

Indigenous and local knowledge system aiding disaster resilience: A case study of flood management in coastal Odisha

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ABSTRACT

In a disaster process, the local community has to resettle and recover from the temporary disturbances. In a natural setting, an ecosystem under threat from various extreme climatic events is required to be restored to its original pristine state for basic survival of the organisms including the humans. However, human systems do not necessarily return to an original or former state post a disaster. Hence, the challenge always remains there to continuously improve and refine existing structures, systems and environments to progress towards better human future. It is in this background, the current study descriptively analyzes the indigenous and local knowledge systems (ILKS) in the context of flood management in a village of coastal Odisha. The paper puts forth the idea that the ILKS create an enabling environment for a better disaster risk reduction approach. Both qualitative and quantitative techniques were used to reach the results. A detailed questionnaire was prepared to record the responses from the people with the use of certain pre-designed indicators. The result finds that the ILKS has a convincing and direct bearing upon the locals which not only facilitates the coping strategy in the short term but also fosters an encouraging motivation to withstand the climatic events without panic. It also finds that when ILKS is associated with community based risk management, the social vulnerability reduces to a considerable extent. The study concludes with some specific suggestions in general terms. The basic rationale of the research is to get an insiders' viewpoint of how the local people have been adapting to regular monsoonal floods using the ILKS having implications in similar kind of studies and application to other regions.

Keywords: Indigenous and local knowledge system, environment, disaster resilience, flood management, coastal Odisha, disaster risks

INTRODUCTION

A disaster is the function of impact of the natural hazards, the exposure to such hazards along with the underlying vulnerabilities of the people facing the disaster. When a disaster strikes, it affects directly to the local population as the first entity to response to the disaster is the community itself. Because, at the primary stage, no rescue or relief team from outside appears immediately or provide instant support activity. It is the locals who have to confront the looming hazard and have to be ready enough to withstand it. It is in this context that the concept of community-based disaster management (CBDM) becomes very popular in recent times in the disaster-prone areas. Returning to the pre-disaster stage corresponds with a tendency of specific communities to revert back to earlier habitations and rebuild their settlements. The lives and livelihood patterns need to be like that of the usual one. Therefore, if the locals could resist to the disasters once it is struck, any later relief works could better facilitate to recover the damage due to the fallout of disaster. In the process, they develop resilience within the community which not only helps in short term recovery but also

in the medium to long term adaptation to the surrounding environment, especially to the natural hazards. The basic rationale of the research is to get an insiders' viewpoint of how the local people have been adapting to regular monsoonal floods using the ILKS having implications in similar kind of studies and application to other regions. The uniqueness of this study is that it puts forth the idea of community resilience in withstanding the vagaries of disasters.

Conceptual frameworks

The Latin meaning of the term “resilience” refers ‘to bounce back’. Disaster resilience is ‘the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions’ (UNISDR, 2009). It is also defined as a ‘community’s capacities, skills, and knowledge that allow it to participate fully in recovery from disasters’ (Coles and Buckle, 2004). It then simply refers to the ability to flourish in the face of disaster risk. On the other hand, indigenous knowledge system refers to a trial and error based method of a community to adjust and adapt to its natural setting. For traditional communities, ILKS is ‘part of the day-to-day interactions with local ecosystems’ (Bwambale et al, 2020). It is nothing but a close association of man with the nature and its objects. It is important for us for ‘recognition, protection and promotion of indigenous and local knowledge’ as it ‘strengthens economic, environmental, social and cultural resilience within societies’ (UNESCO, 2016). While establishing a relation between ILKS and disaster, it is discovered that a disaster is associated with a local investigation process. Even before the era of disaster risk reduction using early warning system and other advanced techniques, many local communities around the world have been equipped with readiness and know-how act and cope with hazards using endogenous knowledge passed down from previous generations (Pratama and Sariffuddin, 2018). In this background, the studied community is found to be associated with innovativeness applying their indigenous knowledge systems, in predicting the hazards, preparing suitable plans and actions pre-emptively, and the societal unity as well. The results are fascinating to prove the point that the native population have been suitably coping with the flood situation in the locality.

The present study has been carried out with the following objectives:

1. To examine the role of local knowledge systems that aid disaster resilience
2. To explain how far the ILKS has helped in adapting the people to disaster events
3. To analyze a micro view of the natives' preparation during disaster situations

Review of literature

Traditional knowledge can contribute to disaster resilience by fostering a sense of community and shared responsibility. It can help strengthen social networks and foster a culture of mutual aid, crucial in times of disaster. Palekiene et al (2015) identified the specific aspects of resilience and linked to regional development concept and highlighted structural dimensions of regional resilience. The UNISDR report

(2008) on ILKS for disaster risk reduction has investigated several good practices in the Asia-Pacific region. It has documented several case studies to highlight the significance of traditional knowledge in managing the disaster events. ILKS are not without its scientific bases. There are different perceptions of modern science towards local knowledge systems such as Un-acknowledging, Utilitarian, Paternalistic, Neo-colonial, Essentialist, Intercultural (Dahdouh-Guebas et al, 2003; Rist et al, 2004). In fact, advanced and modern technological innovations have not been that satisfying in reducing the disaster effects. It views the world from a temporal perspective where humans are believed to be an active agent in modifying every natural possibility into opportunity (Rai and Khawas, 2019). Berkes et al, (2021) discuss the prospects toward adaptive governance using indigenous knowledge and resilience to disaster events. The authors found some literature gaps in establishing a linkage between ILKS, disaster resilience and community based disaster management. This particular study tries to advocate a detailed analysis of people’s preparedness towards a better disaster resilience based on their local knowledge systems. It is because ILKS enhances the social and cultural adaptive mechanisms. People do engage in all necessary steps to learn and practice these knowledge systems that have been the torch bearers in their process of adjustment to the ecological settings. Obi et al, (2021) highlight seven indigenous flood management knowledge systems such as –

- a) Indigenous technical knowledge
- b) Indigenous flood control knowledge
- c) Indigenous flood forecasting knowledge
- d) Indigenous detection of flood magnitude knowledge
- e) Indigenous safety knowledge
- f) Indigenous flood coping knowledge
- g) Indigenous food security knowledge

Area and the people

The 480 km long coastline of Odisha is vulnerable to many natural hazards. Out of six coastal districts, Balasore is a multi-disaster prone district in the northern most corner of the state. The current study was carried out in the Nagram Gram Panchayat of Sadar Block of Balasore district. The village is a site for monsoonal floods as the village is placed near the Budhabalang River. It is a partially perennial river being originated from the Similipal Hills of Mayurbhanj district. Further, being shallow river bed, a heavy rain could flood the human settlements easily during monsoons. Due to high density of population, the river banks are intensely and extensively farmed. Moreover, the banks are encroached with concrete structures, brick clines and paddy fields. It worsens the already existing vulnerabilities further deplorable.

Table 1: Village demography of Nagram, Balasore

| Particulars | Total | Male | Female |
|---------------------|-------|------|--------|
| Total No. of Houses | 144 | | |
| Population | 689 | 338 | 351 |
| Child (0-6) | 86 | 41 | 45 |
| ST | 304 | 149 | 155 |

| | | | |
|---------------|--------|--------|--------|
| SC | 10 | 5 | 5 |
| Literacy | 68.66% | 76.43% | 61.11% |
| Total Workers | 240 | 179 | 61 |

Source: Census, 2011

METHODOLOGY

The research methodology of ethnography has been used. It has helped to analyze in-depth and detailed lifestyles of the local people including the daily nitty-gritties. For secondary sources, a rigorous content analysis and thematic analysis methods were employed. The authors have also employed other tool collecting techniques such as semi-structured interviews, case studies and focus group discussions. Most importantly, for quantifying the subjective variables such as the significant dimensions of indigenous knowledge systems, the authors have taken the following indicator-based questionnaire to get the responses from the people (Table 2). Besides, they have taken random sampling to collect primary data for the below mentioned questions. Accordingly, a specific question is asked and a response is recorded in yes and no format. A ‘yes’ is given a positive number of one (1) while a ‘no’ is given a zero (0) based on the methodological studies of Pinheiro et al (2021). Then the total mark is calculated. The result is given in the next section of result and discussion.

Table 2: The questionnaire & the responses recorded

| Sl. No. | Major dimensions | Variables | Scorecard (Yes-1/No-0) | |
|---------|---|------------------------------|------------------------|----|
| 1. | Indigenous flood forecasting knowledge | Ethno-astronomy | 85 | 35 |
| | | Ethno-climatology | 103 | 17 |
| 2. | Indigenous detection of flood magnitude knowledge | Water depth | 94 | 26 |
| | | Water flow speed | 112 | 8 |
| 3. | Indigenous flood control knowledge (long-term measures) | Tree plantations | 116 | 4 |
| | | Easy passage of river water | 78 | 42 |
| 4. | Indigenous technical knowledge | Non-hampering the river beds | 64 | 56 |
| | | Sandbag filling | 105 | 15 |
| | | Making natural embankments | 106 | 14 |
| 5. | Indigenous safety knowledge | Evacuation | 95 | 25 |
| | | Relief | 89 | 31 |
| 6. | Indigenous flood coping knowledge | Short-term | 57 | 63 |
| | | Long-term | 103 | 17 |
| 7. | Indigenous food security knowledge | Before | 92 | 28 |
| | | During | 71 | 49 |
| | | After | 85 | 35 |

Source: The Authors

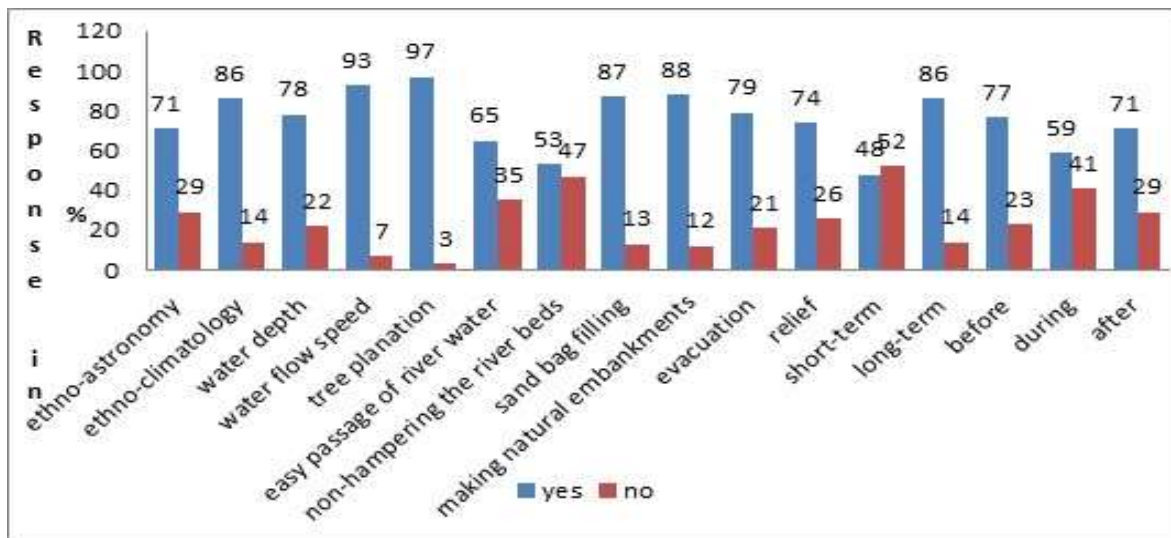
RESULTS

A total of 120 random sampling were taken in three different categories such as age groups of 18 – 29 year, 30 – 60 year and above 60 year. In Figure 1, the total responses recorded per indicator in percentage have

been shown in the three age groups. The distinct age categories were taken to highlight the variation in the opinions and viewpoints. It was found that in the matters of indigenous knowledge, the view of older generations was more prominent while that of the younger generations were ambiguous. The youths mostly preferred to discuss the current system of disaster mitigation while the elderly people focused on the causal factors of different disasters. In the segments of flood and weather forecasting, majority of respondents supported their local knowledge systems that have proven to be effective enough to save them from disaster. It is also observed that people above 30 years have a deep knowledge of the ethno-climatological and ethno-astronomical forecasting. However, to detect the levels of water depth, a mixed response was recorded. Being an intricate area, it is not known to many people including the seniors. In indigenous technical knowledge and indigenous flood control knowledge, almost all people agreed for afforestation programs and tree plantations as seen in other places. Many respondents overwhelmingly credited the cause of sandbag filling and preparing natural embankments for strengthening the structural measure of river banks. In the indicators of passage of flood waters the responses were shocking as a large section of people do not possess the know-how of how to facilitate the easy passage of river waters. Though the concept of e-flow (the usual flow for a river waters to maintain its carrying capacity) is not known to them theoretically, they have been pressing not to disturb the river bed by sand mining.

To address evacuation and relief, members have undergone the required trainings by the authorities. Therefore, the rescue and evacuation works are a success story in the village. Because, in the last several flood events, there are least casualties recorded. The emergency preparations are planned ahead of the annual floods. To cope to the disaster events, locals focused on the long term measures such as the resettlements and recovery projects. For instance, the livelihood loss had to be recovered in an urgent basis for their basic sustenance. In similar lines, a robust food safety was crucial in pre and post disaster periods such as community kitchen and altruistic activities as discussed in the section below. All these factors lead to a better preparedness and resilience to disaster situations. The above questionnaires gave astounding results as given below.

Figure 1: The result



DISCUSSION

Disaster resilience does not come in short time span. It takes a longer period to learn and adapt for the locals to apply the knowledge generations after generations. The local knowledge practices as recorded have reasonably been described in the section below in the context of Nagram village. This section would press upon how far the natives have suitably coped with the flood situation in the locality.

- a) **Indigenous technical knowledge:** not hampering the river beds like not making big holes in the rivers as it may erode the other side of the river during heavy flow of the flood water; can build mud-stone river embankments: using plastic bags filled with sands and cement in weak points but the plastic bags are removed once the points are saved from flood. Else, it may worsen the water blockage.
- b) **Indigenous flood control knowledge:** the indigenous flood control measures include all the initiatives taken at the community level for long term flood prevention and mitigation plans, such as: afforestation programs and tree plantations along the river banks; by not building any structure in the natural course of the river; by not dumping solid wastes stuffs in river banks.
- c) **Indigenous knowledge for flood forecasting:** flood forecasting by the locals is the most intensively focused study area in the current research. It has been discovered that majority of people possess some kind of flood forecasting using bio-climatic indicators. Some of the indigenous knowledge in weather and disaster forecasting are mentioned in the Table 3.

Table 3: Ethno-climatological knowledge systems

| <i>Indicators</i> | <i>Forecasting of Natural hazards</i> | <i>Reliability</i> |
|---|--|--------------------|
| If there is no air movement but waves in the river | Earthquake and rain is forecasted | High |
| If both air with sound and large waves in the river | Earthquake | High |
| If <i>katash</i> , a type of jackal, sounds continuously | Cyclone is looming | Very high |
| If sudden large waves appear in the river | Earthquake | Very high |
| When the sun sets, and on the same horizon, the moon rises | Torrential rain | High |
| If more humidity in the morning time (mainly in June-July) | Heavy and torrential rain in the evening is forecasted. It may turn out to a cyclone | High |
| When air from two directions meet, say <i>Purvali</i> (from the east) with <i>Uttarali</i> (from the north) meets | Sign of heavy cyclonic storms | Very high |
| Similarly when <i>Paschima</i> (air) meets with the <i>Dakshini</i> (air) | Cyclonic formations | Very high |

Source: The Authors

- d) **Indigenous detection of flood magnitude knowledge:** to know the depth and the speed of the water, the native people employ different local based knowledge parameters. For instance, they use white thread tied with an iron rod or ball. They throw that in the river and observe how much has become wet. The color of the thread changes due to the muddy flood water. Accordingly, they can gauge the

depth of the flood water. Besides, they use long bamboo sticks to measure the depth level. Locals can detect the level of water flows by observing this. In similar cases, to know the amount of rainfall, they keep a particular type of elevated/standing utensils/jug (*Thia Surei*) to collect water in the jug.

- e) **Indigenous safety knowledge:** the people of Nagram are well conversed with how to save the inhabitants in the flood situations. They keep all the necessary equipment such as ropes and fish nets to rescue the drowning persons. They are supremely adapted to the river ecosystem. Hence, almost all the locals know the art of swimming and can flow to the streaming flooding water to save any person. Even nowadays, they possess the know-how of fast aids as trained by the local ASHA and ANMs.
- f) **Indigenous flood coping knowledge:** once a disaster has occurred, vital dimension to look after is carrying all the paper documents, medical kits, gold/silver ornaments and so on. For instance, if any vital document is lost, the volunteers contact with the local tehsil and block office for all revenue-related documents so that they can be provided after the flood is over. For estimating the loss of life, property, livestock, the Gram *Sabha* calls meeting to decide the damage per household.
- g) **Indigenous food security knowledge:** one of the most significant aspects of disaster response is the instant and constant food supply to the panicked population. With lots of anxiety and fear, they are evacuated to safer places. Dry foods such as flattened rice (*Chyuda*), rice, *chhatua* are stocked before the flood's arrival from the Village Disaster Fund (VDF). People are motivated to contribute all non-used foods during this time. As people belong to the fishing community and farmers, they collect all the river bank vegetables that are used for community kitchen during the disaster times. The concept of my/his produce is not entertained during this time. It is well understood by all in letter and spirit. In addition, food crops parked in *Anganwadi* center and the schools for the mid-day meals program are used with permission of the village school committee.

Pre-disaster response

The village disaster management committee (VDMC) sits two to three times before the monsoonal rain starts. The *Sarpanch* and other members gather to take pledge to foster mutual help to each other in disaster times. Besides the political representatives, the Gram *Sabha* members and caste leaders join the meeting to prepare for the upcoming flood. They prepare village level plans and minutely discuss the vulnerabilities of village especially the agricultural yield for which timely planting the paddy seed are essential. The VDMC identifies the weak points in the river embankments and vulnerable house structures of the village. The locals contact with the Dist. Disaster Management Committee and the Block Disaster Management Committee. In Nagram village, the members of the youth club, namely the *Binapani* Club and the *Kalinga* Youth Club, and VDMC members, actively participate in all disaster mock drills. As flood takes time unlike the tsunami or cyclonic storms, the village is prepared enough to take stock of the situation. Moreover, as the livelihood is contingent upon fishing, the Gram *Sabha* rates the year as usual or impaired. If it is an average year with sufficient rainfall, it orders a minimum fee to be levied to the Village Community Fund (VCF). If

the year has many livelihood issues or a challenging year (like any pre-monsoon disaster or weak monsoon leading to agricultural damage), no fee is collected. These fees are deposited in the name of the *Sarpanch*, so that he is liable for the expenditure incurred from the VCF. The VDMC also looks after other disaster preparation material such as – plastic bags, syntax tanks, big-sized aluminum utensils, ropes, mats, tarpaulins, jars, tubes, bamboos stick. As the flood is a regular annual affair, major decisions are nearly unanimous. This is one such situation where caste, gender and religion aspects are not only sidelined but also repressed. Accordingly, they keep essential food and relief items and keep contact with the local and district administration. These cultural adjustments boost and foster a sense of community feeling and add vigor to face and withstand the emergency situations.

Response during the disaster

People are now aware enough to withstand the disaster. The most crucial response during the disaster response is to rescue the persons in danger. Flood waters do not see the socio-economic backdrop. They devise many culturally innovative techniques to rescue people struck or drowning in the flowing waters. Some of the rescue methods are given below:

- Several banana trunks are tied together to make it float in water, even in the high current of the river water. It is a ubiquitous method used in all the neighborhoods to rescue people from flood water. As per the local sayings, a banana *patua* (boat) of 7-8 logs can at least float 3-5 individuals easily and quickly.
- Similarly, syntax tanks are specially kept for the flood flurry. It helps during a flood disaster because the hollow cylindrical structures do not submerge below the water level. Hence, 2-3 tanks are joined which makes it a robust floating object and rescue operation is done. The locals also keep reserve of old tubes and aired balls which are the life-saving instruments in the coastal regions. Mainly, tractor tubes and truck/bus tubes are collected by the youths in order to rescue the animals and others.
- Unused wooden doors are very noteworthy used by the locals. However, it is essential to note that the logs of *Sal/Piasal/Saguan* are avoided as they are heavy and may descend into the water. People are well aware of this. Apart that, the wooden doors made up of mango, *chakhunda*, *akasia* are formatted and used by the natives in times of need and rescue.
- Ply tables too are utilized as small floating objects to reach out to people struck in inundated water. Hollow rectangular tins are also employed as suspended material in water. It mainly helps buoyant the rescuer to reach out to persons being flown in flood water. Even aluminum utensils are given importance as a life-saving method in flooding areas.

Conclusion

Indigenous knowledge system has the potential to reduce the woe of the disaster sufferings. In many traditional societies, disaster preparedness and response are seen as collective efforts, with everyone in the community playing a role. It forms the knowledge base for addressing critical sustainability problems of the

21st century (UNESCO, 2016). There are large scale evidences since pre-historic periods for using the local know-how to get rid of emergency situations. Further, ILKS as nature based socio-cultural innovations; it does not impact the physical environment. Rather, it propels the cordial and symbiotic relationships between the man and nature. Since all natural settings are unique in themselves, local knowledge practices based on natives' perception of environment suit the local ecology as well. Mercer et al (2009), in their study of Papua New Guinea, emphasizing the role of ILKS in modern day disaster risk reduction (DRR), pointed out a framework in which relevant indigenous and scientific knowledge could be integrated to lessen community's myriad vulnerability to natural hazards through a participatory approach. It is therefore said that there are few negative ramifications of the ILKS. To add to this, the evacuation techniques and community based relief measures are the path finders in aiding disaster resilience. The case study of Nagram rightly proves the case that local based knowledge and a community based disaster management approach could lessen the wrath of environmental disturbances. However, a lot of urgent steps need to be undertaken, such as proper documentation of traditional knowledge systems, boosting a bottom-up approach to disaster risk reduction, facilitating the village-borne institutions like the youth clubs and so on. Appreciating their local efforts in towards disaster resilience like the constitution of village funds is one such local based administrative approach. All these initiatives must be complemented by the government actions that can provide a scale to reduce, mitigate and adapt to the changing climate conditions, in the form of financial mechanisms or bolstering their local socio-economic-political institutions. Though much statistical models and quantification has not been adopted in the study, after examining the feasibility of ILKS, especially, ethno-climatological ideas in predicting and responding to disasters, the authors imply that these knowledge systems have been able to mitigating the disaster ill-effects in the long term. The study suggests further research on quantitative basis.

Conflict of interests

The authors claim that there are no conflicting interests.

Author's contributions

Both authors contributed equally to the theoretical development, analysis, interpretation, and writing of the manuscript.

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