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Negotiating cyclonic storms on Odisha coast: Integrating meteorological with traditional knowledge

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This paper explores traditional knowledge in four coastal districts of Odisha to understand its nature, role and relevance in negotiating cyclonic storms. It draws from fieldwork carried out in two phases 2007-2009 and 2015-2019 from the district of Jagatsinghpur, Kendrapara, Ganjam and Puri. In each of these locations, people have experience of cyclonic phenomena both as major disasters and as relatively smaller scale recurrent occurrences. The study shows that there is an extensive, informal rule based traditional knowledge system that makes use of multiple observational attributes in association with meteorological warning. In this perspective, prevalent traditional knowledge is neither privileged nor static and as a matter of fact is in a continual dialogue with meteorological information provided through India Meteorological Department's (IMD) cyclone warning services. Based on findings of this analysis, a framework is proposed that integrates traditional and meteorological knowledge systems for a more comprehensive understanding of local rural communities' response to cyclones.

Keywords: Coastal hazard, Cyclone, India, Odisha, Science and traditional knowledge

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The Odisha coast is considered as one of the most cyclone vulnerable regions in India. During the period 1891-2002, a total 356 cyclones made landfall on Indian coast out of which the maximum (98) hit Odisha[1]. The coast of Andhra Pradesh, West Bengal and Tamil Naduare the other states which faceda significant number of cyclonesin the same period. In the last two decades, several severe to extremely severe cyclonic storms have made landfall on the Odisha coast that includes Phailin in 2013, Fani in 2019, Yaas and Jawad in 2021. Cyclonic storms as a weather phenomenon are recurrent and on an average five to six of them form annually in the North Indian Ocean. The Bay of Bengal is relatively more prone as compared to the Arabian Sea. Meteorologically there are two cyclone seasons; Pre-monsoon (April-May) and Post-monsoon (September to December) out of which the Post-monsoon is known for more severe cyclones. This study is borne out of recognition that in spite of having a modern cyclone early warning system (EWS) in India, often coastal vulnerable people fail to evacuate timely during a warning. The existing EWS revolves around hazard warning services provided by the India Meteorological Department (IMD), which is one of the oldest weather services in the country. IMD generates forecasts and warnings for cyclone's landfall location, time, associated wind speed and rainfall etc. using an elaborate observational network, state of the art modeling technique for data analysis, standardized operating procedures for issuing warnings and risk communication to different user groups including vulnerable coastal population for example through color codes, cone of uncertainty etc.[2] Precautionary safety measures such as evacuation to safe shelters is further facilitated at multiple levels for example, at the national level by the National Disaster Management Authority (NDMA), National Disaster Response Force (NDRF), Natural Disaster Management (NDM) Division, Ministry of Home Affairs etc. and at the state and local level by the Revenue and Disaster Management Department, district and local administration. In spite of significant progress in cyclone warning for example relatively much less human death during recent cyclones Phailin, 2013 and Fani in 2019, there are reports of limited adherence to evacuation advisories carrying potential for catastrophic consequences in the event of a high tidal surge[3,4]. Several initial questions have informed the trajectory of this research; a) how do people in a particular coast negotiate a cyclonic storm? b) What kind of traditional knowledge is available resulting from- people's long experiences with the phenomenon? c) If such knowledge exists, how does it relate to meteorological science, and its products communicated through India Meteorological Department (IMD)'s cyclone warning services?. The aim of this study is thus to explore traditional knowledge concerning cyclonic storms with respect to its structure, usefulness, form of evaluation, and limitations. The specific objectives are, a) to delineate nature and form of traditional knowledge that resides in a social context where communities have considerable experiences of cyclonic phenomena, b) to understand how such knowledge remains valid in an era when meteorological knowledge is widely accessible and increasingly seen to be accurate and improved, and c) to explore the nature of exchange if any between meteorological and traditional knowledge.

Traditional knowledge for cyclones

Traditional or indigenous knowledge refers to undocumented, place based knowledge generated within a community culture and transmitted inter-generationally through a variety of means such as experiences, skills, rituals, songs and stories etc.[5-7]. It is "a complete body of knowledge, know-how and practices maintained and developed by peoples, generally in rural areas, who have extended histories of interaction with the natural environment"[8]. In this study, traditional knowledge is interchangeably used with indigenous, and local knowledge although authors have pointed out subtle differences and limitations associated with each of them. 'Traditional' for example is critiqued for its connotation of static-ness, while 'indigenous' can be confusing for its reference to natives and the question concerning who the original natives are[9]? Onyancha (2022) examining usage of these terms in literature observes that the concepts; traditional, indigenous and local knowledge are more often than not used interchangeably[10].

There are several explorations seeking to identify traditional knowledge associated with cyclonic phenomena. Howell (2003) conducted fieldwork in Bangladesh, a country that has suffered extensively from some of the biggest cyclonic disasters in the world[11]. It identifies several categories of traditional knowledge based cyclone indicators, corresponding to weather patterns, animal behavior, and sea/river patterns etc. The author observes, "more research and monitoring is necessary to determine exactly which ones (if any) are reliable in both tidal surge and cyclones, and to what extent they can indicate the severity of an impending disaster". The analysis of Paul and Routray (2013) also in Bangladesh context points towards prevalence of traditional knowledge through several indicators relating to weather, and water conditions, and animal behaviors[12]. A key finding from this study is that such knowledge is acquired largely through one's experiences. In terms of usefulness traditional knowledge of cyclones, more than half the respondents from the aforementioned study living along the shoreline found it to be useful although comparatively, only one third of respondents from the same study living in the islands and a quarter living inland reported that traditional knowledge is useful. Pierce and Hemstock (2022) examined nature and usefulness of traditional knowledge for cyclones in Vanuatu, a small Island nation in the South Pacific that is considered to be amongst the most at risk nations due to climate change[13]. The study conducted in the aftermath of a high intensity (category five) cyclone 'Harold' in April 2020, found that there exists a number of traditional knowledge based warning indicators of different categories such as atmospheric and environmental signs, flora and fauna changes etc. out of which the atmospheric ones or those relating to weather conditions were predominantly identified. The findings are in line with other studies conducted in the South Pacific region. Johnston (2015) for example found a similar pattern in traditional knowledge available in Fiji and Tonga islands[14]. These authors have further raised concern over the sustenance of traditional knowledge in the face of increased mobility and rapid urbanization.

Science and traditional knowledge: Co-production

Traditional knowledge often discussed as an object is in practice a knowledge system which is dynamic and performative, representing a way of acting on the world. There is a greater recognition of the role of such traditional knowledge in dealing with environmental and climate change induced hazards[15-17]. It has led to a call for sustained dialogue and collaboration between traditional and scientific knowledge. Although there is this well intended goal of achieving integration of both forms of knowledge, there is a lack of clarity over how to do it[18]. One perspective for example is that too much time is spent on debating science versus traditional knowledge whereas it should be reframed as dialogue and partnership between science and traditional knowledge[19]. From this perspective, the approach requires to be a co-production of knowledge drawing from the premise that all knowledge forms are partial and incomplete. The idea of co-production draws from a rich intellectual history. Jasanoff (2004) views it as the ways in which we know and represent the world, are inseparable from the ways in which we choose to live in it[20]. Yua (2022) after reviewing different usage of the idea proposes a framework, wherein co-production is “the process of bringing together two different knowledge systems in true partnership and equity, to enhance, learn, and create new understandings on a specific topic”[21]. A number of authors have expanded this line of inquiry, calling for integration of different forms of knowledge. For example, Bartlett *et al.* (2015) advocate ‘two eyed seeing’ integrating modern science with indigenous knowledge in recognition of available strength of different worldviews[22]. Makwara (2013) studying traditional weather forecasting knowledge in Zaka district, Zimbabwe argues that the value of such traditional knowledge can be significantly enhanced if it gets integrated with modern forecasting system[23]. A dynamic nature of interaction of local knowledge with meteorological knowledge was reported in the coastal region of Odisha as part of public understanding of cyclone warning[24]. This study seeks to build on these works and to fill a gap in terms of extricating traditional knowledge available for cyclones in India and its synthesis with meteorological knowledge.

Materials and Methods

Research design

The design of the study follows qualitative method and uses an approach in which findings are tested across multiple sites for validation[25]. In this design, fieldwork was conducted in four different districts in an effort to find replication of results and with an aim to broad base study’s findings[26]. The objective is consolidation of results instead of a comparative analysis across different location.

Field-sites and data collection

Fieldwork for the study was conducted in two distinct phases. The first phase was over a three year period, 2007-2009 from two coastal blocks in Odisha; Ersama and Rajnagar which fall under the district of Jagatsinghpur and Kendrapara, respectively. Each of these two locations have experienced deadly cyclones in the past. For example, 1999 Super Cyclone devastated Ersama block while a similar high intensity cyclone had struck Rajnagar in 1971. In each occasion, more than 10,000 people lost their lives and the particular disaster remains etched in the collective memory of the local population. Based on preliminary findings of first phase data, the second phase data collection was carried out in two other coastal districts of Odisha; Ganjam in February 2015 and Puri in July 2019. The second phase fieldwork, part of a larger project was undertaken after a decadal gap with the objective of exploring relevance of first phase results in other coastal areas of the state. The district of Ganjam and Puri, were selected for second phase taking into account landfall of two extremely severe cyclones, Phailinthat hit Ganjam in October 2013 and Fani striking Puri in May 2019. In each district, specific blocks were selected based on landfall locations of major cyclones from the past and as a result the most affected region.

Table 1 provides details of fieldwork and Figure 1 shows field locations on Odisha map. The villages within fieldwork sites were selected keeping in consideration the following: a) should be within a distance of five km. from the shoreline, while most are located within a few km, b) combination of fishing and non-fishing villages to obtain difference in perspectives, if any c) varied infrastructural conditions such as availability of roads, cyclone shelters, public buildings etc. The technique of Personal Interviews (PI) was used for data collection. The PI respondents were selected using a purposive sampling strategy and attention was given to ensure

Table 1 — Details of fieldwork location

Fieldwork Location	Period of Fieldwork	No. of Personal Interviews
Ersama Block, Jagatsinghpur District	October-November, 2007, 2008	30
Rajnagar Block, Kendrapara District	October-November, 2009	20
Rangeilunda, Chhatrapur Block, Ganjam District	February, 2015	15
Gop, Krushnaprasadpur, Nimapara, Kakatpur Block, Puri District	July, 2019	15

that there is representation from different age groups, caste, occupation, income and gender. A total of 80 Personal Interviews (PI) are considered that included thirty from Jagatsinghpur, twenty from Kendrapara, fifteen each from Ganjam and Puri District. The PI respondents are labeled as PI Numbers 1,2,3 etc. and Table 2 provides a question guide used for conducting interviews. The questions generally were used to retain focus with maximum scope for the respondents to express and share their knowledge. In addition, on-site conversations involving several respondents and on-field observations are considered. The interviews were conducted in local (Odia) language and detailed notes were taken at the time of interviews. In spite of efforts some translation errors are conceded. The field notes were transcribed and coded for analysis.

Results

Onset of a cyclonic storm or '*Batya*'

To be part of a coastal environment involves recognizing the presence of several type of hazards such as cyclone, high tides, coastal erosion, floods etc. A cyclone is viewed to be part of this

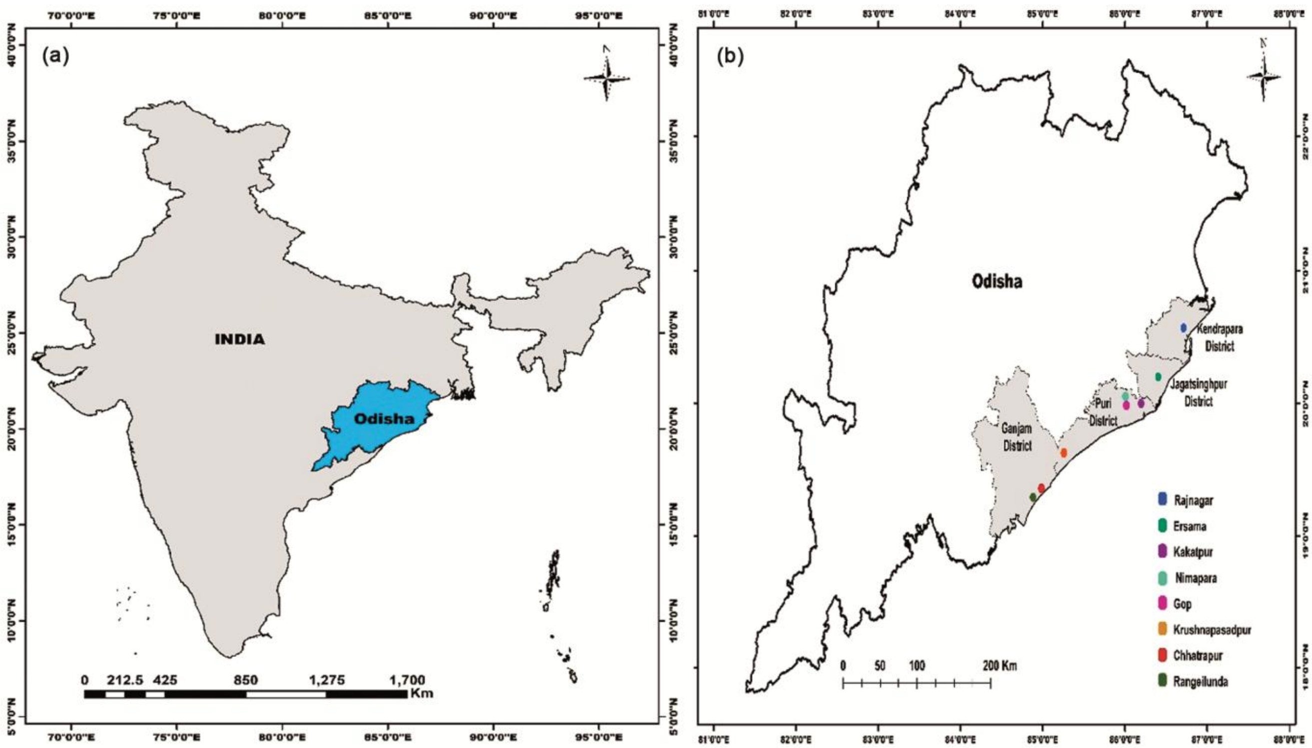

Fig. 1 — a) India map showing Odisha and b) Odisha map showing field sites within districts

Table 2 — Question guide for personal interviews

First phase

1. How many times have you experienced a cyclonic weather?
2. How do cyclones occur?
3. Is there a cyclone season?
4. What kinds of conditions confirm that a cyclone is occurring?
5. When and how a cyclone becomes severe?
6. Which specific risk from cyclones is of maximum concern?
7. Do you receive an IMD cyclone warning? If yes, how do you use them?
8. How do you evaluate your own knowledge?
9. How do you compare IMD cyclone forecasts with your own knowledge?

Second phase

1. What are the indicators suggesting occurrence of a cyclone?
2. Did you find those indicators during the last cyclone (Phailin or Fani)?
3. In what ways, these indicators were helpful
4. Did you evacuate? If yes, what prompted you to do so?
5. Did you observe wind direction, tide cycle?
6. How have your observational parameter changed over the years?
7. Did you receive an IMD warning and if yes, how do you compare it with your own observation?
8. Which kind of improvement in IMD's warning will make your observation redundant?

environment that emerges from inclement weather. Description of a weather preceding a cyclone varies from a rainfall occurring intermittently or in spells (In Odia, '*tuhaku-tuha*)', to a continual rainfall with gusting wind '(*jadhibarsa*)'. Such weather is distinguished from other bad weather, for example, thunderstorms ('*kala-baisakhi'*) or local wind storms '(*bataspawan*)'. There are at least two distinct patterns identified with a '*jadhi*' type weather phenomenon; '*jadhipawan'* in which wind speed is more prominent and '*jadhibarsa'* when rainfall is more noticeable. In both of these varieties, continuity up to several days is a marked feature and they can potentially lead to a more intense and continual rainfall or '*laganabarsa'*. An inclement weather provides early signs but to develop into a cyclonic storm or '*Batya*', requires several other indicators prominently; a) river-mouths stop draining freshwater into the sea b) high-tide water not receding back as per routine cycle and c) onshore wind that picks up speed over a period. In addition, there are a few other signs complementing this form of assessment. "They are a) the sea being rough and making an unusual sound b) black color clouds moving briskly with wind direction, and c) animal and bird' sunusual behaviours". Table 3 provides a summary of indicators with brief descriptions.

A disturbed sea and tide cycle

A general conception of the beginning of a cyclonic storm is through the idea of a disturbance deep inside the sea. Such a disturbance is viewed to be a dynamic that gradually develops and its influence however, is seen to be limited to a geographical region. Its immediate effects are manifested on the shore in the form of a disruption to the regular tide cycle. The high-tides during such occasions don't recede back for a low-tide to commence, exhibiting a sign of abnormality. Fallout of this disruption is the inability of the rivers to drain out fresh water into the sea. Further if such a high-tide condition persists for a longer period, the saline water from the sea side pushes through the same river mouth flooding nearby areas. This disturbance according to respondents is the same as what is meteorologically called a low pressure system. Formation of such a system is considered to be responsible for the inclement weather conditions. A respondent (PI 9) from Ersama, Jagatsinghpur explains the phenomenon as follows:

"Increasing wind speed and rain can lead to an increase in river water, and it signals a disturbance or low-pressure system. The river water increases because it stops draining into the sea and as a result water spills over to the farmland and beyond. This

Table 3 — Traditional knowledge based cyclone indicators

Cyclone Warning indicators with descriptions	
1.	**Inclement weather** described in Odia as any of the following with humidity
a)	*Tuhaku Tuha* (Intermittent spell of light to moderate rainfall)
b)	*Lagana Barsa* (Continual rainfall)
c)	*Jhadi Barsa* (Rainfall with gusting wind)
2.	**Tide cycle behavior**
a)	High tide not receding back: It is observed through several means for example, measured against the saline embankment, local culvert gates requiring to be closed to prevent reverse flow from the seaside, anchoring point of boats on seashore etc.
b)	River or lake water not draining freshwater into sea: Leading to inland flooding
3.	**Onshore wind**:
a)	Several directions such as east, northeast and southeast were identified, corresponding to the nearest distance of sea from a particular location
b)	It signals potential increase in severity because of possible tidal surge
4.	**Observation of sea**:
a)	Sound of sea and tides: 'Shrilling roar'
b)	Strong current, debris floating, and foaming: Sea remains disturbed for weeks after the cyclone(Mostly described by fishers)
5.	**Movement of clouds**:
a)	Direction: Moves with the direction of wind
b)	Speed: Brisk speed, flying type
c)	Color: Black, A few reported that sky color remains reddish
d)	Extent: Deep cover
6.	**Birds and animal behavior**:
a)	Birds: *Batasia* (Storm birds), and Vultures moving at higher altitudes
b)	Animal: Dogs seen going into water, animals making strange sound
7.	**Intensity forecast**
a)	Moon position: Full Moon and New Moon days' signal increase in severity
b)	Wind blowing from the south indicates a declining intensity

blockage at the river mouth happens because sea water swells from its internal disturbances".

Another Respondent (PI 53) from Rangeilunda, Ganjam describes the same in his context:

At the time of cyclone 'Phailin', river Subhadra which is on the other side of this village, had swollen up due to a low pressure system. During the peak period, sea water came as close as 500 meters and tides were breaking here from all directions. The condition was the same at the time of cyclone 'Hudhud' though to a much lesser extent".

Onshore wind causing tidal surge

The inclement weather and abnormality in tide cycles are important indicators but the aspect that elevates the weather phenomenon to a cyclonic status is when wind starts blowing from the seafront. The basic consideration is that an onshore wind sustaining for a period of time carries potential for a tidal or storm surge which is considered to be the principal risk of a cyclone or '*batya*'. There were varied responses as to how strong a wind need be in order to drive up the seawater? Apart from a strong onshore wind, several others factors such as elevation of the village from sea-level to distance from the sea, other topographical features were cited. The following are a few of the responses which highlight different aspects of an onshore wind.

A respondent (PI 46) from Rajnagar, Kendrapara explains: "Wind from the east (sea front) is a clear sign of increasing intensity. The wind speed will be higher from that side because there are no trees or any other type of speed breaker." A different respondent (PI 43) from the same region observes: "You have to understand why the low-tide process does not commence, because onshore wind provides an opposing force preventing a low-tide." Similar observation was made by respondent (PI 73) from Krushnaparsadpur Block, Puri "The maximum threat we feltduring '*Fani*' was when the wind started blowing from the north-west side because in such a case, with Chilika Lake being on the other side, the entire village can get submerged".

The 'onshore wind' as part of traditional knowledge received predominant affirmation across locations although in Ganjam it was not with the same level of uniformity. Take for example, RI (64) from Chhatrapur, Ganjamliving in a fishing village who describes his experience as follows:

"We did not take the high tide condition or the IMD's warning that seriously during Phailin. However, on the day of the landfall, the tides were high, as tall as coconut tree and we have never seen such tides. Our village's elevation level is not much. The wind started from northeast, and we decided to move out".

In contrast, a respondent (RI 54) from Rangeilunda Block, Ganjam provides a different perspective.

"Our village (Parvatipur) is on a high ground and even if there are very high tides, it will be difficult to inundate this area. However the elevation is much less on our northern side and if wind blows from that side, there is a possibility. During cyclone Phailin, repeated government announcements relating to tidal inundation had created a sense of fear amongst us and we evacuated to a neighborhood college. A different respondent (PI 60) from the same region, observes, "During cyclone Phailin, we evacuated for the threat of wind and not storm surge. I don't think seawater can surge that far. There is no such history, at least for this region".

In addition to onshore wind and tide cycle, the observational attributes for a cyclone includes several other indicators relating to a) cloud observation b) sound emanating from sea and tides c) Animal and Bird Behaviors and d) Almanac Forecasts. (Table 3). It is important to note that these indicators are seen together, complementing in an inclusive framework. The following are a few descriptions that provide an overall sense of how they are observed.

A respondent (PI 14) who lost a family member in 1999 cyclone describes sound of sea in the following way. "During this time, the sea makes a different sound (In Odia, '*Guru Garjan*)'. The sound is generated at the river mouth and, with intensification this sound only grows louder".

Respondent (PI 33) from Rajnagar, Kendrapara observes in reference to local almanac;

"The Odia Panji '(*almanac*)' is generally accurate about rainfall, and storms etc. See how correctly they predict solar and lunar eclipses every time, much in advance? We have two panjis '(*almanac*)'; Kohinoor and Khadi-Ratna and between them the Kohinoor is more reliable."

Respondent (PI 62) from Chhatrapur, Ganjam summarizes, "It will be like a rough sea, tides swelling, overflowing, with an onshore wind. The rainfall intensity keeps rising with clouds operating at a low level. You can say all three; wind, clouds and rain converge at this (landfall) time".

South wind signals a diminishing intensity

The most consistent traditional belief found across four field-sites was that, a south wind indicates peaking of the cyclonic storm and it will be a matter of time before the weather settles down. This idea is captured in a popular Odia proverb (*dhaga*), "*Brahmana, Naaka, Badhi: Dakshina Paile Jaanti Chhadi*" (Priests, Astrologers and Flood go only after they receive fees or honorarium or south direction). In this proverb, the cyclone is represented through one of its important consequences, flood and the word '*dakshina*' is used in the sense of fees for the first two terms (Priests and Astrologers) and as 'south direction' for flood. Several respondents articulated this proverb when questioned over the rationale for a wind blowing from south as a sign of declining intensity. A respondent (RI 51) from Rangeilunda Block, Ganjam narrated his experiences during the landfall of cyclone Phailin as follows:

"A day before the landfall, the wind was blowing from the north (sea) side. We kept observing and were expecting that at some point it will move south. It happened on the following day around 1-2 pm. It was strong and lasted for barely three to four hours, and by 4 pm the intensity was declining".

Although wind from the south side is desired, at the same time it is recognized that such wind can be strong and cause significant damage to properties such as houses, public buildings, trees.

RI (66) from Kakatpur, Puri observes while describing the wind directions during the time of cyclone Fani's landfall: "Fani's landfall was around nine in the morning and wind speed must be above 200 km per hour. At this time, there was onshore (east) wind which uprooted a large number of trees. The wind then turned south and lasted for a period of an hour or so but the impact was most severe. A south wind gives relief but in this case it caused havoc. It was gusting, amplifying its effect.

Integrating meteorological knowledge with traditional

Notwithstanding aforementioned description of traditional knowledge relating to cyclones, none of the respondents in any field- sites reported of not being aware of meteorological cyclone warning. The description of India Meteorological Department's (IMD) cyclone warning services, popularly called radio or television warning, varied from a useful service that alerts but at the same time probabilistic and its forecasts catering to a large geographical area that may not hold in a local context. Interview respondents (PI 3) from Ersama, Jagatsinghpur reflects on IMD's warning:

"During a cyclone, IMD forecasts are taken seriously. It is accurate but not to the extent of being precise. For example, forecasting intensity, inundation level etc. are not possible. Further there is always a chance that the wind can change direction to the south leading to a fall in its intensity".

A different respondent from Rajnagar, Kendrapara (PI 31) summarizes "We keep track of IMD's warning and it often provides alerts. However, be it IMD or our own observations, there always remains a possibility of cyclone changing its direction (In Odia, "*Kati Jai Pare*')". A further explanation is provided by (PI 46) from the same region "IMD warning kind of confirms our fear although it may not be accurate every time because the cyclone is a system of wind. Science can at best give a probabilistic projection but it cannot forecast wind accurately".

The idea of alerting is that local population, if unaware will attend closely to cyclonic features post hearing of IMD's warning, or re-evaluate the threat if there are forecasts of tidal surge, high wind speed etc. However, IMD's warning by itself may not be determining their action.

Discussion

A conception of cyclonic storm in coastal Odisha within a traditional knowledge framework is that of a disturbance that initially develops within the sea, but overall a system of wind that causes havoc through interplay with seawater. The tidal surge for example, is a result of such an interaction between onshore wind and seawater. The onshore wind is evaluated to be a potent risk for its propensity to cause storm surge or tidal inundation. The rules in this case however are far from static, for example, in villages located behind wild life sanctuary or coastal forests, inhabitants factored those as protection in estimating particular wind direction. It explains for example, why several respondents in Ganjam district discounted a risk of tidal surge because of topography associated with the Eastern Ghat and the stiff elevation it offers against tidal surge.

The analysis of the study shows that the principal advantages with traditional knowledge is its empirical nature, and its open framework providing scope for varied inputs including meteorological science based forecasts and warning. This research builds on previous work such as Reference Note 11-12 in providing insights on kind of observations that play an important role. Based on findings from the fieldwork, a framework (Fig. 2) is proposed to help

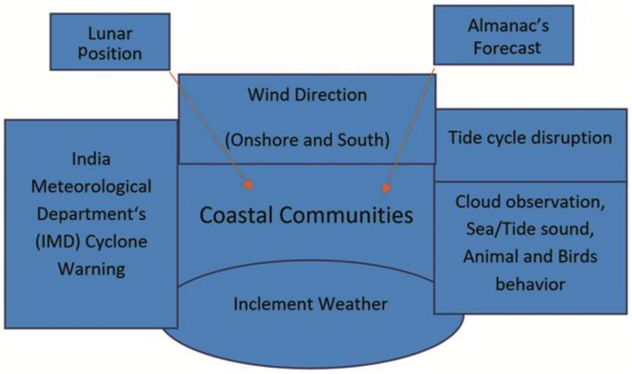

Fig. 2 — Proposed framework for knowledge system driving cyclone response

understand knowledge system to explain local communities' response to a cyclonic phenomenon. The framework views local communities' response to be informed by both traditional knowledge based indicators such as observations relating to the weather, tide cycle, wind direction, cloud movement, animal behavior, almanac forecasts, position of moon etc. and meteorological knowledge in the form of IMD's observation and different kind of cyclone forecasts. The evolution within both knowledge system and interaction across the two forms is dynamic and in an approach where neither is privileged (Reference Note 20). To illustrate, the traditional knowledge based system carries advantages of being locally relevant and amenable for periodic revision of informal rules but also known for its limitation of being reactive to an unfolding weather event and leading to a delayed response. The meteorological knowledge in contrast is given due importance for its advantage of space based observation but at the same time its limitations articulated through several means such as, forecasts being meant for a large geographic area; for being probabilistic in nature; and inability to provide precise forecasts such as wind direction. The societal understanding of response to cyclones thus requires going beyond either form and following a more comprehensive integrated framework.

Conclusion

To conclude, the study seeks to highlight three important findings. The first is to address a gap as far as documentation of traditional knowledge for cyclones in coastal India is concerned. Apart from its general usefulness, documentation serves an important purpose of exploring local's response to cyclonic storms which are expected to increase both in terms of their frequency and intensity due to climate change. The second aspect is a wide prevalence of empirical knowledge based on a range of observations from wind to tide, IMD's warning services to clouds, animal behavior to weather patterns etc. Thirdly, the study proposes a framework that can be useful to integrate meteorological and traditional knowledge together in a dialogue form to explain local response. The study in spite of best effort carries several limitations for example, its sample size from each location is not quite representative. As a result, there may be other forms of traditional knowledge which are missed out. The research design as part of its methodology to validate first phase fieldwork with help of other field-sites while helpful for generalization, carries limitation of not exploring new forms of traditional knowledge. Finally, the study is limited to selected districts in Odisha, and future studies thus may look into existence, similarity and difference of traditional knowledge in other coastal states.

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Conflict of Interest

The author declares no conflict of interest.

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