact

Respondents were reported that they experienced from food insecurity, some of these had food for nine months and rest could not direct food for six to three months. Marginal and small farmers were more vulnerable to the basic five livelihood assets including human capital, natural capital and financial capital[20]. Research showed that women and farmers from marginal and small holdings were more vulnerable and less competent to cope with climate change hazards and limited access to diversified livelihood options[20]. Drought is the severe disaster in the Barind, and the study areas are more vulnerable to drought. Several local practices including frog's marriage, mulching, establishment of mango orchard, planting of trees and home gardening were applied by the respondents. Peoples especially from Hindu family organized frog's marriage to end drought during severe and continuing drought (Table 2). Such type of practice is not providing any science back and it is also sometimes known as superstitions and the functionality on ending drought has not been proven scientifically. Many of them were mentioned that they obtained results and this is their old aged practice. Another way to reduce drought and extreme weather

impacts was to use of mulches around fruit trees at their homestead and crop field for horticultural production. The practice is very much helpful for potato cultivation, tree and fruit production to conserve soil moisture and reduces the impact of extreme temperature by lowering soil temperature. This practice can sustain in drought situation over any times. The other means of protecting drought impacts was establishment of mango orchard. Large numbers of farmers were established mango orchard instead of grain production (where restricted the cultivation and damage to the crops) to protect drought impact on production. The planting of trees make them confident to be immediate measures to protect drought and extreme weather impact. Peoples in the study areas were planted huge numbers of trees including fruits and timber trees along the road side and homesteads. Home gardening is the common practices in the study areas to reduce drought impact especially women were grown vegetables in their homestead for their own consumption and surplus to sell in the market. Field crops based on types and nature require water for its cultivation. Comparatively it is easy to manage home garden rather than field crops during drought. Respondents were mentioned that few of them were migrated alone or along family members to the urban areas (District and Division town) for short term migration and they returned to their home after immediate end of drought.

Local practices used to reduce drought and weather extreme effects

The common mitigation and coping measures against drought include local methods of storing water, food habits, field practices and use of traditional medicine to treat diseases associated with drought. Drinking water is scarce during drought and it become very warm during drought period. Peoples in the study areas were collected drinking water from far away. After collection of drinking water, they were stored it into mud pot to keep water cool during high temperature and drought (Table 3). Even they were put mud pot underground to keep it cool for long time (over the day). The rural poor people have no refrigerator to make water cool for their essential drink. They were very much used to on use of mud pot to make it cool and store drinking water. The farmers in the study areas were worked long time in the field during hot days and rainy days. They were used *mathal* (one type hat which is made from

Table 2 — Local knowledge used to reduce drought impact and extreme weather

Practices	Descriptions
Frog's marriage	Peoples in the study area were arranged marriage for the frog to invite immediate rainfall to end the drought.
Use mulch (Mulching)	Farmers were used straw and water hyacinth as the mulch materials in the horticultural production at their homestead to protect drought impact on production.
Orchard establishment	Farmers were established mango orchard at their homestead and the crop field to mitigate drought impacts as a whole.
Planting of trees	Long back peoples in the study area were planted trees especially palm trees to protect drought and its impacts.
Short term migration	Farmers alone or along with family members were migrated to the urban areas for livelihoods and return to the home after drought effect.
Home gardening	Peoples of the study area especially the women started vegetables gardening in their homestead to protect drought impact on agricultural production.

Table 3—Local practices used to mitigate drought and weather extreme effects

Practices	Descriptions
Use of mud pot	Mud pots (*Matir kolosh*) were used to keep cool and store drinking water during extreme hot days.
Use of *mathal*	Farmers were used special hat made of bamboo locally known as *mathal* to protect them from extreme sunlight during drought.
Eat *Moringa* leaves	Peoples in the study area were used *Moringa* leaves as vegetable to balance their body temperature.
Use palm brown sugar	Peoples in the study area were usually used palm brown sugar to keep them cool during hot event especially during drought.
Wrapping with wet clothes	Farmers were used to wrap their body with wet clothes to make them comfortable in the field or home during drought period.
Eat *kolai ruti*	Peoples in the study area eat *kolai ruti* (special bread) to meet hunger during drought. This type of bread keeps them free from hunger for long time.

bamboo) to protect them from extreme sunlight at the time of field works during extreme hot days and rainy days. *Moringa* (Drum stick) leaves can protect people from *khora* who are affected by drought and balance their body temperature during drought. Local peoples were used brown palm sugar in preparing soft drink (*shorbat*). After drinking this type of *shorbat* (drink), they can keep them cool and sound during drought too. Wild vegetables were collected and consumed by the local people to sustain their harsh livelihoods during drought. The peoples in the study area were felt discomfort at the time of extreme heat and wrapped themselves with wet clothes to feel comfort during severe drought and extreme temperature at day time. Most of them were taken two to three times bath in a day to feel better. They were also changed their food habits during drought. They were eaten *kolai ruti* (bread) to sustain and met their long time hunger. They believed that this bread will meet their hunger for long time as the drought indicated food insecurity. Drought resistant and drought tolerant crops were grown when they understood the sign of immediate drought and low rainfall.

Local measures taken by rural poor to manage drought and extreme weather patterns

In managing high temperature, the respondents were usually taken two times bath during hot. They were drunk more water and store water. They were spread grasses on the tin roof and provide extra ceiling made of bamboo or wood or clothes or jute stick to manage extreme hot[18]. According to Irfanullah & Motaleb (2011) similar observation were reported in their study. Eventually they were planted more trees surrounding their homesteads (Table 4). They were purified pond water by using alum (*fitkary*) or boiling water during drought. Advance fishing was done in the early stage of drought and dries them to store for future usability. Few infrastructural measures were adopted by the local people including excavation or re-excavation of ponds, canals or mini-ponds to store water for domestic use and irrigation. Several studies recommended that the integration of modern technologies with local practices can play a great role to risks reduction in a given locality, especially under unpredictable future climate regimes[15,21,22]. It is anticipated that indigenous knowledge should bring into line, rather than compete with global knowledge systems[23]. This kind of practical knowledge acquired by the community through interacting with the environment, then it means that small holdings' habitual farming cultures are a form of practical indigenous knowledge, since they are pedestal on live experience[24].

Table 4 — Local practices to manage drought and weather extreme

Events	Local practices to manage drought and weather extreme.
High temperature	In case of tin shed roof, spread grasses on the roof to keep it cool. Provide bamboo/wooden ceiling to protect extreme hot. Drink more water Store water Plant more trees
Drought	Excavate pond/ mud well or mini-pond to store rain water Treat water before drinking like boiling and use of alum (*fitkary*). Dry and preserve all fishes before ponds dry.

Conclusion

The local knowledge found in rural communities in Barind is a combination of skills and techniques gained through experiences to live and survive the own way of life. Not all the local knowledge still has remained relevant. The people have developed a wide array of coping strategies, and their local knowledge and practices provide an important basis for facing the even greater challenges of drought. Though their strategies may not succeed completely, they are effective to some extent and that is why the people continue to follow these. Rural communities will need additional support to cope up with the drought and climate extreme, their expertise will offer a great help for the effective management of natural disasters. The farmers who have indigenous knowledge can predict drought and weather extremes and can cope with available strategies. Indigenous knowledge contributes a significant role in a community as they have existed as a whole. In producing best practices, it is important to combine both of the knowledge system.

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