Global Disaster Preparedness Center

RESEARCH PAPER

'DISASTERS CAN'T HAPPEN HERE. LORD JAGANNATH WILL SAVE US': EXPLORING WOMEN'S EXPERIENCE OF BARRIERS TO EARLY WARNING SYSTEM IN ODISHA, INDIA

Authors:

Chinmayee Mishra
Department of Sociology, Utkal University

Dr. Bishnuprasad Mohapatra
Department of Sociology, Malyagiri Mahavidyalaya

Table of Contents

Research Team

Principal Investigator: **Chinmayee Mishra**
Ph.D. Scholar (UGC-Senior Research Fellow)
Department of Sociology, Utkal University
Bhubaneswar, Odisha, India
Email: mishrachinmayee123@gmail.com

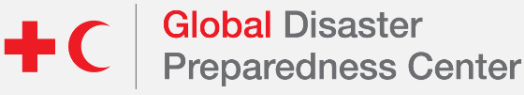
Co-Principal Investigator: **Dr. Bishnuprasad Mohapatra**
Lecturer in Sociology, Department of Sociology
Malyagiri Mahavidyalaya
Pallahara, Odisha, India
Email: ranabishnuprasad@gmail.com
(Former Assistant Professor of Sociology, KIIT Deemed to be University, India)

Field Investigator: **Archita Bala Patra**
Urmila Sahoo

Acknowledgment

We would like to sincerely thank the Global Disaster Preparedness Center and the American Red Cross for providing the opportunity and support through the Small Grant Research Program to complete this project. The research team also gratefully to the research participants for providing their valuable time to participate in this research. We want to extend our gratitude to our filed investigators, namely Archita and Urmila, for their assistance during the tenure of the project.

Research funded by the Global Disaster Preparedness Center of the American Red Cross.



Abbreviations

ADB	Asian Development Bank
AM	Aapda Mitra Memeber
AN	Anganwadi Worker
ANM	Auxiliary Nurse Midwives
AS	ASHA Worker
ASHA	Accredited Social Health Activists
CBEWS	Community-Based Early Warning Systems
CSR	Corporate Social Responsibility
DRR	Disaster Risk Reduction
EM	Elected Member
EW	Early Warning
EWM	Early Warning Model
EWS	Early Warning System
FEWS	Failure Early Warning System
FFA	Force Field Analysis
FGD	Focus Group Discussion
GDPC	Global Disaster Preparedness Center
HHS	Household Survey
IDI	In-depth Interview
KII	Key Informant Interview
NG	NGO Staffs
NGO	Non-Governmental Organizations
OD	ODRAF Member
ODMP	Odisha Disaster Management Program

ODRAF	Odisha Disaster Rapid Action Force
PAS	Public Address System
PHC	Public Health Center
SC	Scheduled Caste
SEBC	Socially and Economically Backward Class
SOP	Standard Operating Procedure
ST	Scheduled Tribe
UN	United Nations
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNISDR	United Nations International Strategy for Disaster Risk Reduction
US	United States
WHO	World Health Organization
WMO	World Meteorological Organization

Abstract

Early warning systems (EWS) are essential to limit the loss of lives and livelihoods due to disasters, especially for the vulnerable population. Studies have shown that women are among the vulnerable groups to disasters. However, not all women are uniformly and equally vulnerable. In this context, the present study aims to explore the barriers women from different socio-economic backgrounds face in accessing early warning messages and how it affects their disaster preparedness. The study was conducted in the Puri district of Odisha, India, which was hit by cyclone Fani in 2019. The study used an exploratory research design followed by qualitative and quantitative methods to collect data from women respondents and stakeholders associated with the dissemination of early warning messages and disaster preparedness. The study used non-probability sampling techniques to recruit samples. In-depth interviews, focus group discussions, and key informant interviews were administered to collect data. The study found that access to early warning does not necessarily ensure actions for disaster preparedness due to lower risk perception. Most of the respondents believed that, as Puri was the abode of Lord Jagannath, disasters would not occur there. Apart from religious belief, other factors such as past experience, language, location of house, vulnerability, place attachment, and lack of access to mobile and TV were identified as barriers to women's access to EWS. The study's findings suggest and provide evidence for the promotion of community-centric, inclusive, and behaviorally informed EWS at the local level.

Keywords: Early Warning System, Women, Disaster, Risk Perception, Barriers, Facilitator, Cyclone Fani, Religion

"We can forecast calamities to varying degrees, we may be able to diminish their intensity to some extent, but when we act as if disasters will not happen, or convince ourselves that we can eliminate their effects, we condemn ourselves to replay tragic events."

Russell K Schutt

1. Introduction

Odisha, a coastal state located in eastern India, has encountered frequent natural disasters as a result of its tropical geo-climatic conditions. It experiences one a cyclone almost every year. Since Odisha is situated along the east coast, it is most severely impacted by tropical cyclones. Over the past century, the region has experienced 260 cyclones making landfalls (Mishra and Kar, 2016). In the last two decades, Odisha has already encountered and experienced 10 deadliest and modest cyclones compared to other coastal states of India (PTI, 2021; Shankar, 2023). The history of cyclone-led vulnerabilities in Odisha can be experienced through different cyclones like the 1999 Super Cyclone, Phailin, Hudhud, Titli, Fani, Bulbul, Amphan, Yaas, Gulab, and Jawad (Shankar, 2023; Sharma, 2022).With the proactive action of the Government of Odisha, the disaster management system, including the Early Warning System (EWS), has been strengthened after the Super Cyclone of 1999 to mitigate the risks. However, challenges still exist among vulnerable groups, particularly women. Besides cyclone-led vulnerabilities, Puri, a district of Odisha, is one of the four pilgrimage sites in India. Odisha is also known globally for being the abode of Lord Jagannath, one of the most revered deities in Hinduism, and for the annual Rath Yatra (Car Festival). The cultural and spiritual history of Odisha is generally surrounded by the culture of Lord Jagannath. The citizens of Odisha, regardless of their caste, color, gender, group, or community, have a strong belief in Lord Jagannath and its culture (Rout, 2024).

Prior studies have shown that cultural and religious perceptions can impact vulnerable community's access to and reaction to early warning messages when coupled with social and economic obstacles (Ayeb-Karlsson et al., 2019; Yore & Walker, 2021; Krishna et al., 2021). However, much of disaster research has focused on the technical aspects of disaster preparedness, whereas there has been less focus on looking into the socio-cultural aspects that determine the response behaviour, such as class, caste, ethnicity, and religious affiliation (Ayeb-Karlsson et al., 2019; Perera, et al., 2020). Early warning systems (EWS) are essential part of disaster preparedness as it can limit the loss of lives and livelihoods due to hazards and disasters, especially for the vulnerable population.

Women are often among the most vulnerable groups in disasters situation. However, it is crucial to understand that women do not form a homogenous group, and not all women are equally vulnerable. So, the research aims to explore the experiences of women's access to disaster Early Warning Messages (EWM), the barriers that women from different socio-economic backgrounds face in accessing early warning messages, and how it affects their disaster preparedness. The study not only tries to explore the women's experience of barriers in accessing EW messages but also looks into the facilitators of EWM in the context of cyclone Fani, which hit Odisha in 2019.

By exploring these barriers, this research can contribute to more effective and inclusive disaster management strategies that consider the unique experiences and needs of women in Odisha. Even though this study is locally specific, its findings can provide empirical evidence that supports our understanding of the broader issues pertaining to the socio-cultural determinants of EWS and disaster preparedness. It can inform policy formulation on where and how to focus on the behavioral aspect of disaster preparedness, which could eventually help increase the effectiveness of EWS.

2. Literature Review

The concept of Early Warning first came during the "...Cold War in the field of national military intelligence to enhance the capacity of predicting potential (ballistic) attacks." (Niels and Simone, 2006 cited in Arnado, 2012) Early warning, which originated as a military idea, was subsequently incorporated into the UN system as a tool to predict natural disasters like earthquakes and tsunamis (Arnado, 2012). The concept of EWS was first referred to at the Yokohama First World Conference on Natural Disaster Reduction (1994). It was formally defined in the document of UNISDR – Living at Risk, in 2004 (Aguirre-Ayerbe et al., 2020). The United Nations states agreed on the principles of the Yokahoma Strategy and Plan for a Safer World for Disaster Risk Reduction. One important agreed principle among the countries was that “early warnings of impending disasters and their effective dissemination using telecommunications, including broadcast services, are key factors to successful disaster prevention and preparedness” (IDNDR 1994 cited in Trogrlic et al., 2022). The Yokahoma Strategy raised attention to the necessity of creating and/or bolstering EWS and requested support for nations most susceptible to natural disasters (Trogrlic et al., 2022).

Hyogo Framework for Action 2005-15 states that EWS are “essential investments that protect and save lives, property and livelihoods, contribute to sustainability of

development, and are far more cost-effective in strengthening coping mechanism than is primary reliance on post-disaster response and recovery" (UNDRR, 2005 cited in Trogrlic et al., 2022). The Hyogo Framework emphasized the need for people-centered EWS, or systems that can support decision-makers' actions, account for differentiated vulnerabilities, and provide direction on how to respond to warning information (Trogrlic et al., 2022). Whereas the Sendai Framework for disaster risk reduction (2015-30) does not identify EWS as one of it as important areas, rather highlights it as one of seven global targets. It calls for countries through Target (g) to "substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030" (UNDRR, 2015 cited in Trogrlic et al., 2022)

2.1. Key Components and Objectives of Early Warning Systems (EWS)

According to UNISDR (2016), EWS is understood as, "an integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication, and preparedness activities systems and processes that enables individuals, communities, governments, businesses, and others to take timely action to reduce disaster risks in advance of hazardous events."

According to Yekeen, Baloun, and Aina (2020), "An early warning system (EWS) is a disaster prediction information tool, used in different fields to acquire and communicate timely and useful warning information for predicted severe events or disaster."

According to Schmeid and Jenkins (1998), "An Early Warning Model (EWM) is an analytic forecasting tool that has been honed by systematic evidence and can be used to identify the likelihood of specified events or conditions occurring in certain locations in the future."

The primary aim of an early warning system is to mitigate potential harm or loss by informing susceptible individuals in advance of an anticipated natural or man-made hazard or disaster (United Nations Office for Disaster Risk Reduction 2006; Action Practical 2008, cited in Yekeen et al. 2020). Early warning systems play an important role in disaster preparedness, response and emergency management (Dutta et al., 2015). Early warning systems (EWS) provide risk information before hazardous events, enabling at-risk individuals to take preemptive measures to mitigate potential dangers (Yore & Walker 2021). These systems typically involve initial warnings from official sources, such as local governments and media, complemented by alerts from secondary sources like employers, family, and friends. For EWS to be effective, it must function technologically

and ensure that the community is responsive, motivated, and capable of taking action. A key requirement is that warnings reach their intended recipients with enough time for them to react, which depends on the reliability of the technology and distribution systems (Yore & Walker, 2021).

According to the United Nations for Disaster Risk Reduction (UNDRR) and United Nations (UN) 2006 reports, EWS consists of four key components: risk knowledge, monitoring and warning, dissemination and communication, and response capability (Sufri et al., 2020; Haque, 2024). Effective EWSs require a strong integration of these components to ensure optimal response and mitigation before a crisis occurs. Risk knowledge or information is important in setting up appropriate strategies in response to early warning messages (including safe areas and evacuation routes), and the risk information needs to reach the most vulnerable (WMO 2010 cited in Trogrlic et al., 2022) so that all can take action to reduce the risks and capitalize the opportunities. However, major focus on hazard (disaster) with less attention for understanding of vulnerability, lack of integration between risk information and within decision-making, and lack of data are some of the gaps highlighted by scholars in the risk information category of EWS (Trogrlic et al., 2022).

It is widely acknowledged that early warning systems (EWS) are a crucial and efficient instrument for reducing the harm caused by natural disasters when it comes to preventive and mitigating actions (DaSilva et al., 2020). EWS's effectiveness depends on the dissemination of risk information to the vulnerable population and their preparedness to act on it (Hoffman and Muttarak, 2017, cited Yore &Walker, 2021). EWS are considered the most important elements in reducing the consequences and impact of natural hazardous poses to societies (Aguirre-Ayerbe et al., 2020). Scholars further argue that EWS are the most important aspect for effective disaster prevention, preparedness and risk reduction. It is considered as the important lifesaving element of risk reduction during the disaster cycle and enhances the coping mechanism of vulnerable communities through appropriate means (Ajibade & McBean 2014).

2.2. Barriers to EWS Effectiveness

According to the United Nations for Disaster Risk Reduction (UNDRR) and United Nations (UN) 2006 reports, EWS consists of four key components: risk knowledge, monitoring and warning, dissemination and communication, and response capability (Sufri et al., 2020; Haque, 2024). Effective EWSs require a strong integration of these components to ensure optimal response and mitigation before a crisis occurs.

2.2.1. Risk Knowledge

Risk knowledge or information is important in setting up appropriate strategies in response to early warning messages (including safe areas and evacuation routes), and the risk information needs to reach the most vulnerable (WMO 2010 cited in Trogrlic et al., 2022; Cao et al., 2024) so that all can take action to reduce the risks and capitalize the opportunities. However, major focus on hazard (disaster) with less attention for understanding of vulnerability, lack of integration between risk information and within decision-making, and lack of data are some of the gaps highlighted by scholars in the risk information category of EWS (Trogrlic et al., 2022). Lack of updated risk information was a major barrier leading to ineffective and delayed responses to disasters (Le et al., 2018; Thieken, and Bubeck, 2024). For example, in the case study of Thua Thien Hue province in Central Vietnam, Pham, Thieken, and Bubeck (2024) highlighted the need to bridge the gaps by providing updated risk information through public platforms without technical and educational barriers.

2.2.2. Monitoring and Warning

Other research indicates uncertainty in forecasting, inadequate monitoring, varying skills of forecasting information, and lack of monitoring infrastructure and forecasting system are the challenges to monitoring and warning components of EWS (Trogrlic et al., 2022). In some cases, despite the existence of monitoring and warning, warnings are not effectively translated into actionable steps or response systems. For instance, Dutta et al. (2015) argued that Cambodia has its own communication system; however, there is a lack of interpretation of information and the use of early warning SOPs. Moreover, the current monitoring and warning services for disaster management are developed using a top-down approach, where decisions and systems are largely controlled by higher-level national authorities. This approach lacks collaboration with local systems, which results in ineffective disaster management (Baudoin et al., 2016; Sufri et al., 2020). The hierarchical nature of the administrative structure restricts coordination and integration between national and local levels, limiting the effectiveness of early warning systems and disaster response (Nguyen et al., 2021; Chinguwo & Deus, 2022; Pham, Thieken & Bubeck, 2024).

2.2.3. Dissemination and Communication

According to the literature, dissemination and communication relate to the methods and procedures used to provide accessible warning and preparedness information to individuals who must take action and those who are at risk (Brown et al., 2019, UNDP 2018 cited in Trogrlic et al. 2022). In order to make sure that everyone who needs warnings receives them, it is necessary to first assess user needs and then choose a sufficiently wide variety of dissemination mediums to reach everyone, including the most

marginalized and vulnerable members of society (Trogrlic et al., 2022). Trogrlic et al. (2022) also argued that dominance of experts, top-down dissemination, lack of feedback mechanism, lack of access to warning information, inadequate communication system, underdeveloped dissemination infrastructure, limited involvement of media and private entities , ineffective engagement of media non-adoption of specific user needs/capabilities and uncoordinated monitoring activities in communicating messages are some of the gaps related to dissemination and communication components of EWSs. Further, Dutta et al. (2015), in their study in Cambodia, found that lack of standard operating procedures (SOP), lack of capacity to make use of generated forecasts to explain to the public, lack of adequate funding and means of transportation and communication, and public awareness are some of the big concerns in dissemination and communication of early warning messages.

Effective disaster response and public acceptance of earthquake early warning systems (EWS) depend heavily on clear and trustworthy communication channels and confidence in the warning messages and the sources given them (Tan et al., 2023). Sahana et al., (2023), in their study at Sundarban, argue that neighbors and relatives are the major source of early warning messages, followed by local villages assembly, radio, television, and newspaper. Further limited outreach of local panchayat is the reason for community members to rely on less reliable sources of early warning messages (neighbors and relatives). In addition, the slow dissemination of early warning messages is the reason for the confusion among community members in preparedness for cyclones and heavy loss.

2.2.4. Response Capability

In addition to the significant concerns in disseminating and communicating early warning messages, ' response capability' is also a crucial factor. The term "response capability" describes a community's awareness of its hazards, capacity to receive risk information and act upon the information (such as where and how to evacuate) (Trogrlic et al., 2022). In addition to offering warning information, a comprehensive early warning system makes it possible to respond to such warnings by taking appropriate action before the event (Trogrlic et al., 2022). In a study in Cambodia, Dutta et al. (2015) highlight the lack of simulations and drills and awareness regarding local knowledge and risk perception. Several factors challenge the response capacity of community members after receiving early warning messages. These include lack of risk awareness, lack of past events reviews, unclear authority and decision-making process, lack of evacuation drills, absence of adequate safe places, routes, concern over living assets, and behavioral reasons (like risk perception of previous experience of disaster) for not responding are some of the important factors that can challenge the response capacity of community member after receiving early warning messages (Trogrlic et al., 2022).

2.3. Barriers to Early Action

In answering the question of why EW information did not lead to early action in Somalia in 2010 and 2011, Lautze et al. (2012) argued that four factors contributed to the failure of early warning (EW) information to prompt early action during the 2010-2011 famine in Somalia. These included: the absence of a functional state to ensure citizens' protection and basic needs; insufficient internal resources to mobilize preventive interventions; delayed international donor responses, which only escalated after the crisis reached famine levels; and the inability of the UN and NGOs to effectively advocate for early action based on the EW information provided.

Ajibade and McBean (2014) in their study argued that inadequate mediums & sources of information, lack of trust in the source of warning, and lack of alternative infrastructure (shelters) are the factors that help early warning systems ineffective for flooding and climate extremes in Lagos slum community of Nigeria. Yore & Walker (2021) pointed that EWS is often seen as unsuccessful in terms of communication and preparedness. In addition to that lack of public awareness, a high level of uncertainty among the population regarding how to react to EW messages, sporadically evacuation drills, and mixed, inaccurate or absent warning information due to damage to communication infrastructure can negatively affect the effectiveness of EWS.

While highlighting studies on disasters like Hurricane Katrina in the US (2005), Super Typhoon Yolanda (2013), the Great East Japan Earthquake (2011), and Cyclone Nargis in Myanmar (2008), Yore & Walker (2021) reveal that insufficient awareness of vulnerabilities and knowledge of risk; lower level of understanding of warnings and danger; lack of information regarding preparedness to act within the EW messages; uncertainties and underestimates of warnings; and use of more technical information have negatively impacted the concerned communities. Sufri and others (2020) identified key challenges to the design and operation of disaster EWSs, which include inadequate integration of Indigenous or local and scientific knowledge into disaster EWS; inadequate financial, technical, and human resources support; lack of integration between community-engaged and government disaster EWS; and lack of routine engagement of all vulnerable groups in the system.

Perera et al., (2020) in evaluating the gaps in early warning mechanisms in Sri Lanka, highlight that the mechanism and communication network was found to be poor. In particular, it can be considered not delivering the early warning to the final mile in time. This inadequate communication system may be the primary source of the public's decreased trust and unwillingness to heed early warnings. Further, inefficiency of the information dissemination process, lack of qualified staff, and constraints of the

equipment used in early warning mechanisms further challenge the EWS system. Dutta and Basnayake (2018), in their assessment of EWSs found that most Southeast Asian countries have well-established EWSs in place, however there are significant gaps in the communications and distribution of early warning information from the national to local levels, which constitute the last-mile connectivity of an effective EWS.

2.4. Socio-Cultural Determinants of Preparedness and Early Action

2.4.1. EWS Accessibility for Historically Marginalized Populations

Disaster Risk reduction strategies emphasize that EWS should be accessible to all. High-risk groups who live in remote and isolated areas face more exclusion (Perera et al., 2020). Women, being one of the vulnerable groups, experience women's experiences of risk, and their response to risk differ from men due to gender differences (Ariyabandu, 2009; Mulyasari & Shaw, 2013). Women's vulnerability to risk is influenced by several factors, including their social status, responsibilities as primary caregivers, and the specific challenges they face in developing countries (Fothergill, 1996). Additionally, their caregiving duties, particularly related to childcare, further intensify their vulnerability (Rivers, 1982; Miyano et al., 1991; Millican, 1993, cited in Fothergill, 1996). Due to women's role as caretakers, which requires them to stay with, support, safeguard, and nurture their family members, women are more vulnerable to disaster risk. In poor nations and developing countries, women face additional hazards because of poverty-related social isolation and limited mobility (Mulyasari & Shaw, 2013).

Scholars have observed that women and men often have differing worldviews, so there is a difference in their perception of risk (Cutter et al., 1992; Gustafsod,1998; Miller, and Schafer,1999; Cvetković et al., 2018). Men tend to concentrate on the technical details of protective measures against disasters (Szalay et al., 1986) and are generally more inclined to take risks (Byrnes, Miller, and Schafer, 1999). In contrast, Fothergill (1996) observed that women often view disaster events with greater seriousness, particularly when the safety of their family members is at risk. Takeuchi and Shaw (2008) view that while women often engage in preparedness activities, they are largely missing out on formal disaster preparedness efforts. Furthermore, one of the main obstacles to risk and disaster preparedness is the marginalization of women in risk communication. Women are deprived of the chance to participate in disaster risk reduction efforts as well as the ability to take action due to a lack of timely and adequate information (Mulyasari & Shaw, 2013).

Due to patriarchal traditions, imposed gender roles, and lack of ownership over dominant resources that provide access to early warning information, rural women's participation in early warning efforts is likely to be hindered (Mathathu and Seedat-Khan, 2022). Risk research shows that people with disabilities are more vulnerable to risks because of socio-economic marginalization, poverty, and restricted political agency. Women with disabilities bear the triple burden of poverty, gender, and disability on top of their caregiver responsibilities (Gartrell et al., 2020). In Cambodia, the most popular and dependable option for women with disabilities to obtain early warning information is through well-established social networks (Gartrell et al., 2020). They further argued that not every woman was very socially linked to her neighborhood. Women who live outside of their village and peripheries and those who are confined to their homes because of disabilities frequently do not receive or miss out on early warning systems messages.

During the early warning phase of crisis management, people with one or more impairments face difficulties interpreting, hearing, and seeing warning signals, as well as having to evacuate due to a lack of appropriate transportation and assistive technologies (Raja and Narasimhan, 2013 cited in Chisty et al., 2021). They further argued that peer group-based information was the sole way to learn about flood warnings. The lack of an inclusive dissemination and communication system, as well as a community-based warning dissemination system, had a substantial detrimental effect on people with disabilities. Individuals with disabilities and intersectional identities encountered obstacles related to inequality when it came to warnings being distributed and communicated.

Chisty et al. (2021), in their study of flood-prone regions of Bangladesh, argued that while people with disabilities are aware of the risks, the existing monitoring and warning system, communication and dissemination channels, and response capacity are not entirely inclusive. According to their study, people with disabilities are becoming more marginalized and excluded since they are not given the chance to take part in monitoring and warning services. They suggested that dissemination and communication systems should emphasize the requirements of people with disabilities in all flood-prone areas in order to develop an inclusive EWS. Initiatives for disaster risk reduction that adhere to a gender-blind approach exacerbate women's vulnerability and reinforce gender disparities. Incorporating a gender viewpoint into early warning systems will not only increase their efficacy but also significantly reduce the number of women who die, especially in rural regions (Mathathu and Seedat-Khan, 2022).

In South Asian context, research indicates that racial and ethnic minorities tend to evacuate less frequently and experience greater losses (Fothergill et al., 1999; Bollin and Kurtz, 2018). Further, Rahman et al., (2022) studied the cyclone vulnerability of the

Rakhain community and the Munda ethnic minority during disasters. Other scholars, such as Attavanich and Kobayashi (2016), conducted a field survey to study the living conditions of Tungwa's Moklen community in post-tsunami housing. Both studies highlighted the vulnerabilities faced by ethnic minorities during disasters.

2.4.2. Religious and Cultural Influences

Religious and culturally based determinants of risk behaviour play important role in determining how people perceive and respond to risk (Dynes and Yutzy, 1965; Mitchel, 2010; Schmuck, 2020). The risk perception of the individual is shaped by the religious belief and cultural values. Scholars have studied how Cultural belief systems have affected the attitude towards risk and decision making (Bode, 1977; Oliver-Smith 1992; Seitz, 2004; Alcántara-Ayala & Oliver-Smith, 2019). While citing the case study of Bangladesh during Cyclone Sidr in 2007, Ayeb-Karlsson et al., (2019) found that many people despite receiving warning did not evacuate. This was attributed to their cultural and religious beliefs. They believed that God would protect them wherever they were if you have obeyed God, so they chose not to evacuate to the shelter homes. The religious interpretation of disasters is not limited to a single faith but is present across all religions (Dynes, 1965; Sun, Deng & Qi, 2017).

Similarly, during the landslide in Nepal during 2014, people believed that either they had offended the gods or that the landslide was a consequence of their violation of sacred rituals. If the cause of the landslide is considered to divine intervention leads to solutions based on religious sentiments, which is where the problem arises. The author suggests that if people believe a disaster can be avoided by following divine will, they are more likely to seek safety through prayer and sacrifice rather than relying on an early warning system. Religious beliefs and superstitions are considered hindrances to ignoring early warnings and disaster preparedness (Howell, 2003; Ayeb-Karlsson et al., 2019).

Some scholars have also pointed out that while religious beliefs may influence the efforts of agencies and individuals. In fact, one of the major barriers to Community engagement in early warning systems is the fatalistic world of disaster (Sufri, Dwirahmadi, Phung & Rutherford, 2020). However, there are group of scholars who view that religion plays an important role as a survival strategy for coping with the effects of disasters (Smith, Pargament, Brant, & Oliver, 2000; Schmuck, 2020). Further, language, which is an important component of culture, and it also plays a crucial role in the effectiveness of early warning systems (EWS). For example, A case study of Latin and indigenous individuals affected by the 2017 Thomas Fire in California highlighted that emergency warnings regarding evacuation areas and respirator masks were initially issued only in English. This language barrier resulted in thousands of immigrants and undocumented

farmworkers continuing to work in the fields without masks, leading to serious health issues (Méndez et al., 2020 cited in Rahmani, Muzwagi& Pumariega, 2022). During disasters, these religious and cultural beliefs can interact with socio economic constraints to which can affect the response behaviour of individual and community.

2.5. Enhancing the Effectiveness of Early Warning Systems

2.5.1. Leveraging Technology for Improved EWS

A robust Early Warning System (EWS) is essential for timely cyclone preparedness, as highlighted by Sahana et al. (2023). Particularly, EWS needs enhancement among remote communities that often rely on unauthorized sources for early warning messages during cyclones. To improve cyclone preparedness and adaptation, there is an urgent need for a comprehensive digital EWS and timely information dissemination. Modern technologies such as Virtual Reality, Augmented Reality, and Digital Twin Infrastructure have attracted considerable attention as advanced tools for 3D visualization of hazards (Girotto, 2023). Additionally, mobile phone technologies, data hubs, and social media platforms play a crucial role in tracking affected areas and facilitating the dissemination of warning messages.

Perera et al. (2020), in their study in Sri Lanka, suggested that creating Community-Based Early Warning Systems (CBEWS) and modernizing last-mile communication technologies, along with effectively utilizing social media and monitoring telecom traffic, can significantly address the challenges of EWS. Furthermore, advanced technologies such as artificial intelligence, remote sensors, and satellites can be employed to analyze data, forecast extreme weather events, and deliver targeted alerts to at-risk communities (UNFCCC News, 2024).

To improve the existing system, Perera et al. (2020) also emphasized the need for either enrolling new staff or introducing technologies that can automate sections of the warning dissemination process. However, community involvement remains crucial, especially for vulnerable groups like disabled, elderly, or illiterate people, who may struggle to receive information through electronic means. In such cases, traditional communication tools, including hand sirens, drums, loudspeakers, and whistles, should be used in combination with modern technology for strengthening EWS (Sufri, 2020).

2.5.2. Strengthening Community Engagement

Involving the community in Early Warning Systems (EWSs) is crucial to preventing environmental damage, minimizing casualties, and saving lives during disasters (Sufri et al., 2020). In the context of seasonal climate forecasts, local EWS plays a significant role

in reducing the vulnerability of farmers from drought (Andersson et al., 2020). The strength of local EWS is associated with the involvement of community members in knowledge distribution and local monitoring, tailoring and simplifying of information in the local context, and adaptive capacity and available resources. However, in the local EWS, community involvement within the process and simplification and tailoring of information in local circumstances help the community in a greater way, even if they don't have adaptive capacity and economic resources. They further argued that smallholder farmers do not respond to EWS forecasts until they become in critical condition, and this happened not due to a lack of knowledge but due to a lack of resources (a lack of ability to respond) and adaptive mindsets.

The local community's direct engagement is the key to establishing a functional and sustainable EWS (Mohanty et al., 2019; Rai et al., 2020). For instance, the community-based strategies implemented by the ODMP during the 2002 cyclone in Odisha have been very effective in raising hazard awareness and improving disaster preparedness (Thomalla & Schmuck, 2004). On the other hand, During Hurricane Katrina in 2005, inadequate cooperation with grassroots organizations, poor warning system execution, and poor coordination led to serious issues for the disaster response (Dyson, 2006, cited in Sufri et al.,2020). In 2008, Cyclone Nargis struck Myanmar, killing 130,000 people in part because of a lack of engagement with local people regarding potential risks (Collins et al., 2009). Andersson et al., (2020) write that EWS information must be locally relevant to the context and must be disseminated and expressed through the local language for a better understanding of the community. A thorough understanding of local settings (social, cultural, economy and political) can aid in efficiently using relevant technology and participatory techniques to inform the public and provide warnings, enabling people to respond to them effectively (Garcia & Feamley, 2016). Community-centric EWS empowers the community to make better decisions (Baudoin et al., 2016).

However, scholars view that the lack of clear community roles and responsibilities in the governance structure of EWS, diminishing spirit of mutual help over cash for work, inadequate funds, lack of community ownership, and religious and fatalistic beliefs are some of the challenges to the community engaged EWS system in Aceh, Indonesia (Sufri et al., 2020). The smooth running of a EWS necessitates guaranteed long-term funding and involves a wide range of stakeholders, including as local communities, several government ministries, the commercial sector, the media, and regional players (Trogrlic et al., 2022).

2.5.3. Prioritizing At-Risk Populations

For an Early Warning System (EWS) to be effective, it must deliver meaningful warnings to at-risk populations and ensure they are prepared to act. The failure of a EWS can often be attributed to a lack of awareness or experience with hazards. To maximize effectiveness, the EWS should consider the target population's daily pressures, beliefs, and expectations, using familiar and appropriate communication channels and messages (Yore &Walker, 2021).In reviewing the effectiveness of early warning systems (EWS), several issues emerge. A notable problem is the lack of cooperation and shared understanding among the various parties involved in EWSs, stemming from the prevailing view that at-risk populations are merely recipients of warnings rather than active contributors (Handmer, 2002; Betts, 2003, cited in Guru and Santha, 2013).

Aguirre-Ayerbe et al. (2020), argued that engagement of the private sector in EWS. It should take into consideration of infrastructural and human vulnerability characteristics. Effective Early Warning Systems (EWS) require a comprehensive approach that includes implementing public awareness campaigns, integrating indigenous knowledge and existing socio-economic conditions, establishing automated response systems, securing sustainable funding, regularly updating hazard data, ensuring and verifying the reception of warning messages, and executing preparedness strategies. They need to be addressed and developed for successful adaptation of multi-hazard EWS in Asian countries. Ray-Bennett (2018) argued that the government of Odisha must improve the early warning system to reduce the number of deaths from disasters. To improve the localized EWS, she stressed more funding, investment in science and technology, and the advancement of communication channels to reach vulnerable communities. Further, The Early Warning System (EWS) should consider factors like demographics, gender, age, culture, and the livelihoods of the intended audience. Planners need to recognize the varying levels and types of vulnerability and capability among different groups, such as minorities, refugees, gender groups, age groups, and individuals with disabilities, to reduce disaster risk (Marchezini et al., 2017). The effectiveness of EWS depends on how well it caters to the needs of vulnerable groups, which includes Indigenous people, ethnic and religious minorities, women, children, the elderly, people with disability, and socio-economically disadvantaged groups (Yore &Walker, 2021; Trogrlic et al., 2022).Dutta and Basnayake (2018),in their study found that more capacity-building and awareness campaigns are required nationally and locally to strengthen EWS in South Asian Regions. These efforts should involve testing current SOPs, holding drills and simulations for particular hazards, and introducing more creative methods for raising community awareness. In order to further strengthen the systems and enhance the connections in communication networks from the national to the local levels, adequate resource allocation is a crucial goal that must be accomplished. This will make the networks more dependable and

efficient and enable timely information to reach the vulnerable sections much more quickly.

2.6. Gaps in the Literature

Although research on EWS proliferated over the years, there are important evidence gaps. Large body of literature have focused on the technical aspect of EWS, but limited research has looked into the socio-cultural and behavioural aspect of EWS (Kelman & Glantz, 2014; Ayeb-Karlsson et al., 2019; Perera et al., 2020). From the review of literature, it can be seen that there are many studies pointing to the barriers to EWS, but there are few studies that focus on the barriers of vulnerable groups and their access to EWS. Women are among the vulnerable groups, yet the voices of these groups have not been explored much. Literature reveals that there are a number of factors that act as barriers, but there is a dearth of studies that show the intersectionality of the vulnerabilities and barriers associated with access to EWS. Existing research has identified numerous factors that hinder access to Early Warning Systems (EWS) for certain groups, particularly vulnerable populations like women. These barriers might include limited access to risk information, social and cultural norms, economic inequality, and communication challenges. Although these barriers have been recognized, there is a noticeable lack of studies that explore how these factors intersect and compound each other. There are general studies on barriers to accessing EWS, but they have rarely identified their particular experiences in their socio-cultural context. Moreover, specific barriers and vulnerabilities faced by local populations in accessing and responding to early warnings have not been adequately explored or documented.

To address the gaps in the literature, the study aims to explore the women's experience of barriers to EWS in the context of Cyclone Fani using an intersectionality approach. The experience of women's access to EWS has been captured from the standpoint of women as well as from the stakeholder's perspective to understand the barriers and facilitators to EWS.

3. Methodology

3.1. Aims and Objectives

The research aims to know the barriers that women from different socio-economic backgrounds face in accessing early warning messages and how it affects their disaster preparedness.

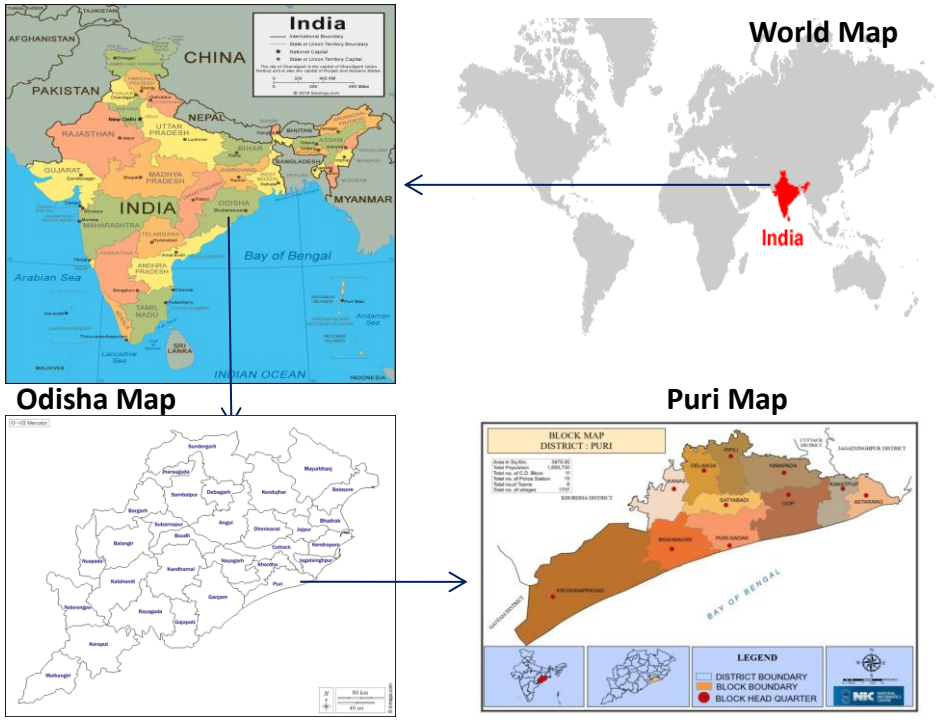
Specific research objectives:

1. To find out the barriers to accessing early warning messages by women during Cyclone Fani.
2. To explore whether early warning messages reach women from disadvantaged socio-economic groups.
3. To study the preventive measures taken by women after receiving early warning messages.
4. To study the factors that influence their actions for disaster preparedness.

3.2. Study Area

The extremely severe cyclonic storm Fani hit the Puri district of Odisha, India, in the morning hours of May 3, 2019. The World Meteorological Organization (WMO) informed via TV, social media that Cyclone Fani was a Category 3 hurricane, and it was the strongest cyclone to hit Odisha in the past twenty years. In the Odisha district of Puri, it has destroyed 1,294 villages and nine towns. In 14 districts of the state, Fani devastated about 1.65 crore people's life and property, causing extensive damage. According to the DLNA Report, which was conducted by the World Bank, Asian Development Bank (ADB), and the United Nations (UN), the total damage and loss from Cyclone Fani were estimated to be Rs 24,176 crore (approximately equal to $3.41 billion USD in 2019), while the recovery needs were estimated to be Rs 29,315 crore (approximately $4.12 billion USD in 2019).

Map 01: Puri District Map locating Odisha, India and World



Source: Collected and compiled from Google search database and Odisha geo portal.

Puri district is located in the eastern region of Odisha, India. This district takes its name from the historic city of Puri, which is one of India's four pilgrimage (Char Dham[1]) sites. More people living in rural than in urban regions make up the district's population. The main sources of economy and livelihood for the Puri people are agriculture, aquaculture, temple culture, and tourism. The district is known for its rich traditional heritage and cultural activities, celebrated through events like the Rath Yatra (Car Festival) and traditional dance forms such as Gotipua, Odissi, and Mahari. It is also known for its handicrafts, such as Pattachitra painting, sand art, applique work, and various cottage industries throughout the region. Puri's geographical features make it particularly vulnerable to cyclones. Being a coastal district (with a coastline extending approximately 150.4 kilometers) located near the seaside, has been receiving major challenges through the hit of continuous cyclones in different time periods, i.e., the 1999 Odisha Super Cyclone, Phailin 2013, Hudhud 2014, Titli 2018, and Fani 2019.

3.3. Research Design

The study used exploratory research design to answer the research questions. Exploratory research is undertaken when there is insufficient knowledge about a

[1]'Char Dham' refers to four holy sites of Hindu pilgrimage that are of high religious importance. The four sites are Rameshwaram, Jaganath-Puri, Badrinath and Dwarka. Lord Jagannath is worshipped in Puri, Odisha.

phenomenon, and the problem has not been clearly defined (Saunders et al., 2007). One of the advantages of this design is its flexibility and adaptability which helps to get new insights and uncover patterns of phenomenon under study (Swaraj, 2019). Exploratory design was considered suitable because though dispersed literature is available on early warning systems and their impact on disaster preparedness and risk reduction, but very few studies have been undertaken to understand the barriers faced, particularly by women from different socio-economic groups to access EWS. This design is helpful for uncovering a wide range of potential barriers and generating insights from diverse perspectives. Further, the study used both qualitative and quantitative methods and data to support the analysis and findings. This study has taken place in two phases that have been discussed below.

3.3.1. Phase I

In Phase I, data was collected from villages/clusters from three blocks: Puri Sadar, Brahmagiri, and Chandanpur block of Puri district of Odisha. Both qualitative and quantitative data were collected from 211 households (only women respondents) through multi-stage purposeful sampling. The study was undertaken from July to December 2019, just after the post-disaster period. The focus was on women, particularly those who are engaged in different livelihood activities.

3.3.2. Phase II

On the basis of the findings of Phase I, we wanted to confirm/validate it from respondents from other cyclone affected blocks and other stakeholders. Data collection for the Phase 2 took place from January to June 2024. Qualitative data was collected from women respondents through FGDs. FGD was selected as a research tool in this phase, unlike household surveys and interviews in Phase I. The reason is that the memories related to disasters fade over the course of time (Tierney, 2019). Where individual memories may fade or be distorted especially due to the impact of the COVID-19 pandemic. However, during FGDs, the respondents can recollect their experiences through their collective memory[2] of disaster.

Stakeholders (both men and women) who were actively involved in the process of dissemination of early warning messages or those who were part of the process (disaster preparedness) were recruited as sample respondents. The data from the stakeholders like the Aapda Mitra members, elected members, NGO staff, Anganwadi workers, ASHA

[2] Collective memory is the remembering of the past by individuals, groups, community, organizations, families, as well as various society stakeholders. It includes shared frameworks that shape and filter purportedly "individual" memories, as well as representations of the past experiences using narrative structures, memorials, and other commemorative forms. It is a social process by which communities retrieve, conceptualize, and memorialize the past in various forms such as memorials, experiences, emotions, museums, and rites.

workers, Disaster response teams (ODRAF), and Government officials were collected through key informant interviews.

3.4. Sampling and Recruitment

The total sample is comprised of the stakeholders who are at the receiving end of the EWS (Women respondents) and other stakeholders who are at the giving end of the EWS like the Aapda Mitra, Anganwadi Workers, ASHA workers, elected representatives, ODRADF members, NGO staffs.

Aapda Mitra: An Aapda Mitra is a trained and skilled community volunteer in India who is ready and available to assist with disaster response and management. These community volunteers are part of a government project launched by the National Disaster Management Authority (NDMA), Government of India to create a community-based response system for natural disasters such as cyclones, floods, earthquakes etc

Anganwadi Workers: A crucial part of the health and development of women and children in rural India is played by anganwadi workers, who are frontline health workers.

ASHA workers: Accredited Social Health Activists, or Asha ASHA workers, are professionals in community health. Their main function is to serve as an intermediary between the rural populace and the government-funded health services. In particular, in areas like immunization, disease prevention, and maternity and child health, ASHA workers play a critical role in advancing healthcare at the community level.

Elected representatives: Any individual chosen by the electorate to represent them in a governing body is known as an elected representative. The interests of those living in their constituency are served by elected officials. This might include taking care of regional problems, promoting improved infrastructure, or making government services more accessible.

ODRADF members: ODRAF (Odisha Disaster Rapid Action Force) members are highly trained professionals who specialize in responding to disasters and emergencies in Odisha, India. They belong to a specialized unit established by the Government of Odisha to manage natural calamities such as cyclones, floods, and other urgent crisis situations that demand swift and expert action.

NGO staffs: NGO staff are individuals employed by non-governmental organizations (NGOs), which are independent organizations focused on tackling social, environmental, and humanitarian challenges.

Participants were recruited from 7 blocks of Puri district. It includes women residing in the block who have experienced cyclone Fani. In the Phase I, multistage purposeful sampling was used for the household survey. Multi-stage purposeful sampling is a

sampling that involves selecting sample in two or more stages, incorporating 'purposive sampling' in all stages (Onwuegbuzie & Leech, 2007; Ramanujan, Bhattacharjea & Alcott, 2022). This sampling method was chosen to select women from three blocks Chandanpur, Brahmagiri and Puri Sadar. Villages and clusters from these blocks were selected on the basis of livelihood of women. Women in Puri were mostly engaged in livelihood related to agriculture, aquaculture, temple culture and tourism. In the villages and clusters, a sample was selected to ensure representation of women from different socio-economic groups. The rationale behind this sampling was to capture a diversity of experiences among women, as they do not form a homogeneous group.

The women participants for FGDs in Phase I were recruited through purposive sampling as livelihood specification was required as the research objective of doctoral work of the researcher. However, in the Phase II participant were selected through convenience sampling. The participants who had experienced Fani and were willing to participate in the FGD and IDI were included in the sample. The stakeholders like ASHA workers, Anganwadi workers, members of the ODRAF Team, NGO staffs, and local elected representatives were also recruited through purposive sampling. After interviewing ODRAF staffs, we found that Aapda Mitra workers were more engaged at the grassroots level, and we got the first contact of an Aapda Mitra from the ODRAF team. Then, other Aapda Mitra participants were recruited through snowball sampling.

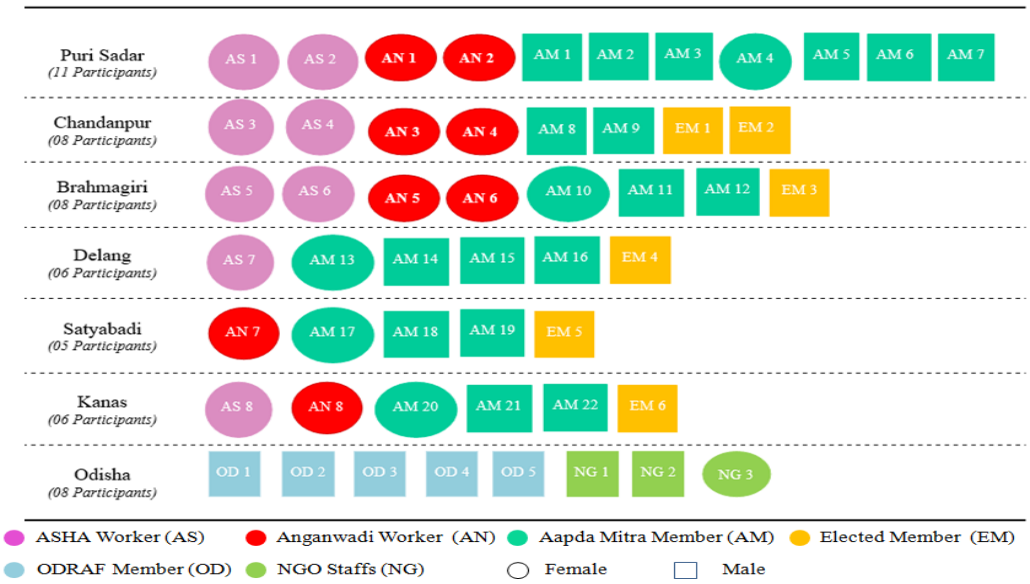
The total sample size of the study is 384 respondents (see Table no. 01) were collected from both the households and stakeholders through a multi-stage sampling method. Out of 384 samples, 211 samples were collected from women through household surveys and 173 respondents were from various stakeholders. Within the stakeholder sample, 52 samples were the stakeholders from various agencies working for the dissemination of EW information. The remaining 121 samples were gathered from 16 focus group discussions (FGDs). In each FGD, there were 6 to 10 participants.

Table 01: Structure of Sample Size

Participants	Tools of Data Collection	Sample Size	Phase- I	Phase – II
Women	Household Survey	211 HHS	✓	
Women	Focus Group Discussion	15 FGD	✓	✓
ASHA workers	Key Informant Interview	8 KII	✓	✓
Anganwadi workers	Key Informant Interview	8 KII	✓	✓
ODRAF members	Focus Group Discussion In-depth Interview	1 FGD 5 IDI		✓
Aapda Mitra volunteers	In-depth Interview	22 IDI		✓
NGOs staffs	In-depth Interview	3 IDI		✓
Elected members	In-depth Interview	6 IDI	✓	✓

Total IDIs – 36, Total KIIs –16, Total HSSs – 211, Total FGDs – 16

Figure 01: *Stakeholders from various agencies working for dissemination of EW information (arranged block wise)*



3.5. Data Collection

To obtain qualitative and quantitative information community-based participatory research technique was administered. The experiences and narratives of the women respondents and stakeholders were collected through household survey (HHS) and in-depth interviews (IDI). Focus group discussion (FGD) and key informant interviews (KII) were carried out to collect data through a semi-structured interview schedule.

A semi structure interview schedule (with both close and open-ended questions) was used to gather data from the household survey. They were used as FGD guides for the women participants according to the objective of the present study. Interview schedules with open-ended questions, separate for major categories of stakeholders, were used to collect data through IDI. Only for the Aapda Mitra team, the study used a semi-structured interview schedule. In this interview schedule, the barriers and facilitators were identified and scored by Force field Analysis from the fieldwork. They were translated to the local language (Odia) and the schedule was prepared using Akruti software (multi-lingual tool). Informed consent was obtained from the participants verbally by the interviewer. The interviews (IDIs, KIIs) and FGDs were conducted in the local language. Field notes were taken, and audio recordings were done in case of the participants those who gave consent for recording.

After conducting the interviews and FGDs, extracting data, and incorporating them through thematic analysis, the study identified barriers and facilitators relating to accessing EWS by women. First, we tried to find and list out the barriers and facilitators

for strengthening EWS from women participants and other stakeholders. These factors were listed in the semi-structured interview schedule that was prepared for the Aapda Mitra team members. They were asked to score the factors from 1 to 10 (lower to higher order). Then, the mean score was calculated for each factor and the total score of the barriers and facilitators were presented. (Figure no. 04).

3.6. Data Analysis

The data were analyzed using a thematic analysis approach (Barun and Victoria, 2006; Nowell et al., 2017). They were analyzed manually by the research team from the transcripts of interviews. The transcripts were translated from the local language (Odia) to English language for better understanding. Firstly, the themes related to the experience of women's access to EWS and disaster preparedness were identified and grouped from the data collected during Phase-I. Secondly in Phase-II, analysis of the FGDs and stakeholder interviews were used to validate the data collected in Phase-I regarding the experience of women's access to EWS. Thirdly, the analysis of the qualitative data was also used to list out the barriers and facilitators of FFD analysis. Further, the collected data was explained through the intersectionality framework. Intersectionality framework is a methodological approach that explores intersection of multiple social identities that shape the experience of individuals (Crenshaw, 2013; Atewologun, 2018; Bauer et al., 2021). The qualitative data collected through IDI, KII and FGD will look for the patterns that reveals how intersection of social identities influence the barriers and facilitators to early warning information and overall experience of women in disaster with regard to early warning. Intersectionality framework was also used in selecting sample purposively from diverse demographic population in terms of their age, marital status, caste, level of education, income and livelihood. The focus was to ensure a comprehensive understanding of the vulnerable group being studied.

3.7. Ethical Considerations

The present research adhered to all the ethical guidelines while collecting and analyzing data from the women participants and other stakeholders. Those participants and stakeholders who agreed were taken into the study sample without being forced. The research team had taken informed consent verbally from all the participants and stakeholders prior to the collection of the data. Anonymity and confidentiality of the respondents and their responses have been maintained throughout the analysis, interpretation of the data as well as reporting the findings of the study. To ensure anonymity, the researchers have protected participants' privacy by coding their names and keeping the verbatim content intact during transcription without revealing any personal identities. The researcher obtained informed consent forms (from individuals, gatekeepers, and stakeholders) and will refrain from sharing confidential information with others. The researchers have adhered to General ethical guidelines and have also tried to possibly address disaster related ethical guidelines. Culturally sensitive reporting, clear and respectful communication, respect for local culture and tradition was taken

into consideration during the research. Ethical approval for this project was sought and granted from the Institutional Ethics Committee (Human) of Utkal University (IEC Reference No: IEC/UU/2024, Application No: 12/2023) prior to commence of the project work.

Two major biases that were arising in the study were selection bias and recall bias. To address the selection bias the researcher tried to give coverage to diverse sections of women as a group. The study collected data from various stakeholders engaged in providing early warning information. The collection of data on Cyclone Fani nearly five years after the event raised concerns about recall bias, as individuals may struggle to accurately remember their experiences. To mitigate this potential issue, the researchers conducted focus group discussions in the Phase- II of data collection.

Inclusion Criteria

- Women and stakeholders who gave consent for the study.
- The study has included only one woman from a household.
- Women from different socio-economic strata.
- Stakeholders (both male and female) who have been working for the disaster-affected people and areas .
- Disaster Response Personnel engaged in the Early Warning System and Evacuation has been interviewed to know their perspectives on barriers and facilitators to EWS.

Exclusion Criteria

- The proposed representatives for other categories have not been picked up from the household where a sample respondent is already been chosen.
- Young girls below the age of 11 years.
- Sick and older women who were unable to recall the incident.

4. Results

4.1. Socio-demographic Profiles

4.1.1. Women Respondents

The socio-economic and demographic features of the respondents are given below (Table no. 02). Sample women predominantly belong to the 35-50 age group, followed by the 19- 35 age group. Women belonging to the Scheduled Caste (SC) community (38

percent), and Socially and Economically Backward Classes (SEBC) (32 percent) were more visible in the sample. The study gave coverage to marginalized women to know about their experiences. This further gave the impression that in the coastal districts, the workforce participation among women belonging to the lower caste was higher in comparison to the women of the higher caste. The sample consisted of 72 percent married women, 14 percent widows and 12 percent unmarried women. Illiteracy persisted among the women of the study area (50 percent). The per annum income of households was noted to be very marginal. 57 percent of sample respondents belong to landless families. The poverty and marginalized conditions experienced by women can be reflected in their access to and possession of limited gadgets. All the women respondents practiced Hinduism, as the villages were purely Hindu-dominated regions.

Table 02: Socio-demographic profile of women respondents

Indicators	Classification	Total (N=211)
Age	11-19	4 (1.89)
	19-35	39 (18.48)
	35-50	94 (44.54)
	50-65	54 (25.59)
	65-80	17 (8.05)
	Above 80	3 (1.42)
Caste	General	51 (24.17)
	SEBC	68 (32.22)
	Schedule Caste	81 (38.38)
Marital Status	Married	152 (72.03)
	Unmarried	25 (11.84)
	Widow	30 (14.21)
	Any Other	4 (1.89)
Level of Education	Illiterate	106 (50.23)
	Primary	52 (24.64)
	Secondary	49 (23.22)
	Graduate	4 (1.89)
Household Income	Below 20,000	65 (30.80)
	20,000-40,000	54 (25.59)
	40,000-60,000	32 (15.16)
	60,000-80,000	30 (14.21)
	80,000-1 lakh	17 (8.05)
	Above 1 lakh	13 (6.16)
Landed Property	Yes	91(43.12)
	No	120 (56.87)
Gadgets	Cell Phone	192 (90.99)
	TV	143 (67.77)
	Fridge	25 (11.84)

Source: Field Data

4.1.2. Stakeholders and FGD Participants

The socio-demographic profile of the key stakeholders in dissemination of EW information and FGD participants under the study are given below (see table 03). The stakeholders include ASHA workers, Anganwadi workers, Aapda Mitra members, local elected members, NGO staffs, and ODRAF members, whereas. FGD participants include women groups as well as ODRAF team members. In the stakeholder sample, both men and women respondents were taken into consideration looking into their nature of association with the EWS, unlike the household survey where data was collected only from women. In the stakeholder sample, 21.38 percent male members were taken into the study. In the sample, stakeholder predominantly belongs to the 26-35 years age group, followed by the 36-45 years age group. Though illiteracy persists among the stakeholder sample, but all the key informants are literate against the FGD participants. Married persons constituted nearly 75 percent of the stakeholders. In the stakeholder sample, everyone followed Hinduism, and mostly all the respondents belonged to the SEBC (40.46 percent), followed by General (30 percent) and SC (28.9 percent) caste groups.

Table 03: Socio-demographic profile of stakeholders

Indicators	IDIs / KIIs (N-52)	FGD (16 FGD/121 Participants)	Total (173)
Gender			
Male	30 (57.7%)	7 (5.8%)	37 (21.4%)
Female	22 (42.3 %)	114 (94.2%)	136 (78.6%)
Age			
Up to 25	2 (3.9%)	11 (9.1%)	13 (7.5%)
26 to 35	28 (53.9%)	42 (34.7%)	70 (40.5%)
36 to 45	12 (23.1 %)	34 (28.1%)	46 (26.6%)
46 to 55	9 (17.3%)	21 (17.3%)	30 (17.3%)
Above 56	1 (1.9%)	13 (10.7%)	14 (8.1%)
Education			
Illiterate	0 (0%)	47 (38.8%)	47 (27.2%)
Primary Level	0 (0%)	25 (20.7%)	25 (14.5%)
Secondary Level	8 (15.4%)	26 (21.5%)	34 (19.6%)
Higher Secondary Level	15 (28.8%)	16 (13.2%)	31 (17.9%)
Graduate and above	29 (55.8%)	7 (5,8%)	36 (20.8%)
Caste			
General	25 (48.1%)	27 (22.3%)	52 (30.1%)
SEBC	19 (36.5%)	51 (42.1%)	70 (40.5%)
SC	7 (13.5%)	43 (35.5%)	50 (28.9%)
ST	1 (1.9%)	0 (0%)	1 (0.5%)
Marital Status			
Married	41 (78.9%)	88 (72.7%)	129 (74.5%)

Unmarried	8 (15.4%)	12 (9.9%)	20 (11.6%)
Widow	3 (5.7%)	17 (14.1%)	20 (11.6%)
Any other	0 (0%)	4 (3.3%)	4 (2.3%)

Source: Field Data

4.2. Access to Early Warning Messages

4.2.1. Awareness Levels

An EWS keeps a hazard from turning into a disaster event. Early warning messages are most effective when people are informed about potential risks in a timely manner, fully comprehend the information, and take appropriate action (Fakhruddin, Gluckman, Bardsley, Griffiths, & McElroy, 2021; Seng, 2012). There are two components to early warning. The first is the communication of risk information, and the second is the response of the public to these alerts. (Fakhruddin, Clark, Robinson, & Hieber-Girardet, 2020). It assists communities in minimizing harm, taking preventative action, and saving properties and lives. (WMO, 2020). They would have adequate time to get ready if they are aware of the disaster in advance. That being said, not everyone processes information at the same pace.

The data collected from the HHs in Phase-I indicates that up to 90 percent of respondents were aware that cyclone was approaching. Out of the total sample respondents, 38.62 percent knew about the cyclone three days in advance, 23.28 percent knew about it five days in advance, 17.28 percent knew about it one day in advance, and 14.81 percent knew about it one or two days in advance. Just 5.8 percent of the responders said that they received the information six days before to the cyclone. The women who were unaware of the cyclone beforehand were from lower socio-economic groups. An adolescent girl with a disability, women from harijan sahi, and those who resided in the interior location did not receive early warning messages. The reason behind their inaccessibility is discussed in the barrier section.

The place where cyclone Fani made landfall was Puri. In order to find out if the respondents knew anything about the landfall site, they were asked “Did you know about the landfall site?”. Forty percent of the participants who knew about the cyclone were aware that it was expected to make landfall in Puri. Nevertheless, the landfall site was unknown to roughly 60 percent of the respondents. The risk information about the date of the cyclone, landfall site, and knowledge about the speed of the cyclone is mentioned in table no. 04.

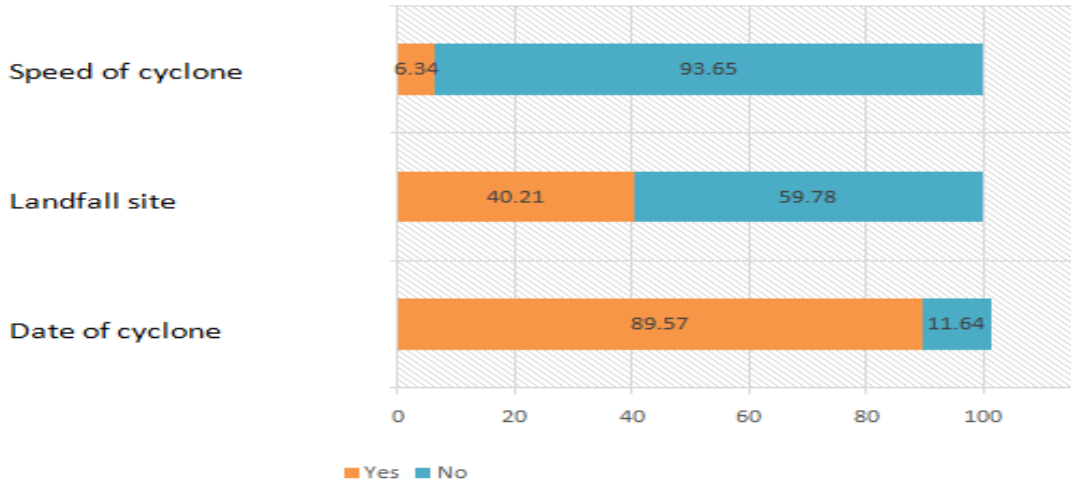
Table 04: Knowledge of risk information of the respondents

Risk information	Class	Number of Respondents	Percentage
Date of cyclone		N=211	
	Yes	189	89.57
	No	22	11.64
Knew about the cyclone before		N= 189	

	1 day	33	17.28
	2 days	28	14.81
	3 days	73	38.62
	5 days	44	23.28
	6 days	11	5.8
Landfall site	Yes	76	40.21
	No	113	59.78
Speed of cyclone	Yes	12	6.34
	No	177	93.65

Source: Field data

Figure 02: *Knowledge of risk Information (In Percent)*



Source: Field data

4.2.2. Source of Risk Information

Various organizations handle and execute early warning messages based on the type and scale of the disaster. The meteorological department, for example, monitors and detects the upcoming hazard. Numerous sources are used to disseminate information about the risk. Neighbors, friends, and community members reaffirm risk information they get from various sources (Perry & Lindell, 1997; Sims & Baumann, 1983). Respondents were questioned regarding source of early warning messages in their local communities. In response, 40.21 percent of the participants stated that television was their main source of information, followed by 16.93 percent who knew it from neighbors, 10 percent who read the newspaper, and 13.75 percent who heard it over the public address system. However, it is important to note that although people have obtained information from a variety of sources, the major source of risk information is highlighted in Table 05.

Table 05: Sources of Early Warning Messages

Primary Source	Number of respondents (N= 189)	Percentage
Television	76	40.21
Newspaper	19	10.05
Public Address System	26	13.75
Local administration	11	5.82
local key person (Volunteers, ASHA, Anganwadi Worker, School teacher)	17	8.99
Neighbours	32	16.93
Social Media	8	4.23

Source: Field data

During the survey, the respondents were also asked about the role of community health workers in creating awareness among women regarding disaster preparedness of women and adolescent girls, to which the respondent replied:

> "…..A meeting was called by Anganwadi didi. She explained what precautions we need to take. I listened to her, but I had to go back home as I had to make lunch and was in a hurry. Many of us took the meeting lightly as we already knew that the cyclone was coming, and she was telling us basic things to do. The pictures were taken of the meeting. Others were present there, but I came back as I had some work."
>
> [AG R- 34]

> "We were given leave for 1st, 2nd and 3rd May. Then again, our Supervisor, madam, messaged that there is an instruction from CDPO Madam that Fani is coming on 3rd May. Then, our holiday was cancelled, and the supervisor, Madam, called for a meeting. On the 28th, we heard about Fani. I had called a meeting on 2nd May for all the women of the village to alert them about the disaster as we had got the instruction from our Supervisor. I made them understand how to prepare themselves for the upcoming disaster. But they laughed and said don't we know all these things? I said you might know, but it is my duty to inform you all. I don't stay in this village, so when I left, I handed over the keys (school) to the helper. People from harijan sahi and Nayak sahi they stay in kuchha houses. If they come to stay, they may face difficulties. They stayed here for nearly 15 days. After the cyclone, I even went to the extent of bringing the stocked vegetables from my home to cook them for the children to avoid a halt in their food habits. After Fani, when the internet connection was not there, it was difficult to transfer funds; I spent some money from my side to meet the expenses of the Anganwadi".
>
> [Anganwadi worker]

Thus, the above statement shows the proactive role played by community health workers not only in disseminating EW messages and information but also for disaster preparedness and helping out vulnerable women in the post-disaster period. This type of humanitarian action extended beyond community health workers and includes key stakeholders such as Aapda Mitra members and local elected representatives, who also played a crucial role in disaster preparedness. However, it was found that although risk information was given to the women respondents, they did not take the warnings seriously.

4.3. Preventive Measures Taken

The second component of disaster preparedness is concerned with the concrete action taken by the respondents. The women under sample coverage were asked to recall their actions once they were alerted before the disaster took place. The replies to this query received from the women are presented in table 06.

Table 06: Preventive measures taken after receiving EW messages (N=189)

Common Actions	**%**	**Livelihood Specific Actions**	**%**
Evacuation & occupying shelter homes, safe home	41.26	Storing agricultural produce	8.99
Protecting documents and precious material	38.09	Unleashing animals	19.04
Helping kin and neighbours	14.28	Covering with sheets	3.7
Buying food	25.92	Keeping boats and nets	5.82
Buying Medicines	15.87	Storing dry fish	12.16
Unleashing animals	19.04	Tried to harvest fish	3.17
Keeping water	40.21	Storing raw materials, products	6.87
Charging electric equipment	59.78	Packing mobile shop units	12.16

Source: Field Study

Note: Total does not add up to 100%, as multiple responses were allowed. The percentage represents the respondents who took preventive measures, including their own actions as well as their dependence on others, such as family members, friends, and neighbors.

As it is perceptible from the table 06, before the disaster, women are found to have taken many activities, i.e., evacuation & occupying shelter homes, moving into safe homes, protecting documents and precious materials, unleashing animals, buying food and medicines, arranging and storing water. However, there are certain activities they have carried out themselves, and in some activities, they have taken the help of others.

It was found that 90 percent of women got help from their family members to take up activities related to the public sphere, like buying food and medicine. However, in the case of the actions that were related to the private sphere and household activities, they

were more active and less dependent on partners, family members and external agencies. The other activities taken by women in the preparation were livelihood-specific actions. Women from agriculture were reported to be engaged in storing agricultural produce, covering them with tarpaulin sheets and unleashing the animals. They were more dependent on family members for storing grains than for unleashing animals or covering sheets on things that they wanted to prevent from being destroyed in the cyclone. In the case of women engaged in aquaculture, women depend more on their husbands to keep boats and nets, whereas, for the storage of dried fish, very few respondents took the help of their family members. Some women who were engaged in pisciculture tried to harvest the fish, but for this, they depended completely on their partners. Women who did work related to temple culture and tourism mostly packed their mobile shop units and products as a part of their disaster preparedness in order to prevent their products from being damaged by the cyclone.

The community health workers were asked during the KII regarding the actions taken by them for the pregnant and lactating mothers.

> "There were five pregnant women in our village; as soon as we got information from Anganwadi Didi (AWW), we went to their houses and asked them to get admitted into the PHC. One of them did not agree and said that I was staying in Pucca house, so why did I need to go to the hospital? But we said that we can't take risks; if anything happens suddenly or in between, we will be helpless and can't do anything. We had got strict orders from the supervisor to take them (pregnant women)"

[ASHA, KII]

Aaada Mitra team who were assigned for the evacuation process, when asked what instructions were given to the people before Evacuation, she replied

> "We told them to carry essential materials like jami patapauti (land documents), Adhaar card, bank passbook, gold and other ornaments, and dry food. Some of them were reluctant to leave some of their family members in one place and go to shelter homes."

[Aapda Mitra, Kanas Block, AA 3]

The narratives underscore the challenges faced by the community workers in convincing individuals to evacuate. Despite their initial reluctance, there is a need for clear communication about the risks involved and the importance of following established protocols to ensure the safety of pregnant and lactating mothers during disaster, which the community workers followed. Some respondents hesitated to follow the community workers because they were reluctant to leave behind their family members and go to shelter homes. It affected the evacuation process, which is an important part of disaster preparedness.

4.4. Barriers to Accessing and Responding to EW

In order to look into the risk perception of the respondents, it was crucial to ascertain through EWMs whether they were aware of the impending cyclone. If they were aware, when did they receive that information, sources of information, and how did they respond to it? The prominent themes that emerged from the qualitative data gathered from women respondents from the Phase I & II field study are discussed below.

4.4.1. Past Experiences

The past disaster experience has had substantial effects on their risk perception (Ardaya, Evers, & Ribbe, 2017; Mishra & Suar, 2007; Wachinger, Renn, Begg, Kuhlicke, 2012). Previous encounters and experiences have effects on a person's risk perception and protective behaviour (Norris et al., 1999; Weinstein, 1989). People think more clearly about risk when they have personal experience with it (Weinstein, 1989). However, people typically establish some heuristics—a method of calculating or judging risk based on their memories—based on their prior experiences with disasters, which may lead to bias in how they perceive risk (Mishra & Suar, 2007). Disaster experiences in the past can influence how people view their susceptibility to a certain disaster. It may have an impact on how people and communities view and react to future risk. Memories from previous experiences act as benchmark or reference point for assessing the potential of future risks.

This study found that more than 90 percent of women respondents had the past experience of disaster. Despite this, their perception of risk remained low, due to the low severity of previous cyclones in the Puri district. This result may be linked to the "normalisation bias" (Mileti & O'Brien, 1992) that distorts risk perceptions by making people underestimate the potential threat as they get accustomed to a hazard. Secondly, most cyclones that impact Odisha typically form in October, which is the period when cyclone warnings are most common. However, Cyclone Fani was an unusual event as it was a summer cyclone that struck Odisha in May. This early occurrence of a cyclone in a month outside the usual peak period affected how the warning was received and perceived. Respondents were accustomed to receiving cyclone warnings primarily in October, so this deviation from the expected timing likely affected their perception of the threat and their urgency in taking preventive measures.

4.4.2. False Alarms and the Cry Wolf Effect

Research have shown that smaller percent of the population acts upon receiving disaster warnings because they are skeptical about the warning messages. Initial warnings messages make people comply with the preparedness, and repeated warnings result in less perceived risks (Hansson et al., 1982). Several studies discuss the "cry wolf effect," which occurs when a large number of false warnings damage the early warning system's credibility (Sawada, Kanai, & Kotani, 2022; Simmons and Sutter, 2009; Mogil, 1980). This

goes beyond just a false alarm; if the disaster does not materialize after the warning, the threat's perceived seriousness and reliability are called into question (Atwood & Major, 1998). From the qualitative data gathered for this study, participants described how they had been making preparations after receiving cyclone warnings of past, but they had not taken the early warnings seriously when the disasters did not materialize, had a low intensity, or did not affect their region. Some of the voices of the women respondents, which reflected the lower risk perception of the respondents, are given below.

> "Every year, we get warnings that a cyclone will happen, this cyclone is coming, but cyclone never happens here, so I did not take it seriously." [R AG 6]

> "During Phailin, Hud Hud, Titli also they said the cyclone is coming but here it was not severe. How will we know that this time cyclone will happen or not. Television shows that a cyclone is coming nearer but at the end it does not happen here or there is only rain and wind with low speed." [R AQ 14]

> "Last time when we heard about the warning then we started shifting our belongings to that house (pucca room).... This is asbestos house and we feared that our stuff would be destroyed in cyclone. It took an entire day to shift things and then the cyclone did not happen. After that, again I had to shift it back to the rooms. So, this time also I thought cyclone will not happen and did not put any effort into preparing beforehand. But this time cyclone was so severe. I tried shifting things to that room with the help of my family members, but still they got damped. Mostly, the raw materials (sholapiths) from which we make this (Odissi ornaments) got wet." [R TE 8]

4.4.3. Religious Beliefs and Cultural Norms

Puri district of Odisha is one of the 'Char Dham' pilgrimage sites. Many respondents acknowledged that they believed that disaster would not happen here as this is the abode of Lord Jagannath. Their belief was stronger than the risk information. To quote a respondent from Penthakata:

> "...but I believed that disasters can't happen here. If it happens, Lord Jagannath will save us. So, I did not move to the shelter when we were asked to go to a higher place. We live here (near the sea). I was there with my two children (pointing towards them). When sea came nearer, I believed Jagannath will save us. When it came much closer, I thought that Jagannath will save us. When water reached my house, I understood that Jagannath would not come to save us and I have to save myself and my children ...."
>
> [R AQ 27]

> "We thought that if 1999 Super Cyclone which affected Odisha could not affect us then how will Fani affect us. We will not have cyclone in Puri as Prabhu (Lord) Jagannath stays here and will protect us."
>
> [R AG 66]

> "When we were trying to convince them to go to higher places and shelter homes when we got the instructions for Evacuation. Many of them were confident that this time also cyclone will not happen. Like previous years this time also nothing will happen as this is Puri."
>
> [AM 3]

During the FGDs, women said they were confident that the cyclone would not impact Puri. When they were further asked about the reason behind it, some respondents said that it was due to God's presence in Puri while others referred to past experience. They also gave an example of how the 1999 Super cyclone that affected other Odisha areas could not affect Puri. This belief was associated with past experiences where other coastal districts of Odisha were affected by cyclones; Puri, a coastal district, never experienced the severity of the cyclone. This made them believe that the intensity of the cyclone had been low in Puri as Lord Jagannath resides here. They believed that even though the cyclone hit Puri, Jagannath would save them. Religious belief shaped their risk perception, making them vulnerable both in pre-disaster and post-disaster conditions. This illustrates how religious factors limit the effectiveness of early warning systems by determining how people interpret risk. This finding is in coherence with the cultural theory of risk (Douglas, 1992), which is based on the premise that collective beliefs influence individual risk perception.

4.4.4. Underestimating Cyclone Severity

Findings from the Phase I household survey show that although 90 percent of respondents were aware of the approaching cyclone, however, 93.6 percent were not aware of its speed (refer Table 04). This was one of the most univocal expressions of women across different socio-economic categories that the researchers found from the field study. The perceived severity of the cyclone was lower in comparison to the actual severity of the cyclone. For this reason, the respondents could not also estimate the loss. This risk perception was affected by partial information.

4.4.5. Communication Constraints

Communication is an integrated element of effective EWS (Oktari et al., 2014). Failure to communicate EW messages to the communities, particularly to the last mile communities, can lead to the failure of the EWS and a chance of more risk and vulnerability.

It was commonly observed from the study that women interaction with the public sphere is lesser than in the private sphere. They prefer to interact with family members and neighbors, and their neighborhood interaction is limited to surrounding women. There was less interaction with the public sphere (markets, shops, public gathering, meetings etc.) and more dependent on family members for outdoor activities. As most of the EW messages and information were shared in the public sphere and mostly accessed by the male members, they were hardly disseminated to their counterparts. In several instances, women in marginalized groups faced barriers to accessing information that men did not, largely due to traditional gender roles, mobility limitations, and social norms that restrict their interaction with other community members.

The early warning messages reach women in the form of instructions for preparedness rather than giving maximum information regarding the cyclone. Due to this, many women were unaware of the landfall site and regarding the speed of the cyclone.

> "…My husband went to market and there people were discussing about cyclone. He came home and told us about the cyclone and asked to me fill the water jars…"
>
> [AQ R3]

> "Men have more information not only about cyclone but also other village issues because they are going outside. We are inside busy with daily chores and children. We cannot roam in the village. We talk to our neighbours. But they often come to our house or we talk near our house boundary."
>
> [FGD 4, P3]

> "I was newly married during Fani. It would not look good if I step out of the house and talk freely with other villagers. Now I often talk with our neighbours but that time I could not. In the morning of the cyclone day, we had to rush to the shelter home. But the shelter home was already packed…"
>
> [AG R37, IDI]

In another context of communication constraints of EW messages, language played an important role, and in this study, two particular regions (Nolia Sahi and Penthakata) experienced language as the main constraint in decoding EW messages. Nolia Sahi and Penthakata are settlements for a fishing community that has migrated from the neighboring state of Andhra Pradesh. Their mother tongue is Telugu, and they hardly speak Odia. They are acquainted with specific forms of local language, particularly in the context of business. Despite their ability to communicate effectively for business purposes, they still experience challenges or limitations with the language. The earning warning messages through the Public Addressal System were done in local (Odia) language. So, it was difficult for the community to decipher the early warning. The volunteers (Aapda Mitra) of the evacuation team were also the local people who spoke

Odia language. While discussing with these volunteers, they agreed that they have also faced similar communication challenges during the evacuation process of the fisher folk community.

4.4.6. Infrastructure Constrains

Women from the Dalit community reside in the margins of the village in Harijan Sahi. This structural arrangement is found in most of the villages under study. The location of houses on the margins of the village in Harijan Sahi significantly affects the ability of women from the Dalit community to receive information through the public address system. This spatial separation from the central areas of the village not only reflects their social marginalization but also has practical implications for their access to early warning information and services. Their location in the periphery of the village means that they are distanced from the village's main roads, where public address systems (PAS) announcements are made. PAS usually aims to reach a large number of people quickly, often making announcements on the village's main roads, inadvertently excluding those living on the margins. A Dalit women respondent said, "*We live here. The vehicle came to the main road. There was some announcement, but what announcement was made, we could not hear it. Those who stayed that side (higher caste lanes) could hear it*."

Another respondent from the Harijan sahi said, "*No one will come here to make an announcement. Four-wheelers cannot enter here. They make an announcement on the main road*". As the houses of the Dalit women are located on the margins with narrow road connectivity, the sound or reach of the public address system may not effectively cover these peripheral areas. The announcements made via this system may not be audible or accessible to them, leaving them out of access to information that is easily available to those living closer to the village center or main roads.

The study finds that the physical and social marginalization of Dalit women, who live on the outskirts of the village in Harijan Sahi, directly impacts their access to vital public information. This situation highlights a broader issue of inequality, where marginalized communities are not only socially and economically disadvantaged but also face practical challenges in accessing essential services and information.

4.4.7. Challenges for Women with Increased Risk Factors

Although there is risk information, still vulnerable women, particularly those who are pregnant, elderly, or living with disabilities, may face physical barriers that prevent them from accessing information or evacuating in time. To quote the mother of an adolescent girl with hearing and speech impairment

> “…. The Prachargadi (Public Addressal System) came and announced something. I could not hear it as it was far. Generally, when prachargadi comes I ask them for pracharpatra (written instructions) and give it to my daughter (hearing impaired)

> to read. This time the prachargadicame but it passed that way (road). They did not come into the village.....Unlike previously, this time pracharapatra was not given. So, I could not give it to my daughter. She can't hear or speak. We live here (referring to kutcha house). At least we could have covered the important things..."

[R-42, IDI]

The situation of adolescent girls with disability highlights the challenges faced by individuals with disabilities, particularly in accessing and understanding early warning messages during disasters. One of the respondents [R TC 144], who was a caregiver of elderly women with disability (mentally ill), also expressed the difficulty in moving her to a safe place before the disaster, along with her children.

One of the Aapda Mitra workers, while narrating their experience of Fani, said that-

> ".....a pregnant women of Nolia Sahi refused to move to PHC (Primary Health Centre) even after I explained her. As she was pregnant, she wanted to stay with her family and not move to PHC with us without her family members. They denied because they don't know us and they feel safe within their home and with their family members."

[AM 6, IDI]

The reluctance of the pregnant women stemmed from her feeling safer at home with her family, especially because she was pregnant. Since she was unfamiliar with the volunteers, she did not agree to evacuate. The emotional and psychological barriers can influence individuals' decisions during disasters, particularly when they feel a strong attachment to their family and home. In another case, an elderly women narrated her experience of Cyclone Fani,

> "I was there in my house (kutcha) when the cyclone started. When I saw the speed of the cyclone increasing after that, I started rushing to our neighbour's house as they had pucca house. While I was going, a huge asbestos sheet few and hit my thigh. I started bleeding but our neighbours helped in dressing the wound. When it went out of control, they took me for surgery. Although my son could not bear the entire cost of the operation, my community members and neighbours supported us financially."

[Elderly women, R-55]

The experience of the elderly women highlights several factors that affected her during the disaster, including structural vulnerability (living in kutcha house), physical injury due to mobility issues, and financial constraints she faced after being impacted by the disaster. Timely Evacuation to a safe place after receiving the early warning could have

prevented her from being in a vulnerable position. Moving to a secure location before the cyclone intensified would have likely spared her from the injury and the subsequent need for surgery, highlighting the importance of heeding early warnings and ensuring prompt action, especially for vulnerable individuals like the elderly.

4.4.8. Place Attachment and Hesitation to Evacuate

As part of disaster preparedness, evacuation planning begins as soon as the early warning is received. The local government and authority issues warnings advising residents to leave the vulnerable and high-risk regions and relocate to a safe location. The study found that in addition to higher land, government shelter homes, under-construction buildings, pucca houses in the area, and relatives' homes were among the locations to which individuals fled during evacuation. Although the evacuation process wasn't abrupt, the responders had their own concerns prior to leaving. There were numerous reasons for hesitation in evacuating. The most common reason given by 34.04 percent of respondents was that they were afraid of having their belongings stolen or destroyed in the disaster, which prevented them from leaving their homes. Nearly 20 percent of respondents hesitated to leave as their neighbours stayed behind. The evacuation was more group-focused, because 11.70 percent of respondents chose not to leave because others in their community did not. Respondents (14.89 percent) who lived close to the Jagannath temple believed that God would save them and that they would not be impacted by the disaster.

Besides all these factors, it has also been noticed from the FGDs and other stakeholders' interviews that people are less reluctant to move after receiving the warning because of their attachments to their homes, fear of damaged or loss of household assets (TV, Fridge, Furniture, etc.) as well as livelihood assets, and to take care of domestic animals. It was further observed that the women's attachment towards their own(ed) place – Home and Assets, is prevalent across different types of houses (kutcha or pucca or semi pucca) and socio-economic conditions.

4.4.9. Limited Access to Technology

Vulnerable women, particularly those whose socio-economic condition is low, lack access to technology such as Television, smartphones, radios, or the internet, which is necessary to receive early warning messages beforehand (Nayyar et al., 2019; Sibiya, 2022). It was observed from the field and FGDs that, in general, women members lack access to phones and those having access to phones lack internet compatibility. Particularly, women mostly use keypad phones (nearly 74 percent) for daily telephonic conversations with family and relatives rather than other activities like banking, shopping, entertainment, social media, news, etc., which are mostly available on smartphones. Although the government forwarded continuous EW text messages and alertness to every user in the cyclone-affected areas, lack of access to mobile, the

prevalence of illiteracy, and the lack of seriousness towards the text messages exacerbated the digital divide among women.

At the same time, as most of the women engaged in household activities and disaster preparedness with the direction of their family members, they get less time to look into the TV or mobile for cyclone information. This digital divide prevents them from being informed about imminent risks. Earlier, it was found that the primary source of information for 40 percent of respondents was Television. During the FGD, women also said that those who had access to television and mobile phones had information about the cyclone beforehand.

> "Despite the information in the village, we could not do anything to save our houses. Those who stayed on that side (higher caste lanes) took precautions but we did not get much information as we neither have TVs nor anyone told us as we are living in the corner (Harijan sahi). No one even helped us."

[P-51]

The statement of a Dalit women shows the inequality in access to information and resources, highlighting how marginalized communities, such as those living in Harijan Sahi, are disproportionately affected by disasters. Despite receiving some information about the cyclone, they were unable to take necessary precautions.

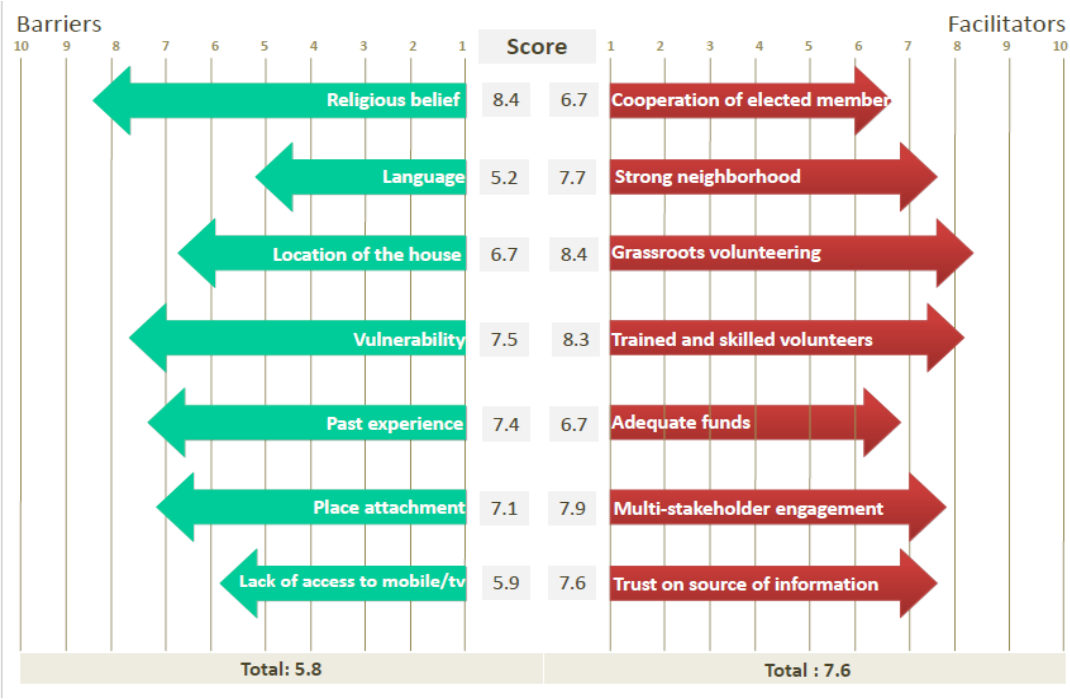
4.5. Facilitators of Early Warning Access

The women respondents, as well as the stakeholders also mentioned about the facilitators that that helped in strengthening the EWS. They are grassroots volunteering, trained and skilled volunteers, cooperation of elected members, strong neighborhood, adequate funds, multi stakeholder approach, and trust in the source of information were found as some of the facilitators apart from the barriers that are discussed above. In this context, the present study used Force Field Analysis (FFA) to know the strength of the barriers and facilitators from the stakeholder's perspective.

4.5.1. Force field analysis

The barriers and facilitators for access to EWS emerged from the interviews and FGDs conducted in both Phase I and II from the women and stakeholders. They are shown in the figure no. 03 with their mean score. The stakeholders' perception regarding barriers and facilitators to the EWS of the Aapda Mitra members was taken in order to conduct the force field analysis. It can be seen in Figure no. 03 on the basis of the score, religious belief (Score- 8.4) and vulnerability (age, pregnancy, and disability) (Score- 7.5), and past experience (Score- 6.7) were scored as top barriers for access to EWS.

Figure 03: Force Field Analysis of Barriers and Facilitators (N=22)



In terms of facilitators, the mean scores of Grassroots volunteering (Score- 8.4), Trained and skilled volunteers (Score- 8.3), and multi-stakeholder engagement (score- 7.9) were found to be the most important factors of facilitators for the access to EWS according to the Aapda Mitra members. The total mean scores for the barriers were found to be 5.8, and for the facilitators, it was 7.6. This shows the robustness of the Odisha Government and other stakeholders in disaster preparedness. However, through this study, the basis that affects the reachability and accessibility of EWS is explored. There are areas where change and improvement are required at the ground level for better delivery of EW information.

5. Discussion

This study aimed to explore the barriers to early warning systems that women faced during Cyclone Fani. The barriers to early warning were captured through women's experience and also from the stakeholders' perspective those who were engaged in the disaster preparedness process at the community level. The early warning system was found to be generally effective, reaching 90 percent of the respondents. Despite the high overall reach, those who did not receive these warnings were particularly women from lower socio-economic groups and those residing in the villages' margins. This indicates socio-economic factor as a barrier in access to or reception of risk information. Women from lower socio-economic backgrounds did not have access to mobile phones, radios, or televisions, which are common channels for disseminating early warnings. A study by Mileti (1995) also revealed that socio-economic-demographic-psychological characteristics are some of the factors at the receiver end that influence the public response to EWS. Similarly, Mathathu and Seedat-Khan (2022) also argued that patriarchal traditions, imposed gender roles, and lack of ownership over dominant resources are important factors that help women access early warning information. This finding from the present study could be expanded upon in future research to explore the issue further and develop effective approaches to address how socio-economic factors impact the dissemination of early warning messages.

Despite the high reach of the early warning messages, there was a lack of adequate disaster preparedness from the women respondents. The risk perception of women was found to be low that is why they did not prepare before the disaster. The low-risk perception among women was a key reason for their lack of disaster preparation. This low perception of risk resulted in inadequate preparedness, leaving the community vulnerable to the cyclone's impact, leading them to more harm and loss due to cyclone Fani. A study by Yore and Walker (2021) also found that the residents of the study area were aware of the approaching storms, but essential information on their severity and potential impact was either delayed or not understood fully, resulting in low levels of evacuation and safety-seeking behaviour. In addition, Sahana et al. (2023) also revealed from their study of coastal communities of Sundarban Biosphere Reserve that communities are found to be more vulnerable due to a lack of awareness of EW messages, leading to delays in emergency preparedness.

The present study emphasizes strengthening access to early warning messages in terms of access to information and how the respondents acted on that information for disaster preparedness (Hoffman and Muttarak, 2017; Yore and Walker, 2021). Apart from lack of access to television, mobile, religious belief and lower risk perception, other barriers to

the early warning system were found to be related to language, location of the house, vulnerability of women, past experience, and place attachment. A force field analysis was conducted to determine the strength of the above-mentioned barriers with the Aapda Mitra team. Religious beliefs (Score- 8.4) and, vulnerability (age, pregnancy and disability) (Score- 7.5), and past experience (Score- 6.7) were scored as top barriers for access to EWS.

In Puri, the strong belief that Lord Jagannath would protect the city from natural disasters significantly shaped residents' perceptions of risk. This belief created a sense of security, leading many to downplay the severity of the approaching cyclone. Such perceptions align with the concept of "faith-based fatalism," where belief in divine protection diminishes the perceived need for proactive disaster preparedness. Their reliance on faith rather than practical safety actions illustrates a broader pattern where religious or cultural beliefs can influence disaster response behaviours, leading to lack of disaster preparedness. Research by Clarke and Parris (2019) supports the idea that fatalistic attitudes influenced by religious beliefs can obstruct effective disaster response. Further, Bempah and Øyhus (2017) provided valuable insights into how different factors influence risk perception in communities facing frequent flooding. Their study found that in Buipe, religious beliefs played a dominant role in shaping residents' perceptions of both the causes and risks of floods, while in Nawuni, it was the residents past experiences with flooding that primarily informed their risk perception. In this study, however, the findings reveal that both religious beliefs and past disaster experiences have a role in shaping risk perceptions among respondents. Unlike the communities studied by Bempah and Øyhus, where either religion or experience predominated, the respondents in this study demonstrated that both factors were influential. Their past experiences (of either not encountering disasters or facing ones of lesser severity) have reinforced and strengthened their religious belief that cyclones cannot occur in Puri. This belief contributed to the failure of EW messages at the receiving end, further increasing their vulnerability. However, Cyclone Fani broke the notion that disasters cannot happen in Puri. It would be interesting for further study to explore whether, in the event of a future cyclone warning, religious beliefs will dominate risk perception or if past experiences of Cyclone Fani will influence people's responses.

Past experience or hazard (in)familiarity can have both positive and negative experiences. While Anderson (1969) and Gruntfest (1997) provide evidence that familiarity with hazards can lead to improved response behaviours, Ketteridge and Fordham (1998) and Kilpatrick (1957) discuss how familiarity can obstruct effective message reception and action. This explains why elderly women who had faced the 1999 super cyclone in Odisha and the adolescent girls who had not experienced it were more alert after receiving the early warning messages. Meanwhile, the cyclone warning every

year and the lower intensity of the cyclone affected the respondents' perception of risk. It was found that more than 90 percent of women across different livelihoods had the past experience of disaster. Still, their risk perception was low because, in the Puri district, the intensity of the past cyclones was lower. This finding can be related to the "normalization bias" (Mileti & O'Brien, 1992) that hinders risk perceptions where people downplay the potential threat as they get accustomed to a hazard.

The vulnerable women, particularly those who were disabled, pregnant, elderly, or single, poor and Dalit faced challenges in accessing and acting upon early warning information. The case of the poor adolescent girl with disability highlights the limitations of audio warning messages to reach those with hearing impairment. The intersection of poverty and disability further complicated her situation as she lacked access to alternative means of receiving warnings like mobile or television. Similarly, the habitation of Dalit women in the periphery of the village made it difficult for them to receive audio warning messages that are not meant to cover longer distances. Additionally, limited financial resources prevented them from owning devices which could provide alternative channels for receiving risk information. Health challenges, mobility issues and dependence on others act as hindrances for acting upon the early warning messages for elderly, pregnant and single women. These findings can be directly linked to the conclusions from Gartrell et al. (2020), where they have argued that women who live outside of their village and peripheries and those who are confined to their homes because of disabilities frequently do not receive or miss out on early warning systems messages in Cambodia. Further, like our study findings, ' periphery villages lack access to EW messages', the findings of Perera et al. (2020) similarly argued lack of poor mechanisms and communication network early warning messages failed to deliver to the final mile communities in time.

Findings from the interviews and FGDs show that most of the respondents acknowledged the proactive involvement of community workers in the dissemination of early warning and also in the evacuation process. The FFA conducted in this study reveals that the facilitating factors for the early warning system scored 7.6, significantly higher than the barriers, which scored 5.8. This indicates that the efforts and strategies put in place to enhance disaster preparedness currently outweigh the challenges the community faces. The higher score for the facilitating factors suggests that the decentralization approach of the State for disaster preparedness and robust implementation of the task at ground level is proving effective. Odisha is recognized as India's most disaster-prepared State. During Cyclone Fani, a remarkable 1.2 million people were evacuated within 24 hours, with the State declaring it as the "biggest human evacuation in history". The practical implications of disaster mitigation policies are observed in the dissemination of early warning messages, evacuation, and construction of cyclone shelters in Odisha. The preventative measures also aim to build

local skills and managerial capacities, particularly among women (Fortham, 2001; Schmuck, 2001). Given the positive impact of the facilitating factors, it is crucial for the State to continue supporting and reinforcing these aspects. While the facilitating factors are strong, the presence of barriers scoring 5.8 indicates that challenges still exist. Identifying and addressing these barriers through targeted interventions will be essential in further strengthening the overall disaster management framework, particularly the early warning system.

5.1. Recommendation and Policy Implications

On the basis of the present study findings and discussion, the following recommendations and policy implications are made for the betterment of EWS and disaster preparedness in general and women in particular.

The findings of the study support the implementation of behaviorally informed Early Warning Systems. Behaviourally informed Early Warning Systems (EWS) require that the authorities involved in disseminating early warning messages consider the social and behavioral aspects of the community while designing these messages. Additionally, there should be efforts to promote behavioural changes among community members through disaster education, training, and support.

The stakeholders' capacity and skills, including grassroots volunteers engaged in women-sensitive EWS, must be strengthened and enhanced. Regular and frequent training and community interactions of the stakeholders, particularly grassroots volunteers towards women-centric EWS, are needed to address the multifaceted EWS barriers and improve the disaster knowledge of the public in general and women in particular.

ASHA and Aganwadi workers need to be facilitated with proper training and skills to convince and build trust among women for disaster preparedness. Further, grassroots volunteers like Aapda Mitra workers need to be recruited from the local community, having knowledge on local geography, local use language, and culture to build trust and better deliver EW messages.

The Government and its policy must encourage participatory actions from women at risk and vulnerable while preparing and disseminating EW messages and information in multi-lingual formats through different mediums. Further, women's issues need to be included in the cycle of disaster management process.

Government and other stakeholders need to identify and document appropriate and acceptable behaviors of women relating to EW messages and preparedness for better acceptance among the community. A woman-centric EWS must be established for quick

delivery of messages and effective early action. Further, the study also suggests establishing a community-based early warning system for better dissemination of EW messages and information and disaster preparedness at the community level in general and for women in particular.

Grassroots volunteers need to be provided with identity cards and basic remunerations for their work. Providing specific identification to volunteers is crucial in building trust in the community. They can be perceived as trusted sources of information and can also be trusted during the evacuation process.

The government's prime concern must be reaching out to the last-mile communities residing in the village's periphery regions. For that, in addition to the announcement of EW messages through running vehicles at the important locations, volunteers must use hand mike to announce the messages. Pasting of posters in the village and distribution of pamphlets can add to multiple sources of risk information. Information can reach persons with disability and others coming from disadvantaged backgrounds. Multiple sources of early warning messages also can increase information credibility and improve people's risk perception.

Women's participation in EWS is essential. Their involvement in EWS will ensure that early warnings are effectively communicated within their communities, especially to other women and vulnerable groups. Their participation can increase the effectiveness of EWS and reduce their dependency. This inclusiveness can lead to better-prepared communities where fewer people are caught off guard and in need of rescue.

Lastly, with the growing importance of Corporate Social Responsibility (CSR) in India as well as in Odisha, the study proposes intervention of CSR through corporate government nexus to strengthen the existing multi-agency strategy for EWS in Odisha as well as to facilitate better delivery of EWS system through funding, networking, technological innovation, human resource, and policy support.

5.2. Limitations of the study

The study was conducted in Puri, a region that has unique religious and cultural beliefs centered on Lord Jagannath. So, the findings may not resemble the risk perception of the communities with different cultural or religious backgrounds, but it can provide evidence regarding socio-economic and cultural factors that determine the behavioural aspects of disaster preparedness. The study faced limitations in conducting a detailed examination and integration of the relationships among all socio-economic variables. The study has narrated and discussed cases showing intersections of some variables in creating vulnerabilities. The researchers also faced challenges for field work due to ongoing heat

waves from March to May 2024 and general elections during the data collection period. The election period required significant involvement from stakeholders who were part of the sample. Their election duties made it challenging to schedule interviews and collect data as planned. To ensure the safety of the researchers and the participants from the heat waves, we tried to conduct the fieldwork in the morning and evening hours.

6. Conclusion

Ensuring the inclusiveness of EWS and reaching vulnerable groups are important for effective disaster risk reduction. It includes improving the understanding of the barriers that women face in accessing EWS, which is essential for improving EWS and reducing the vulnerability of women. It was found that most of the respondents had access to early warning but they did not prepare before the disaster. We argue that access to early warning information does not necessarily ensure actions for disaster preparedness. The lack of preparedness resulted in lower risk perception. Socio-economic and cultural factors contribute to the vulnerability of women and also act as a barrier to access to and implementation of early warning messages. The intersection of women's vulnerabilities impacts their ability to receive, understand, and act on early warning messages and exacerbates individuals' overall vulnerability. Odisha is known globally for creating an early warning system to disseminate information to the last-mile community. This can be seen at the ground level as the study found that the facilitators for access to EWS were stronger than the barriers. Proactive involvement of the community workers and volunteers at the grassroots level is a major facilitating factor for effective EWS. However, by addressing these barriers through targeted and tailored interventions for vulnerable groups, we can enhance disaster preparedness and resilience.

References

Aguirre-Ayerbe, I., Merino, M., Aye, S. L., Dissanayake, R., Shadiya, F., & Lopez, C. M. (2020). An evaluation of availability and adequacy of Multi-Hazard Early Warning Systems in Asian countries: A baseline study. International journal of disaster risk reduction, 49, 101749.

Ajibade, I., & McBean, G. (2014). Climate extremes and housing rights: A political ecology of impacts, early warning and adaptation constraints in Lagos slum communities. Geoforum, 55, 76-86.

Alcántara-Ayala, I., & Oliver-Smith, A. (2019). Early warning systems: lost in translation or late by definition? A FORIN approach. International Journal of Disaster Risk Science, 10, 317-331.

Andersson, L., Wilk, J., Graham, L. P., Wikner, J., Mokwatlo, S., & Petja, B. (2020). Local early warning systems for drought–Could they add value to nationally disseminated seasonal climate forecasts?. Weather and Climate Extremes, 28, 100241.

Ardaya, A. B., Evers, M., & Ribbe, L. (2017). What influences disaster risk perception? Intervention measures, flood and landslide risk perception of the population living in flood risk areas in Rio de Janeiro state, Brazil. International journal of disaster risk reduction, 25, 227-237.

Ariyabandu, M.M. (2009), 'Sex, gender and gender relations in disasters', in Enarson, E. and Dhar Chakrabarti, P.G. (Eds.), Women, gender and disaster: Global issues and initiatives, Los Angeles: Sage, pp. 5–17.

Arnado, M. A. M. (2012). Women's involvement in conflict early warning systems: Moving from rhetoric to reality in Mindanao. Centre for Humanitarian Dialogue. https://www.files.ethz.ch/isn/154708/Women%20s%20involvement%20in%20conflict%20early%20warning%20systems%20FINAL_2.pdf

Atewologun, D. (2018). Intersectionality theory and practice. Oxford research encyclopedia of business and management, 1-20.

Attavanich, M., & Kobayashi, H. (2016). Living conditions in post-tsunami houses: A case study of the moklen ethnic minority group in Tungwa village, Phang Nga province, Southern Thailand. International Journal of Disaster Risk Reduction, 19, 12-21.

Ayeb-Karlsson, S., Kniveton, D., Cannon, T., Van Der Geest, K., Ahmed, I., Derrington, E. M., ... & Opondo, D. O. (2019). I will not go, I cannot go: Cultural and social limitations of disaster preparedness in Asia, Africa, and Oceania. Disasters, 43(4), 752-770.

Ayeb-Karlsson, S., Kniveton, D., Cannon, T., Van Der Geest, K., Ahmed, I., Derrington, E. M., ... & Opondo, D. O. (2019). I will not go, I cannot go: cultural and social limitations of disaster preparedness in Asia, Africa, and Oceania. Disasters, 43(4), 752-770.

B. W. Smith, K. I. Pargament, C. Brant, J. M. Oliver. (2000) Noah revisited: Religious coping by church members and the impact of the 1993 Midwest Flood, Journal of Community Psychology 28(2) 169-186

Baudoin, M. A., Henly-Shepard, S., Fernando, N., Sitati, A., & Zommers, Z. (2016). From top-down to "community-centric" approaches to early warning systems: Exploring pathways to improve disaster risk reduction through community participation. International Journal of Disaster Risk Science, 7, 163-174.

Baudoin, M. A., Henly-Shepard, S., Fernando, N., Sitati, A., &Zommers, Z. (2016). From top-down to "community-centric" approaches to early warning systems: Exploring pathways to improve disaster risk reduction through community participation. International Journal of Disaster Risk Science, 7, 163-174.

Bauer, G. R., Churchill, S. M., Mahendran, M., Walwyn, C., Lizotte, D., & Villa-Rueda, A. A. (2021). Intersectionality in quantitative research: A systematic review of its emergence and applications of theory and methods. SSM-population health, 14, 100798.

Bempah, S. A., &Øyhus, A. O. (2017). The role of social perception in disaster risk reduction: Beliefs, perception, and attitudes regarding flood disasters in communities along the Volta River, Ghana. International journal of disaster risk reduction, 23, 104-108.

Bode, B. (1977). Disaster, social structure, and myth in the Peruvian Andes: the genesis of an explanation. Annals of the New York Academy of Sciences, 293(1), 246-274.

Bolin, B., & Kurtz, L. C. (2018). Race, class, ethnicity, and disaster vulnerability. Handbook of disaster research, 181-203

Braun V, and Victoria C. (2006). Using thematic analysis in psychology. Qual Res Psychol., 3(2):77–101.

Byrnes, J. P., Miller, D. C., & Schafer, W. D. (1999). Gender differences in risk taking: A meta-analysis. Psychological bulletin, 125(3), 367.

Cao, A., Nakamura, S., Otsuyama, K., Namba, M., & Yoshimura, K. (2024). Current status and Challenges in Operating Flood Early Warning Systems at the local level in Japan. International Journal of Disaster Risk Reduction, 104802.

Clarke, M., & Parris, B. W. (2019). Understanding disasters: managing and accommodating different worldviews in humanitarian response. Journal of International Humanitarian Action, 4, 1-9

Collins, Andrew, Maunder, Nick, McNabb, Michele, Moorhead, Anne and van Aalst, Maarten (2009) World Disasters Report 2009 - Focus on early warning, early action. Project Report. International Federation of Red Cross and Red Crescent Societies.

Crenshaw, K. W. (2013). Mapping the margins: Intersectionality, identity politics, and violence against women of color. In The public nature of private violence (pp. 93-118). Routledge.

Cutter, S. L., Tiefenbacher, J., & Solecki, W. D. (1992). En-gendered fears: Femininity and technological risk perception. Industrial Crisis Quarterly, 6(1), 5–22

Cvetković, V. M., Roder, G., Öcal, A., Tarolli, P., &Dragićević, S. (2018). The role of gender in preparedness and response behaviors towards flood risk in Serbia. International journal of environmental research and public health, 15(12), 2761.

Da Silva, G. F. P., Pegetti, A. L., Piacesi, M. T., Belderrain, M. C. N., &Bergiante, N. C. R. (2020). Dynamic modeling of an early warning system for natural disasters. Systems Research and Behavioral Science, 37(2), 292-314.

De Silva, K., Amaratunga, D., & Haigh, R. (2015). Gender equity in disaster early warning systems. University of Moratuwa. https://eprints.hud.ac.uk/id/eprint/27310/1/item%2012.pdf

Dutta, R., & Basnayake, S. (2018). Gap assessment towards strengthening early warning systems. International journal of disaster resilience in the built environment, 9(2), 198-215.

Dutta, R., Basnayake, S., & Ahmed, A. K. (2015). Assessing gaps and strengthening early warning system to manage disasters in Cambodia. IDRiM Journal, 5(2), 167-175.

Fakhruddin, B. S., Gluckman, P., Bardsley, A., Griffiths, G., & McElroy, A. (2021). Creating resilient communities with medium-range hazard warning systems. Progress in disaster science, 12, 100203

Fakhruddin, B., Clark, H., Robinson, L., & Hieber-Girardet, L. (2020). Should I stay or should I go now? Why risk communication is the critical component in disaster risk reduction. Progress in disaster science, 8, 100139.

Fordham, M. (2001). Challenging boundaries: a gender perspective on early warning in disaster and environmental management. United Nations Division for the Advancement of Women.

Fothergill A, Maestas EG, Darlington JD. . Race, ethnicity and disasters in the United States: a review of the literature. Disasters 1999; 23:156 - 73; http://dx.doi.org/10.1111/1467-7717.00111; PMID: 10379098

Fothergill, A. (1996), 'Gender, Risk and Disaster', International Journal of Mass Emergencies and Disasters, Vol. 14 No. 1, pp. 33–56.

Gaillard, J. C., Lavigne, F., de Coster, B., Juvin, N., Flohic, F., Texier, P., ... &Sartohadi, J. (2008). People's behaviour in the face of volcanic hazards. Journal of Volcanology and Geothermal Research, 172(3-4), 273-287.

Garcia, C., & Fearnley, C. J. (2016). Evaluating critical links in early warning systems for natural hazards. Natural Hazards and Disaster Risk Reduction, 53-67.

Gartrell, A., Calgaro, E., Goddard, G., &Saorath, N. (2020). Disaster experiences of women with disabilities: Barriers and opportunities for disability inclusive disaster risk reduction in Cambodia. Global Environmental Change, 64, 102134.

Girotto, C. D., Piadeh, F., Bkhtiari, V., Behzadian, K., Chen, A. S., Campos, L. C., &Zolgharni, M. (2023). A critical review of digital technology innovations for early warning of water-related disease outbreaks associated with climatic hazards. International Journal of Disaster Risk Reduction, 104151.

Guru, B., & Santha, S. D. (2013). People-centred early warning systems and disaster risk reduction. INPUT PAPER. UNISDR and GAR. https://www.researchgate.net/profile/Balamurugan-Guru/publication/274838618_People-Centred_Early_Warning_Systems_and_Disaster_Risk_Reduction_-_A_Scoping_Study_of_Public_Participatory_Geographical_Information_Systems_PPGIS_in_India/links/552b58370cf29b22c9c1a75d/People-Centred-Early-Warning-Systems-and-Disaster-Risk-Reduction-A-Scoping-Study-of-Public-Participatory-Geographical-Information-Systems-PPGIS-in-India.pdf

Gustafsod, P. E. (1998). Gender Differences in risk perception: Theoretical and methodological erspectives. Risk analysis, 18(6), 805-811.

H. Schmuck, "An act of Allah". Religious explanations for floods in Bangladesh as survival strategy, International Journal of Mass Emergencies and Disasters 18(1) (2000) 85-95. [9] B. W. Smith, K. I. Pargament, C. Brant, J. M. Oliver. Noah revisited: Religious coping by church members and the impact of the 1993 Midwest Flood, Journal of Community Psychology 28(2) (2000) 169-186

H. Schmuck, (2000) "An act of Allah". Religious explanations for floods in Bangladesh as survival strategy, International Journal of Mass Emergencies and Disasters 18(1) 85-95.

Hansson, R. O., Noulles, D., & Bellovich, S. J. (1982). Knowledge, warning, and stress: A study of comparative roles in an urban floodplain. Environment and Behavior, 14(2), 171-185.

Haque, A., Akter, M., Hussain, M. M., Rahman, M. R., Salehin, M., & Rahman, M. (2024). An integrated risk-based early warning system to increase community resilience against disaster. Progress in Disaster Science, 21, 100310.https://doi.org/10.1016/j.ijdrr.2020.102046

J. T. Mitchell, The hazards of one's faith: Hazard perceptions of South Carolina Christian clergy, Global Environmental Change Part B: Environmental Hazards 2(1) (2000) 25-41.

Kelman, I., & Glantz, M. H. (2014). Early warning systems defined. Reducing disaster: Early warning systems for climate change, 89-108.

Ketteridge, A. M., & Fordham, M. (1998). Flood evacuation in two communities in Scotland: lessons from European research. International Journal of Mass Emergencies & Disasters, 16(2), 119-143.

Kilpatrick, G. S., & Douglas, A. C. (1957). Superficial glandular tuberculosis. British Medical Journal, 2(5045), 612.

Krishna, R. N., Ronan, K., Spencer, C., &Alisic, E. (2021). The lived experience of disadvantaged communities affected by the 2015 South Indian floods: Implications for disaster risk reduction dialogue. International Journal of Disaster Risk Reduction, 54, 102046.

Lautze, S., Bell, W., Alinovi, L., & Russo, L. (2012). Early warning, late response (again): The 2011 famine in Somalia. Global food security, 1(1), 43-49.

Marchezini, V., Trajber, R., Olivato, D., Munoz, V. A., de Oliveira Pereira, F., & Oliveira Luz, A. E. (2017). Participatory early warning systems: Youth, citizen science, and intergenerational dialogues on disaster risk reduction in Brazil. International Journal of Disaster Risk Science, 8(4), 390-401.

Mathathu, T., & Seedat-Khan, M. (2022). 'Leaving No-one Behind': Mainstreaming Gender in Flood Early Warning Systems. Alternation, 29(2).

Mileti, D. S. (1995). Factors related to flood warning response. In US-Italy research workshop on the hydrometeorology, impacts, and management of extreme floods (pp. 1-17).

Mileti, D. S. and P. W. O'Brien. 1992. Warnings during Disaster: Normalizing Communicated Risk. Social Problems, 39:40-57.

Mishra, S. and Kar, D. (2016) Cyclonic Hazards in Odisha and its Mitigation, Orissa Review, January 2016, p. 37-41.

Mishra, S., & Suar, D. (2007). Do lessons people learn determine disaster cognition and preparedness?. Psychology and Developing Societies, 19(2), 143-159.

Mogil, M. H. (1980). The weather warning and preparedness programs: the national weather service and the mass media. In Disasters and the mass media (pp. 205-13).

Mohanty, A., Hussain, M., Mishra, M., Kattel, D. B., & Pal, I. (2019). Exploring community resilience and early warning solution for flash floods, debris flow and landslides in conflict prone villages of Badakhshan, Afghanistan. International journal of disaster risk reduction, 33, 5-15.

Mulyasari, F., & Shaw, R. (2013). Role of women as risk communicators to enhance disaster resilience of Bandung, Indonesia. Natural hazards, 69, 2137-2160.

Nayyar, T., Aggarwal, S., Khatter, D., Kumar, K., Goswami, S., & Saini, L. (2019). Opportunities and challenges in digital literacy: Assessing the impact of digital literacy training for empowering urban poor women. University of Delhi.

Norris, F. H., Smith, T., &Kaniasty, K. (1999). Revisiting the experience–behavior hypothesis: The effects of Hurricane Hugo on hazard preparedness and other self-protective acts. Basic and Applied Social Psychology, 21(1), 37-47.

Nowell LS, Norris JM, White DE, Moules NJ. (2017) Thematic Analysis: Striving to Meet the Trustworthiness Criteria. Int J Qual Methods. 16(1). https://journals.sagepub.com/doi/full/10.1177/1609406917733847.

Oktari, R. S., Munadi, K., & Ridha, M. (2014). Effectiveness of dissemination and communication element of tsunami early warning system in Aceh. Procedia Economics and Finance, 18, 136-142.

Perera, C., Jayasooriya, D., Jayasiri, G., Randil, C., Bandara, C., Siriwardana, C., ... &Kulatunga, A. (2020a). Evaluation of gaps in early warning mechanisms and evacuation procedures for coastal communities in Sri Lanka. International journal of disaster resilience in the built environment, 11(3), 415-433.

Perera, D., Agnihotri, J., Seidou, O., &Djalante, R. (2020). Identifying societal challenges in flood early warning systems. International Journal of Disaster Risk Reduction, 51, 101794.

Perera, D., Agnihotri, J., Seidou, O., &Djalante, R. (2020b). Identifying societal challenges in flood early warning systems. International Journal of Disaster Risk Reduction, 51, 101794.

Perry, R. W., & Lindell, M. K. (1997). Principles for managing community relocation as a hazard mitigation measure. Journal of contingencies and crisis management, 5(1), 49-59.

Pham, T. D. M., Thieken, A. H., & Bubeck, P. (2024). Community-based early warning systems in a changing climate: an empirical evaluation from coastal central Vietnam. Climate and Development, 16(8), 673–684. https://doi.org/10.1080/17565529.2024.2307398

PTI (Press Trust of India) (2021). Odisha encountered 10 cyclones in two decades: Official records. Available at https://www.business-standard.com/article/current-affairs/odisha-encountered-10-cyclones-in-two-decades-official-records-121120400748_1.html Accessed on 29th Aug 2024

R. R. Dynes, D. Yutzy, The religious interpretation of disaster, Topic 10: A Journal of the Liberal Arts (1965) 34-48.

Rahman, M. M., Arif, M. S. I., Mahdi, I., Rafi, M. A., Chisty, M. A., & Khan, S. J. (2022). Cyclone vulnerability in ethnic minority: a case study among rakhain community of Bangladesh. International Journal of Disaster Risk Reduction, 83, 103449.

Rahmani, M., Muzwagi, A., &Pumariega, A. J. (2022). Cultural factors in disaster response among diverse children and youth around the world. Current psychiatry reports, 24(10), 481-491.

Rahmani, M., Muzwagi, A., &Pumariega, A. J. (2022). Cultural factors in disaster response among diverse children and youth around the world. Current psychiatry reports, 24(10), 481-491.

Rai, R. K., van den Homberg, M. J., Ghimire, G. P., &McQuistan, C. (2020). Cost-benefit analysis of flood early warning system in the Karnali River Basin of Nepal. International journal of disaster risk reduction, 47, 101534.

Ray-Bennett, N. S. (2018). Disasters, deaths, and the Sendai goal one: Lessons from Odisha, India. World Development, 103, 27-39.

Rout, P. (2024). Cultural Identity and Diversity of Odisha: A Conceptual Study. The Academic, 2 (3), pp. 113-119.

Sahana, M., Patel, P. P., Rehman, S., Rahaman, M. H., Masroor, M., Imdad, K., & Sajjad, H. (2023). Assessing the effectiveness of existing early warning systems and emergency preparedness towards reducing cyclone-induced losses in the Sundarban Biosphere Region, India. International journal of disaster risk reduction, 90, 103645.

Saunders, M., Lewis, P. and Thornhill, A. (2007) Research Methods for Business Students. 4th Edition, Financial Times Prentice Hall, Edinburgh Gate, Harlow.

Sawada, Y., Kanai, R., & Kotani, H. (2022). Impact of cry wolf effects on social preparedness and the efficiency of flood early warning systems. Hydrology and Earth System Sciences, 26(16), 4265-4278.

Schmeidl, S., & Jenkins, J. C. (1998). The early warning of humanitarian disasters: Problems in building an early warning system. International Migration Review, 32(2), 471-486.

Schmuck, H. (2000). “An act of Allah”: religious explanations for floods in Bangladesh as survival strategy. International Journal of Mass Emergencies & Disasters, 18(1), 85-95.

Schmuck, H. (2000). “An act of Allah”: religious explanations for floods in Bangladesh as survival strategy. International Journal of Mass Emergencies & Disasters, 18(1), 85-95.

Seitz, S., 2004. The Aeta at the Mt. Pinatubo, Philippines: A Minority GroupCoping with Disaster. New Day Publishers, Quezon City

Seng, D. S. C. (2012). Improving the governance context and framework conditions of natural hazard early warning systems. IDRiM Journal, 2(1), 1-25.

Shankar, R. (2023). 10 Deadliest cyclone to have hit Odisha in last 2 decades. Times of India. Available at https://timesofindia.indiatimes.com/city/bhubaneswar/10-deadliest-

cyclones-to-have-hit-odisha-in-last-2-decades/photostory/100469166.cms Accessed on 29th Aug 2024

Sharma, V. (2022). Here's list of cyclones that Odisha has witnessed so far. Odisha TV. Available at https://odishatv.in/news/weather/here-s-list-of-cyclones-that-odisha-has-witnessed-so-far-176216 Accessed on 29th Aug 2024.

Sibiya, G. N. (2022). Information and communication technology in disaster preparedness by eThekwini Municipality (Doctoral dissertation).

Simmons, K. M., & Sutter, D. (2009). False alarms, tornado warnings, and tornado casualties. Weather, Climate, and Society, 1(1), 38-53.

Sims, J. H., & Baumann, D. D. (1983). Educational programs and human response to natural hazards. Environment and behavior, 15(2), 165-189.

Smith, B. W., Pargament, K. I., Brant, C., & Oliver, J. M. (2000). Noah revisited: Religious coping by church members and the impact of the 1993 Midwest flood. Journal of community psychology, 28(2), 169-186.

Smith, B. W., Pargament, K. I., Brant, C., & Oliver, J. M. (2000). Noah revisited: Religious coping by church members and the impact of the 1993 Midwest flood. Journal of community psychology, 28(2), 169-186.

Sufri, S., Dwirahmadi, F., Phung, D., & Rutherford, S. (2020). Enhancing community engagement in disaster early warning system in Aceh, Indonesia: opportunities and challenges. Natural Hazards, 103(3), 2691-2709.

Sufri, S., Dwirahmadi, F., Phung, D., & Rutherford, S. (2020). Enhancing community engagement in disaster early warning system in Aceh, Indonesia: opportunities and challenges. Natural Hazards, 103(3), 2691-2709.

Swaraj, A. (2019). Exploratory research: Purpose and process. Parisheelan Journal, 15(2), 665-670.

Szalay, L.B.,Inn, A., Vilov, S.K., Strohl, J.B. (1986). Regional and Demographic Variations in Public Perceptions Related to Emergency Preparedness. Institute for Comparative Social and Cultural Studies Inc. Bethesda. Md.

Takeuchi, Y., & Shaw, R. (2008). Gender and Disaster Risk Reduction: Perspective from Japan. Kyoto: Kyoto University.

Tan, M. L., Vinnell, L. J., Valentin, A. P. M., Prasanna, R., & Becker, J. S. (2023). The public's perception of an earthquake early warning system: A study on factors

influencing continuance intention. International journal of disaster risk reduction, 97, 104032.

Thomalla, F., & Schmuck, H. (2004). 'We all knew that a cyclone was coming': disaster preparedness and the cyclone of 1999 in Orissa, India. Disasters, 28(4), 373-387.

Thomalla, F., & Schmuck, H. (2004). 'We all knew that a cyclone was coming': disaster preparedness and the cyclone of 1999 in Orissa, India. Disasters, 28(4), 373-387.

Trogrlić, R. Šakić., van den Homberg, M., Budimir, M., McQuistan, C., Sneddon, A., & Golding, B. (2022). Early warning systems and their role in disaster risk reduction. In Towards the "perfect" weather warning: bridging disciplinary gaps through partnership and communication (pp. 11-46). Cham: Springer International Publishing.

UNFCCC News (2024, July 5). Technology for Early Warnings and Risk-Informed Adaptation. https://unfccc.int/news/technology-for-early-warnings-and-risk-informed-adaptation

UNISDR (2009). Making Disaster Risk Reduction Gender Sensitive: Policy and Practical Guidelines.https://www.preventionweb.net/files/9922_MakingDisasterRiskReductionGenderSe.pdf

Wachinger, G., Renn, O., Begg, C., &Kuhlicke, C. (2012). The risk perception paradox—implications for governance and communication of natural hazards. Risk analysis, 33(6), 1049-1065.

Weinstein, N. D. (1989). Effects of personal experience on self-protective behavior. Psychological bulletin, 105(1), 31.

WMO. (2020). Natural hazards and disaster risk reduction. https://public.wmo.int/en/our-mandate/focus-areas/natural-hazards-and-disaster-risk-reduction

World Bank (2021). Gender Dynamics of Disaster Risk and Resilience. https://www.worldbank.org/en/topic/disasterriskmanagement/publication/gender-dynamics-of-disaster-risk-and resilience#:~:text=Women%20play%20an%20active%20role,women's%20position%20in%20the%20community.

Yekeen et al. (2020) Early Warning Systems and Geospatial Tools: Managing Disaster for Urban Sustainability. In W. Leal Filho et al. (eds.), Sustainable Cities and Communities, Encyclopedia of the UN Sustainable Development Goals, Springer Nature Switzerland https://doi.org/10.1007/978-3-319-95717-3

Yore, R., & Walker, J. F. (2021). Early warning systems and evacuation: rare and extreme versus frequent and small-scale tropical cyclones in the Philippines and Dominica. Disasters, 45(3), 691-716.