RAAH FOUNDATION'S CENTRE FOR POLICY RESEARCH AND ACTION

Agricultural Livelihood of Indigenous Women in Palghar, Maharashtra

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Authors

S. Abi Sritha

Shruti Botare

Fellowship Lead & Editor

Sunidhi Hegde

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EXECUTIVE SUMMARY

This paper explores the convergence of climate change, gender relations, and indigenous resilience in the lives of tribal women in the Palghar district of Maharashtra located in the ecologically sensitive Western Ghats region of India. There is growing climatic uncertainty, manifested in erratic monsoons, prolonged drought, and vanishing forests, which result in exacerbating unequal challenges for indigenous women whose livelihoods centre around agricultural production, hydrologic control of resources, and domestic activities of subsistence.

Utilizing a 19-day field research study involving 7 tribal villages in the Jawhar Taluk, this project uses a mixed-methods approach by combining structured questionnaires with qualitative in-depth interviews. We investigate the multifaceted influence of climate change on women's farm productivity, access to soil and water resources, economic vulnerability and well-being at the household level. The project also examines the gendered nature of adaptation and uses participatory qualitative methods to demonstrate how women interpret rainfall patterns, manage broken aquifers, and sustain traditional cultivation through the use of traditions of indigenous ecological knowledge. The evidence presented suggested that while tribal women have developed elaborate, nuanced and context-laden coping strategies for water scarcity and climatic stress, they invariably fall outside of formal governance. State-led interventions such as borewell schemes and the Har Ghar Jal program systematically ignore local hydrogeological context, including women's knowledge of everyday life, further perpetuating vulnerability rather than alleviating it.

This research is important in underscoring how indigenous women's knowledge needs to be central to climate policy and water management, and how we need to treat adaptation in a way which is both gender-just and grounded in culture. It concludes on being inclusive and involving women's participatory role as actors of ecological resilience rather than recipients of support.

INTRODUCTION

Climate change is one of the most serious and complex issues facing the world today, with far-reaching implications that disproportionately affect vulnerable groups worldwide [IPCC, 2023; Smit & Wandel, 2006]. While the deterioration of the global environment is well understood as an issue of pressing concern, the gendered consequences of such impacts, particularly on poor, marginalized indigenous groups, are too often inadequately addressed [Terry, 2009; Alston, 2014]. This study examines the complex interrelationships between climate change, water scarcity, and the livelihoods of tribal women in Palghar district, Maharashtra, India. It emphasizes their rich lived knowledge and intimate ecological understanding as important, yet too often forgotten, determinants of sustainable water governance and climate change adaptation [Agarwal, 2010; Lebel et al. 2010].

The Western Ghats, recognized globally as an international hotspot of biodiversity [Myers et al., 2000], are now facing increasingly unpredictable monsoon cycles and protracted periods of aridity [Gadgil & Guha, 1995; Sen & Srivastava, 2019]. Such climatic uncertainty reinforces the already widespread concern of water availability; a crisis keenly felt in the Palghar district. In this context, ecological degradation has a significant, gendered burden on tribal communities, and women bear the disproportionate brunt of it as a result of their central roles in water gathering and domestic household management [UNDP, 2011; Resurreccion, 2008]. Our study assumes that tribal women in Palghar not only experience water scarcity more intensely than men but also employ unique, gendered strategies that are inextricably linked to indigenous ecological knowledge [Nightingale, 2011; Shiva, 1989]. Their rich understanding of seasonal cycles, unique characteristics of fragmented subterranean aquifers, and biodiversity-driven water pointers, such as specific flower patterns, insects, and soil textures, form a sophisticated and critical knowledge system. This system allows them to predict water availability months in advance, often producing knowledge that mainstream meteorological monitoring misses [Gupta, 1998; Nazarea, 1999].

Despite the demonstrated effectiveness of these traditional knowledge systems, they are always relegated to a secondary status to standardized, technology-driven solutions, which have always been ineffectual in the case of Palghar's problematically laterite-dominated landscape and intricate hydrogeology [Chambers, 1997; Scott, 1998]. The district's fractured aquifer system, characterized by disconnected patches rather than continuous groundwater flow, renders conventional boring methods often ineffective [Singh et al., 2002]. Nevertheless, women in these societies possess highly localized cognitive maps of hundreds of potential water collection sites and a sophisticated appreciation of recharge rates, fluctuations in water quality, and sustainability thresholds for each source [Warren et al., 1995; Pretty, 1995]. This in-built paradox underlines a key failing in current water governance systems, where localized, experiential knowledge is repeatedly downgraded [Agrawal, 2002].

The gendered segregation of water work among Palghar tribal societies generates a critical paradox: women gain extensive and complex ecological knowledge through everyday work—frequently spending an average of 4 to 6 hours a day on the processes of water collection, treatment, storage, and conservation—yet are denied access to formal governance processes [Jackson, 1993; Carney, 1992]. Such intense involvement, while generating profound understanding of local hydrogeology, allows no room for constructive contributions to official decision-making processes. Consequently, the complex water governance system invented and practiced by women through everyday work, such as the care of percolation pits, defence of natural springs by designated vegetation barriers, and management of seasonal variability among diverse sources of water, is systematically ignored by formal institutions [Rocheleau et al., 1996]. Furthermore, government interventions, such as the often-opaque distribution networks of water tankers and schemes like 'Har Ghar Jal,' serve to reinforce existing gender biases by ignoring women's interests, local knowledge, and everyday routines, thereby inadvertently expanding water insecurity [Mehta, 2005; Sultana, 2011].

This study attempts to critically analyze the lacuna between the critical localized, gendered ecological understanding and dominant hierarchical models of governance. By putting tribal women's voices and understandings at the forefront, this study hopes to bring the necessary changes in the design of institutions to the fore. It will examine how institutions of governance can be redesigned to incorporate and appreciate experiential, place-based knowledge and traditional technical analysis [Kothari, 2006; Goldman, 2005]. With climate projections indicating increased extremes in the monsoons of the Western Ghats, endangering both centralized water systems and traditional means of harvesting in one go [MoEFCC, 2010; TERI, 2009], it becomes crucial to understand and recognize these adaptation measures to ensure water governance and enhanced climate resilience among these vulnerable groups.

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LITERATURE REVIEW

The growing global debate on climate change has inevitably provoked concerns about its extensive and multidimensional implications for human societies and natural systems worldwide [IPCC, 2023; Stern Review, 2007]. Extensive literature highlights how such climatic changes, especially variations in hydrological cycles, lead to increased variability of rainfall, longer drought spells, intensified water scarcity, and spasmodic spells of flood events [Mishra & Singh, 2011; Vorosmarty et al., 2000]. Such changes directly threaten agricultural production, food security, and the availability of essential natural resources, with specific implications for highly climate-sensitive societies [Wheeler & von Braun, 2013]. In the Indian context, regions such as the Western Ghats, identified as a global biodiversity hotspot and a critical source of water for peninsular India [Myers et al., 2000; TERI, 2009], are increasingly subject to the adverse implications of these climatic deviations. Studies have recognized discernible tendencies of erratic monsoon patterns, extremely long dry spells, and unseasonal heavy rainfalls in the region, which have significantly reduced water availability for ecological systems as well as human societies, thus leading to increased agrarian distress [Gadgil & Guha, 1995; Sen & Srivastava, 2019; Krishnaswamy & Sreerekha, 2010]. Such environmental degradation tends to disproportionately affect vulnerable agrarian and Indigenous societies, which are directly dependent on frequently depleting natural resources for livelihood and sustenance, thus further aggravating existing socio-economic vulnerabilities [Adger, 2006; Barnett & Adger, 2007].

The impacts of climate change are highly heterogeneous, heavily influenced by dominant social hierarchies, and gender is an important determinant that affects both vulnerability and adaptive capacity [Terry, 2009; Alston, 2014; Denton, 2002]. Ecofeminist and gender and development theory have extensively documented the manner in which women, particularly from rural and indigenous communities, bear a disproportionate burden of exacerbated and often invisible consequences caused by environmental crises, traceable to their culturally constructed roles in household resource management, subsistence agriculture, and the care economy [Shiva, 1989; Agarwal, 1992; Jackson, 1993]. For instance, in most developing countries, including rural India, fetching water is a daily routine that is heavily loaded on women and girls [UNDP, 2011; UNICEF, 2019]. As climate change exacerbates the scarcity and inaccessibility of water sources, this burden becomes more onerous, creating more physical demands, longer travel distances, fewer opportunities for educational and income-generating activities, and more exposure to health hazards and gender-based violence [Resurreccion, 2008; Sultana, 2011; Lambrou & Nelson, 2010]. The large volume of literature hints at a critical understanding of the multifaceted, usually more severe, impacts of water scarcity for women, an eventuality acutely monitored in locations such as Palghar, where daily existence is essentially tied to the acquisition of essential resources for household livelihood and agriculture.

Unlike the grossly underplayed role of women in formal policy and governance structures, the indigenous knowledge systems (IKS) and traditional ecological knowledge (TEK) of these groups, especially women, contain rich knowledge of local environmental processes and sustainable resource management, which is critical to climate adaptation [Gupta, 1998; Nazarea, 1999; Rajasekaran, 1993]. Scholarship has universally highlighted the sophisticated knowledge of indigenous groups about local ecosystems, seasonal rhythms, biodiversity, land uses, and resource indicators, which has been accumulated over generations of direct contact and observation of their specific environments [Warren et al., 1995; Pretty, 1995; Berkes et al., 2000]. For instance, traditional knowledge often includes sophisticated bioindicators, such as specific flowering patterns of plants, migratory or nesting patterns of insects and birds, changes in soil texture or color, or the development of specific fungi, which can foretell seasonal changes, weather regimes, or availability of sub-surface water with much greater precision and anticipation than generalized conventional meteorological monitoring systems in specific microclimates [Gadgil et al., 1993; Nazarea et al., 2013]. This literature highlights the important, but often minimized, value of incorporating such local, place-specific knowledge into broader climate adaptation efforts, moving beyond a purely top-down, technocratic approach to environmental problem-solving and suggesting more culturally specific and potent solutions [Agrawal, 2002; Lebel et al., 2010; Reid et al., 2014].

Nevertheless, a recurring and pertinent issue in the literature is that rich local knowledge continues to be disconnected from formal, hierarchical policy and governance regimes [Chambers, 1997; Scott, 1998; Leach et al., 1999]. Top-down water governance approaches, made with a generic "one-size-fits-all" frame of reference, risk neglecting the complex, localized hydrogeological conditions of the varying regions. This is borne out by the ineffectiveness of uniform interventions, such as mass-scale borewell drilling or traditional boring, in areas such as Palghar's fractured aquifer system with isolated

groundwater pockets and no continuous flow of water [Singh et al., 2002; Mehta, 2005; Ray & Reddy, 2009].

The policy-making process, conducted with minimal active involvement by local actors as a rule, results in interventions that have the chance to inadvertently undermine already developed community-based resource management practices and compound existing gender inequalities [Sultana, 2013; Kothari, 2006]. For example, water tanker supply systems operated by the state, for all their intention to address scarcity, have the chance to undermine customary water-sharing practices, introducing new dependencies, and empowering women by centralizing decisions on access away from the local communal realm [Mehta, 2005]. Similarly, interventions like 'Har Ghar Jal' (Water to Every Household), for all their nobility of purpose, contribute to undermining women's ecological knowledge through the priority given to infrastructure development over rich appreciation of local water sources and cultural adaptations, thus failing to leverage existing local knowledge towards sustainable purposes [Joshi et al., 2019]. The widespread exclusion of women's perspectives from these official decision-making arenas is frequently exacerbated by variables such as time pressure linked with their copious everyday water-related tasks, exclusionary cultural norms, and technical language use that excludes local knowledge systems [Carney, 1992; Jackson, 1993; Momsen, 2004]. Such a situation is a significant obstacle to the imposition of genuinely equitable, efficient, and sustainable strategies for water management.

Despite the massive disadvantage and systemic weaknesses of Indigenous women, they are increasingly recognized not only as passive victims of climate change impacts but also as active agents of change and resilience in their communities [Nightingale, 2011; Rocheleau et al., 1996; Dankelman & Davidson, 1988]. Global and regional scholarship has charted a range of innovative adaptive strategies that women employ in the context of environmental stress, such as strategic crop changes in agriculture and diversified livelihood portfolios, the maintenance of traditional water harvesting systems, the protection of key ecological recharge zones through targeted vegetation barriers, and the practice of seasonal rotation between several water sources as a function of their detailed knowledge of local hydrogeology [Agarwal, 2010; Terry, 2009; Ford & Smit, 2004]. This new body of literature points to the necessity of moving beyond tokenistic representation and fundamentally rethinking governance structures to recognize and integrate experiential, place-specific knowledge along with quantitative analysis and scientific knowledge [Goldman, 2005; Kothari, 2006; Armitage et al., 2011]. The growing recognition of the socio-ecological resilience promoted by these gendered adaptive strategies makes a strong case for their recognition, support, and integration into holistic policy programs, particularly in light of climate models predicting increased severity in monsoon patterns for vulnerable regions such as the Western Ghats [MoEFCC, 2010; TERI, 2009]. This study seeks to contribute to this critical debate by empirically recording the lived experiences and indigenous knowledge of the tribal women of Palghar, offering nuanced insights for designing more equitable, effective, and climate-resilient water governance strategies that empower local communities.

METHODOLOGY

This study was conducted in Jawahar Taluk of the Palghar District of Maharashtra, India. The district is located in the northern region of the state of Maharashtra, which lies on the west coast of India. The district is geographically surrounded by the Western Ghats, a region of international fame as a hotspot of biodiversity, renowned for possessing special, ecological characteristics and intense monsoon rain. The Palghar District is characterized by its laterite-dominated terrain and complicated hydrogeology, with a fractured aquifer system. This geological structure had a significant bearing on water availability and accessibility, with the district being highly susceptible to the effects of climate change, such as erratic monsoon patterns and prolonged spells of dryness.

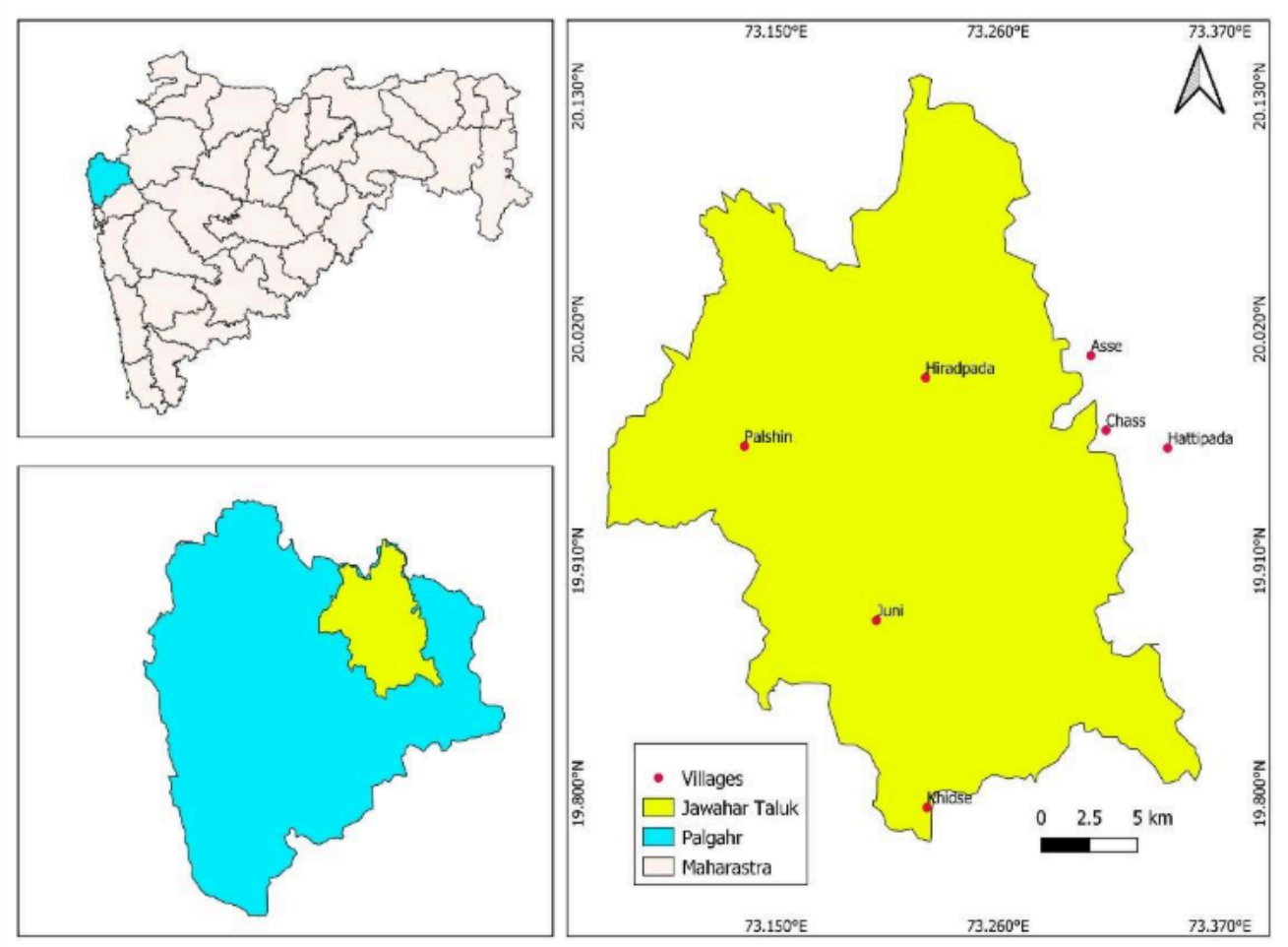

Fig. 1. Geographical Location of the Study Area in Palghar District, Maharashtra, India, with surveyed Villages.

Research studies in the Palghar District focused on Jawhar Taluk, a bounded administrative area with indigenous populations whose livelihood is based on nature and organic agriculture. The data collection for this research involved reaching out to indigenous people living in villages across the boundaries of Jawhar Taluk, specifically concerning water scarcity and changing agricultural practices. The villages included in the research were Hiradpada, Palshin, Juni, Asse, Chass, Hattipada, and Khidse, which were marked by red dots on the provided map. These locations represent subsets of indigenous

women's daily lives, and their experiences, shaped by water scarcity and evolving agricultural practices, were the core of the research.

The selection of this particular field site held significant value. It is susceptible to climate change, has a high density of indigenous women, and faces a well-documented issue of water management. This field site offered a crucial case study to explore the complex interplay of climate change, gender relations, and resilience. It also highlighted the undervalued yet vital traditional ecological knowledge possessed by indigenous women regarding their use of ecological resources for water management and adaptation to changing environmental conditions.

The primary participants for this study were tribal women farmers residing in the selected villages of the Palghar district. Tribal women were chosen as the focal participants because they are consistently responsible for household water management and agricultural labour and they possess an extensive body of indigenous ecological knowledge about water and land.

A purposive sampling technique was used to ensure participant selection provided a rich pool of relevant data to meet the study aim. The key criteria for participant selection included:

- Identifying as a tribal woman.
- Engaging in farming and household water management.
- Having lived in the study area over time (to understand their interaction with climate changes like temperature and rainfall).
- Willingness to participate and provide informed consent.

Data were collected through face-to-face interviews and focused group discussions (FGDs) during June 2nd to June 19th to ensure clarity and capture community-level insights. The group discussions also allowed participants to express collective concerns and validate individual responses. The combination of structured questionnaires and open discussions ensured that both measurable and narrative data were captured to support a comprehensive analysis.

Fig. 2. Data Collection with the indigenous women from Palghar, Maharashtra

The questionnaire was structured into several parts to systematically gather both quantitative and qualitative data.

1	Part A: Introduction and Informed Consent: Ensures compliance with ethical requirements.
2	Part B: Background of the Respondent: Gathers demographic information (age, family size, crop-farming role, land size, crop types, and other income sources).
3	Part C: Perceptions and Climate Change Impact on Agriculture: Examines perceived weather change and its impact on farming operations, crop yield, and soil quality.
4	Part D: Livelihoods and Economic Vulnerability Impacts: Examines changes in agricultural dependence, forest product availability, and household welfare.
5	Part E: Coping Strategies, Adaptive Techniques, and Indigenous Knowledge: Explores traditional agriculture, its relevance today, and the transmission of knowledge. This section will be instrumental in deciphering advanced ecological knowledge.
6	Part F: Migration: Analyses the effect of climatic conditions on male, female, and family migration patterns.
7	Part G: Health, Well-Being, and Gender-Specific Impacts: Considers health implications and perceived gender differences in climate impacts.
8	Part H: Access to Support and Interventions: Assesses awareness and availability of formal support systems and identifies preferred forms of assistance.
9	Part J: Closing and Interviewer's Observations

Research Questionnaire

Important Considerations Before Use:

1. **Language:** This is in English. It must be translated accurately into Marathi or the local tribal dialect. Consider back-translation to ensure accuracy.
2. **Cultural Sensitivity:** The interviewer must be trained to ask questions respectfully and empathetically. Build rapport before diving into sensitive topics.
3. **Pilot Testing:** Test this questionnaire with a small group of women (not part of the main study sample) to identify any confusing questions, awkward phrasing, or missing areas.
4. **Interviewer Training:** Ensure interviewers understand each question, its purpose, and how to probe for more detailed qualitative answers.
5. **Consent:** The introduction and consent process is paramount.
6. **Flexibility:** This is a guide. Interviewers should be prepared to adapt and ask follow-up questions based on responses.
7. **Observation:** Some data (as per your plan) will come from observation, not just direct questions.

Questionnaire for Tribal Women Farmers: Climate Change Impacts in Palghar District
Interviewer: _____
Date: _____
Village/Pada Name: _____
Respondent ID (Anonymous): _____

Part A: Introduction and Consent:

Namaskar! My name is ____ and I am a researcher working with Raah Foundation as part of the GRT Research Fellowship. We are trying to understand how changes in weather and climate are affecting farming and daily life for women like you in this region.

Your participation is voluntary. You can choose not to answer any question or stop the interview at any time. Your answers will be kept confidential and used only for this research study to understand the situation better. Your name will not be used in any reports.

The interview will take about [e.g., 45-60 minutes].

Do you have any questions for me before we begin? Are you willing to participate?"
[ ] Yes [ ] No (If no, thank them and end. If yes, proceed.)

May we also take notes? And with your permission, may we make an audio recording of our conversation? This helps us remember everything accurately. You can ask us to stop recording at any time.

Audio Recording Consent: [ ] Yes [ ] No

Part B: Respondent's Background (Quantitative & Qualitative)

1. Age (approximate years): _____
2. How many people live in your household? _____
   - Adults (18+): _____ Children (<18): _____
3. What is your main role in farming? (e.g., planting, weeding, harvesting, selling, all of it)
4. How many years have you been involved in farming? _____ years
5. What is the total size of land your family farms (owned or leased)? (Local units are fine, e.g., acres, gunthas) _____
6. Is this land irrigated, rain-fed, or both? [ ] Fully Irrigated [ ] Partially Irrigated [ ] Fully Rain-fed
7. What are the main crops you have grown in the last year?
8. Apart from farming, what are other ways your family earns income or gets food? (e.g., forest produce, daily wage labour, livestock)

Part C: Perceptions and Impact of Climate Change on Agriculture (Qualitative & Quantitative)

(Interviewer: Explain "climate change" in simple terms – like long-term changes in rainfall patterns, temperature, seasons, not just one bad year).

1. Over the last 10 years or so, have you noticed any changes in the weather patterns here (e.g., rainfall, temperature, seasons)?
2. [ ] Yes [ ] No [ ] Unsure. If Yes, can you describe these changes? (Probe: timing of rain, amount of rain, hotter days, colder winters, unseasonal events)
3. How have these changes affected your farming practices? (Probe: planting times, types of crops, need for more/less water, new pests/diseases)
4. Compared to 10 years ago, how has your crop yield (amount harvested) changed for your main crops? Crop 1 (Name: _____): [ ] Increased significantly [ ] Increased slightly [ ] Stayed the same [ ] Decreased slightly [ ] Decreased significantly ; Crop 2 (Name: _____): [ ] Increased significantly [ ] Increased slightly [ ] Stayed the same [ ] Decreased slightly [ ] Decreased significantly ; If yields have decreased, what do you think are the main reasons?
5. Have you noticed any changes in soil quality on your farm over the last 10 years? (e.g., more dry, less fertile, soil erosion)
6. [ ] Yes [ ] No [ ] Unsure. If Yes, can you describe these changes?
7. How has the availability of water for farming changed over the last 10 years? (Probe: wells, ponds, streams, rainfall)
8. [ ] More water available [ ] Less water available [ ] About the same ; Can you tell me more about this?

Part D: Impact on Livelihoods and Economic Vulnerability (Qualitative & Quantitative)

1. Has your family's reliance on farming for food and income changed in the last 10 years? [ ] More reliant on farming [ ] Less reliant on farming [ ] About the same

Part E: Coping Strategies, Adaptive Techniques, and Indigenous Knowledge (Qualitative)

1. When you face challenges in farming due to changing weather (like less rain or too much rain, new pests), what do you and your family do to cope? (Probe: changing crops, different farming methods, seeking other work)
2. Are there any traditional farming methods or knowledge passed down from your elders that you use to deal with these weather-related challenges?
3. [ ] Yes [ ] No [ ] Some. If Yes or Some, can you give examples? ; Do you think this traditional knowledge is still useful today? Why or why not? ; Is this knowledge being passed on to the younger generation?

Part F: Migration (Qualitative & Quantitative)

1. In the last 10 years, have any men from your household or community had to migrate (go to cities or other places) for work more often or for longer periods due to difficulties in farming or lack of local work?
2. [ ] Yes, more often/longer [ ] No, about the same [ ] Less often/shorter [ ] No one migrates. If Yes, what are the main reasons for this increased migration? (Probe for links to climate/agriculture)
3. If men from your household migrate for work, how does this affect your own work and responsibilities at home and on the farm? (Probe: increased workload, new types of work, decision-making)
4. Has climate change or changes in farming influenced whether women or entire families from your community migrate seasonally?
5. [ ] Yes [ ] No [ ] Unsure. If Yes, can you explain how?

Part G: Health, Well-being, and Gender-Specific Impacts (Qualitative)

1. Have you noticed any changes in the health of people in your family or community in recent years that you think might be linked to changes in climate, farming, or food availability? (Probe: new illnesses, more frequent illnesses, nutrition-related issues)
2. How do these challenges (related to climate, farming, income) affect your own well-being or stress levels?
3. In your opinion, do these climate-related changes affect women differently than men in your community? If so, how? (Probe: workload, access to resources, decision-making power, health)

Part H: Access to Support and Interventions (Qualitative & Quantitative)

1. Are you aware of any government schemes or programs from NGOs (like Raah Foundation or others) to help farmers adapt to climate change or improve farming? [ ] Yes [ ] No. If Yes, which ones? _____ ; Have you or your family benefited from any of these? [ ] Yes [ ] No ; If Yes, how did it help? _____ ; If No, why not? (Probe: didn't know how, not eligible, difficult to access) _____

2. Do you have access to things like climate-resilient seeds, better irrigation methods, or information about new farming techniques? [ ] Yes, easily [ ] Yes, with some difficulty [ ] No, not really [ ] Don't know ; If access is difficult or non-existent, what are the barriers?

3. What kind of support or help do you think would be most useful for women farmers in your community to cope with the challenges you've discussed?

Part J: Closing

Thank you so much for sharing your time and experiences with us. This information is very valuable for our research. Do you have any final thoughts or anything else you would like to share with us, or any questions for me? Thank you again.

Interviewer's Observations (To be filled out after the interview):

- Non-verbal cues, general environment, any other relevant observations.
- Was the respondent comfortable? Any difficulties during the interview?
- Any specific observations related to farming practices, housing, water sources seen during the visit.

The data used within this research, as presented in the different figures and tables, went through a rigorous process of analysis that combined qualitative thematic analysis for qualitative data and descriptive statistics for quantitative data. Mixed-methods research was required to provide an in-depth evaluation of the complex facets of climate change, gender-differentiated impacts, use of traditional knowledge, and the impact of external interventions on Palghar tribal women.

The collected data were systematically organized and analysed using both Microsoft Excel and SPSS (Statistical Package for the Social Sciences) software. In the initial stage, responses from the questionnaire were entered into Excel, and descriptive statistics, such as frequencies and percentages, were calculated using Pivot Tables to summarize and interpret the patterns of responses across different variables.

To examine whether there were significant differences in perceptions and responses among different age groups, a Chi-square test of independence was performed using SPSS. This statistical test allowed for the assessment of associations between categorical variables, particularly in understanding how age-related differences influenced respondents' views on climate change impacts, migration, traditional practices, and support needs.

RESULTS

DEMOGRAPHIC PROFILE OF RESPONDENTS

The age composition of the 48 respondents indicates a well-balanced age distribution, with the majority being those between 30 and 40 years (39.6%), followed by 41 and 50 years (31.3%) and those between 51 and 60 years (29.2%). The observation depicts the respondent population as being of a considerable age and, therefore, experienced in life and agricultural issues. The vast majority of the respondents (91.7%) gave agriculture as their primary livelihood, indicating a high degree of dependence on farm activities. The landholding distribution indicates that the majority of the families (62.5%) had between 4 and 6 acres of land under cultivation, followed by 35.4% with 1 to 3 acres; this may depict that the respondents were small to medium-scale landowners. Women working in agriculture depict a broad range of engagement in the sector, where 60.4% attested to being engaged in all farm activities—presumably planting, weeding, harvesting, and selling—while an additional 33.3% indicated that their engagement was for all activities except selling. The statistical description portrays the important role of women in agriculture, depicting their multitasking skill in their agricultural activities. The majority of the land under cultivation (75.0%) employs purely rain-fed irrigation, indicating their dependence on unpredictable rainfall for the majority of their farm output. The majority of the respondents (60.4%) indicated a high degree of experience in agriculture (11-20 years), providing a rich pool of experiential experiences; considerable experience was also indicated in other categories (1-10 years: 12.5%, 21-30 years: 18.8%, 31-40 years: 8.3%). In addition to farming, horticulture (37.5%) and daily wage labour (31.2%) were the most frequent additional sources of income, indicating that agricultural livelihoods were augmented by various sources of income sources. Poultry farming (10.4%) and transport services (4.2%) were negligible, while less than a fifth (16.7%) of the respondents indicated the lack of any alternative income sources.

Table 1: Demographic Characteristics of Tribal Women Respondents in Palghar District, Maharashtra

S.NO.	Variables	Categories	Frequency	Percentage
1	Age Class	30-40	19	39.6
		41-50	15	31.3
		51-60	14	29.2
2	Occupation	Asha worker	2	4.2
		Farming	44	91.7
		Tailoring	2	4.2

S.NO.	Variables	Categories	Frequency	Percentage
3	Land	1-3 acres	17	35.4
		4-6 acres	30	62.5
		7-10 acres	1	2.1
4	Major role in farming	All above	29	60.4
		Except selling, all	16	33.3
		Planting	3	6.3
5	Irrigation	Fully rain fed	36	75
		Partially irrigated	12	25
6	Farming experience	1-10 years	6	12.5
		11-20 years	29	60.4
		21-30 years	9	18.8
		31-40 years	4	8.3
7	Other income source	Horticulture	18	37.5
		None	8	16.7
		Poultry	5	10.4
		Transportation	2	4.2
		Wages	13	31.2

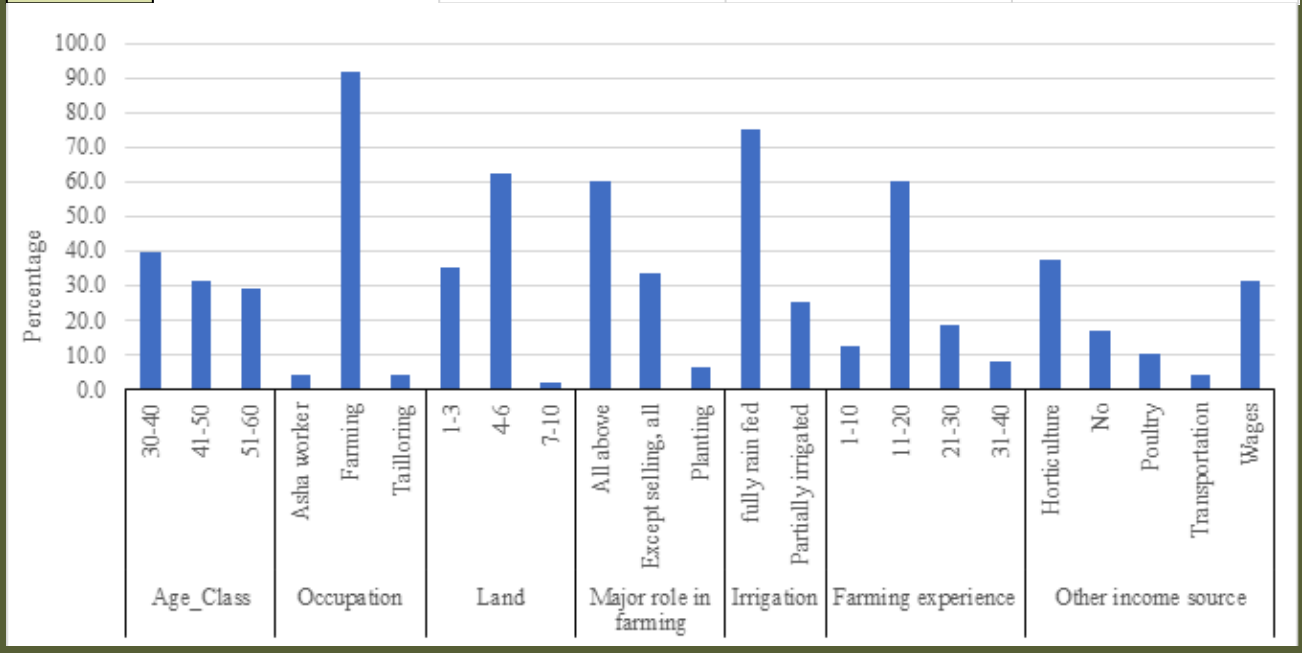

Fig. 3. Distribution of Socio-Demographic Variables Among Tribal Women Respondents
(This figure would visually represent data from Table 1)

IMPACT OF CLIMATE CHANGE ON AGRICULTURE

All respondents (100%) mentioned experiencing changes in weather during the past 10 years, suggesting universal perception of climate variability. Furthermore, in regards to the kind of changes, the most common categories observed were "Hotter days" (33.3%), "Heavy rain" (29.2%), and "Timing of rain" (29.2%), while "Unseasonable events" was cited by 8.3%. The weather changes have a direct impact on farm operations, in the form of mainly "Crop damage" (37.5%), & "Planting times" (33.3%), followed by "Need for more water" (16.7%), & "Diseases" (12.5%); though there is a tremendous impact to grower livelihoods thus, it is interesting to note that 100% of the respondents observed "Increased" crop income. This increase is most attributed to "Market demand" (75%), while "Water availability" (16.7%) and "Seeds availability" (8.3%) are of lesser importance. This suggests that the changing climate is affecting the growth of crops, and although the current increased crop income may filter out serious production vulnerabilities. In regards to perceived change in soil, 33.3% of the respondents observed a change in "Soil quality", while "Soil erosion" (75% of stranded respondents) is a more common concern than "Less fertile" (25%). In regards to change in water availability for agriculture, the highest perceived change was reported to be from "Rainfall" (58.3%), followed by "Water tank" (16.7%), while "Bore well," "Open well," and "Pond" (8.3% each) were relatively less significant sources of water. This is indicative of how significant rain is and how reliant we are on additional water tanks.

Table 2: Perceived Climate Change Impacts on Agricultural Practices and Soil Quality by Tribal Women

S.NO.	Variables	Categories	Percentage
1	Weather change	Yes	100
		No	0
2	Noticed changes	Heavy rain	29.2
		Hotter days	33.3
		Timing of rain	29.2
		Unseasonal events	8.3
3	Effects on farming	Crop damage	37.5
		Diseases	12.5
		Need of more water	16.7
		Planting times	33.3

S.NO.	Variables	Categories	Percentage
4	Crop income	Increased	100
5	Reason in increase crop income	Market demand	75
		Seeds availability	8.3
		Water availability	16.7
6	Soil quality changes	No	66.7
		Yes	33.3
7	Changes in soil(n=16)	Less fertile	25
		Soil erosion	75
8	Changes in water availability	Bore well	8.3
		Open well	8.3
		Pond	8.3
		Rainfall	58.3
		Water tank	16.7

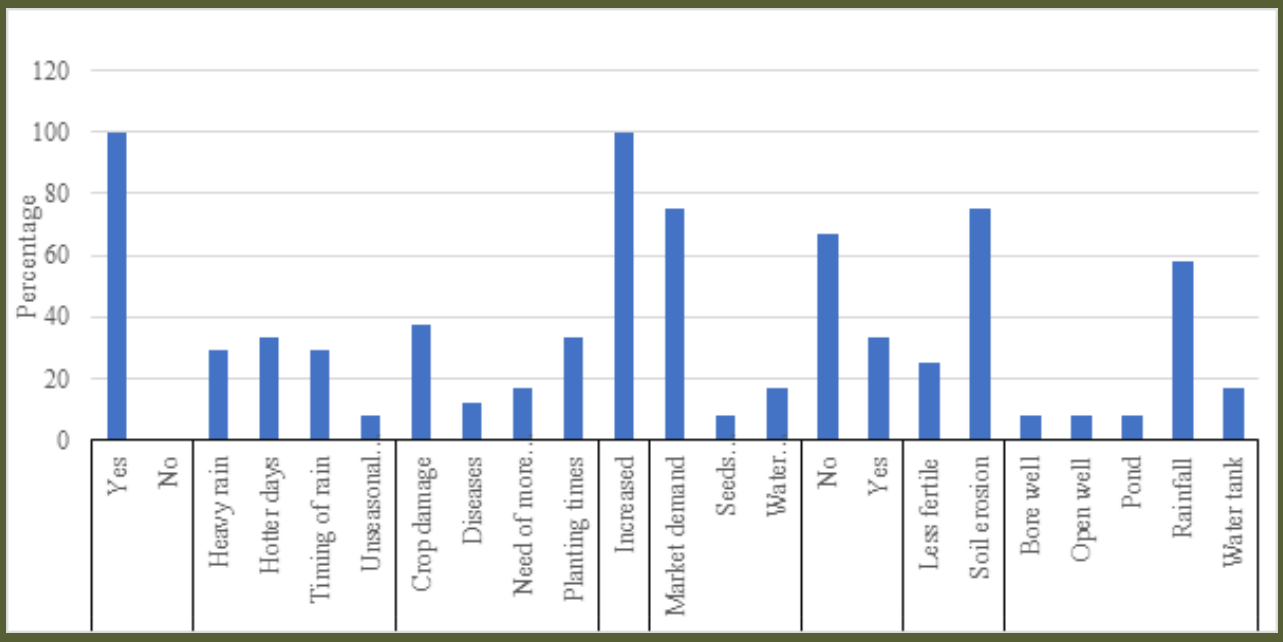

Fig. 4: Reported Climate Change Manifestations and their Effects on Farming
(This figure would visually represent data from Table 2)

LIVELIHOODS AND ECONOMIC VULNERABILITY IMPACTS

The statistics report a considerable livelihood dependency change, with 66.7% of the households being "More reliant" on agriculture in the last 10 years and 33.3% "About the same." This suggests increased dependency on agriculture, perhaps due to shifts in income opportunity or pressure from population. The large proportion of the respondents (75%) utilizing forest produce suggests the importance of forest produce in their livelihood. But 83.33% of the respondents utilizing forest produce reported availability of forest produce is "Less available," which may suggest deterioration of the environment or diminished access. This diminished availability of forest produces significantly affected availability for "Food" (58.3%) and "medicine" (25%) for their households. Yet, despite all of this, and somewhat paradoxically, all of the respondents reported that ". facilitating the basic needs of survival" had become easier (75% "Much easier," 25% "Slightly easier"). All of the respondents who assigned credit for the shifts in their livelihood strategies to "Agriculture" (68.7%), which suggests improved agriculture outputs (perhaps due to the markets demand characterized in Table 02), or other supporting programs that are currently benefiting the respondents, aside from "More livelihood options" (31.3%).

Table 3: Changes in Livelihood Reliance and Forest Produce Availability Among Tribal Households

S.NO.	Variables	Variables	Frequency	Percentage
1	Reliance on farming	About the same	16	33.3
		More reliant	32	66.7
2	Do you collect forest produce	No	12	25
		Yes	36	75
3	availability of forest produce	About the same	8	16.7
		Less available	40	83.3
4	If less, its effect	Food	28	58.3
		Medicine	12	25
5	Changes in ability to meet basic needs	Much easier	36	75
		Slightly easier	12	25
6	Reason behind changes in basic needs	Agriculture	33	68.7
		More livelihood option	15	31.3

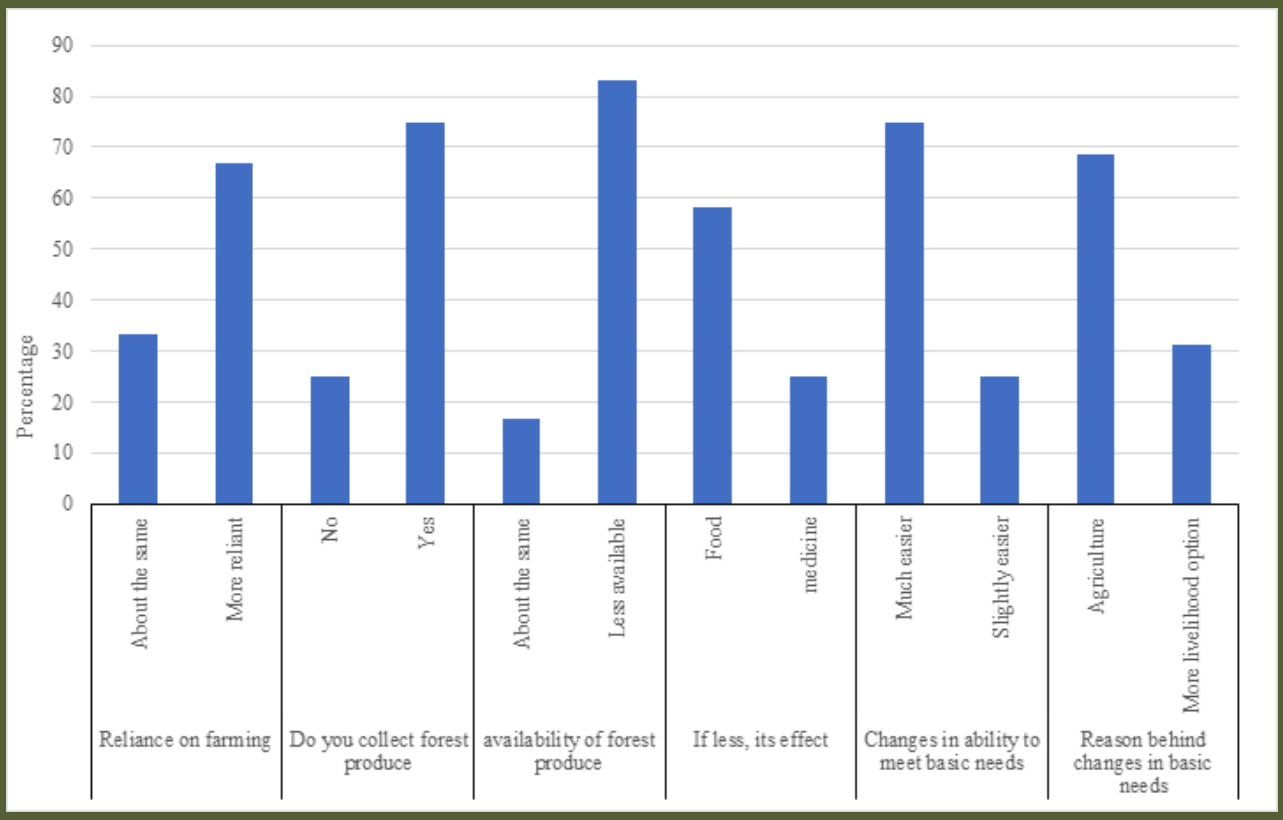

Fig. 4: Economic Vulnerability and Shifting Livelihood Dependencies (This figure would visually represent data from Table.03)

TRADITIONAL TECHNIQUES AND INDIGENOUS KNOWLEDGE

For challenges identified as weather-related category, "Excessive rainfall" (45.8%) was the highest concern of respondents, followed by "Insufficient rainfall" (37.5%) and "Pests" (16.7%). All respondents (100%) employed "Some" traditional farming practices, suggesting the ongoing significance of indigenous knowledge. More specifically, "Employing bulls" was the most common usage (54.2%), followed by a combination of "Seed preservation, Bulls, Bio fertilizers" (29.2%), and "Employing Bulls, Bio fertilizers" (16.7%). A huge majority (75%) reported that these traditional practices were "Yes" still useful in the modern age, most importantly for "economic" reasons (52.8% of whom found them useful), as well as because they were "suitable for the landscape" (27.8%), and "favourable for work" (19.4%). Of the 25% of respondents who felt that these practices were "No" no longer useful, the only reason given was "time consumption" (100%). This would suggest that while traditional practice remains applicable to some degree, the requirements of time and labour may be the barriers to their use.

S.NO	Variables	Categories	Frequency	Percentage
1	Faced challenges due to weather	Less rain	18	37.5
		Pests	8	16.7
		Too much rain	22	45.8

S.NO	Variables	Categories	Frequency	Percentage
2	Are you using traditional farming?	Some	48	100
3	If yes, mention	Preserving seeds, Bulls, Bio fertilizers	14	29.2
		Using bulls	26	54.2
		Using Bulls, Bio fertilizers	8	16.7
4	Are they useful today	No	12	25
		Yes	36	75
5	If yes, reason(n=36)	economic	19	52.8
		Favarable to work	7	19.4
		Suitable for landscape	10	27.8
6	If no, reason (n=12)	Time consumption	12	100

Table 4: Utilization and Perceived Efficacy of Traditional Farming Techniques in Adapting to Climate Challenges

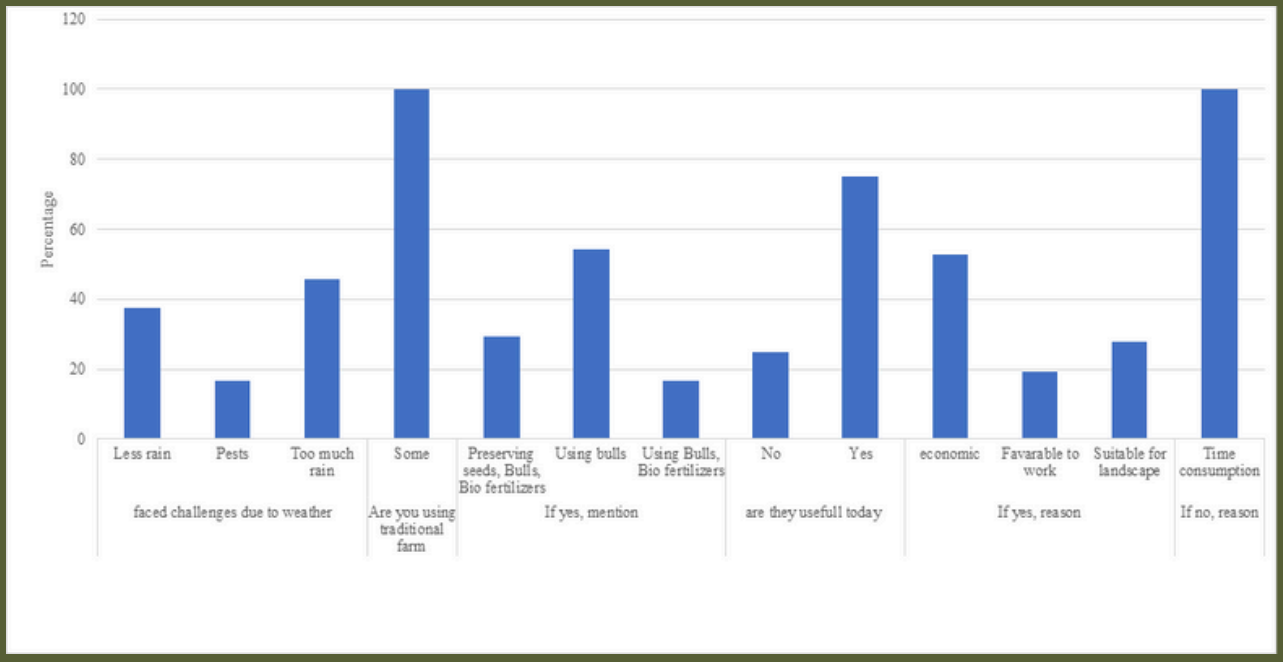

Fig. 6: Adoption and Perceived Utility of Indigenous Agricultural Practices
(This figure would visually represent data from Table 4)

MIGRATION AND ITS EFFECT ON WOMEN'S DAILY LIVES

In terms of migration, 35.4% of participants reported the migration of males in their household, while 64.6% reported no migration of males. The participants indicating migration had three main concerns for women under the conditions of male migration. They reported that the primary effect was limited 'increase in work load' (64.7%), and" decision-making " (29.4%), and a limited change in "access to resources" (5.9%). Interestingly, in the 100% of the participants expressed that climate change and changes in farming have affected their families. They reported two primary effects, "Scarcity of food" (41.7%) and "Economic loss" (39.6%) with health (18.8%) issues not far behind. It demonstrates how changes related to climate-induced agricultural changes transition into social problems affecting the basic structure of family welfare.

Table 5: Impacts of Male Migration on Women's Daily Lives and Household Well-being in the Context of Climate Change

S.NO.	Variables	Categories	Frequency	Percentage
1	Have men migrated	No	31	64.6
		Yes	17	35.4
2	Affects of men's migration	Access to resources	1	5.9
		Decision-making	5	29.4
		Increase work load	11	64.7
3	Has climate change changes in farming affected	Yes	48	100
4	How its affecting	Economic loss	19	39.6
		Health	9	18.8
		Scarcity of food	20	41.7

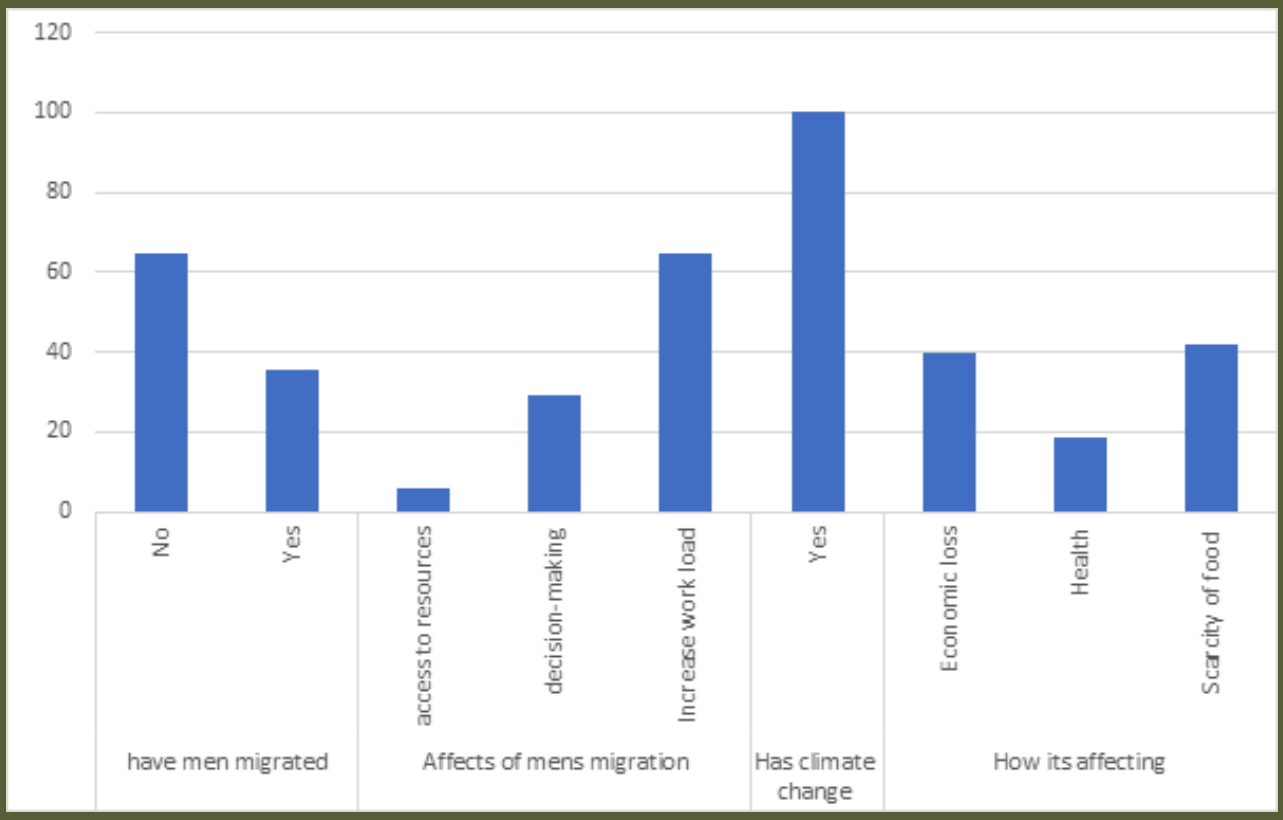

Fig. 7: Gendered Consequences of Migration and Climate-Induced Agricultural Shifts
(This figure would visually represent data from Table 5)

ACCESS TO SUPPORT AND INTERVENTIONS

IMost respondents (70.8%) are "aware of any schemes" that aim to support farmers; 29.2% are not. The "Raah foundation" (35.3%) and "Govt. Subsidies" (26.5%) did appear to be the most commonly cited, while noted combinations were also somewhat common. There was a small majority (54.2%) that reported they "benefited" from any of these schemes while 45.8% had not. Of those that mentioned having benefited, the vast majority (84%) claimed they benefited from "Providing water sources", while there were (20%) that also mentioned "Providing seeds". When asked what type of support they would like, the rankings did not change and "Providing water sources" was still the highest priority (50%), while "Providing tractors subsidy" (29.2%) and "Providing another livelihood" (20.8%) appeared next. This is a strong indication of the immediate and ongoing requirements for uncertainty around reliable water access to support livelihoods and the mechanical/equipment support.

Table 6: Awareness, Benefits, and Desired Formal Support Mechanisms for Tribal Women Farmers

S.NO.	Variables	Categories	Frequency	Percentage
1	Aware of any schemes	No	14	29.2
		Yes	34	70.8

S.NO.	Variables	Categories	Frequency	Percentage
2	Which one	Govt.Subsidies	9	26.5
		Govt.Subsidies, Agriculture department	4	11.8
		Govt.Subsidies, Raah foundation	9	26.5
		Raah foundation	12	35.3
3	Have you benefited	No	22	45.8
		Yes	26	54.2
4	How it benefited	Providing seeds	5	20
		Providing water sources	21	84
5	What support want	Providing another livelihood	10	20.8
		Providing tractors subsidy	14	29.2
		Providing water sources	24	50

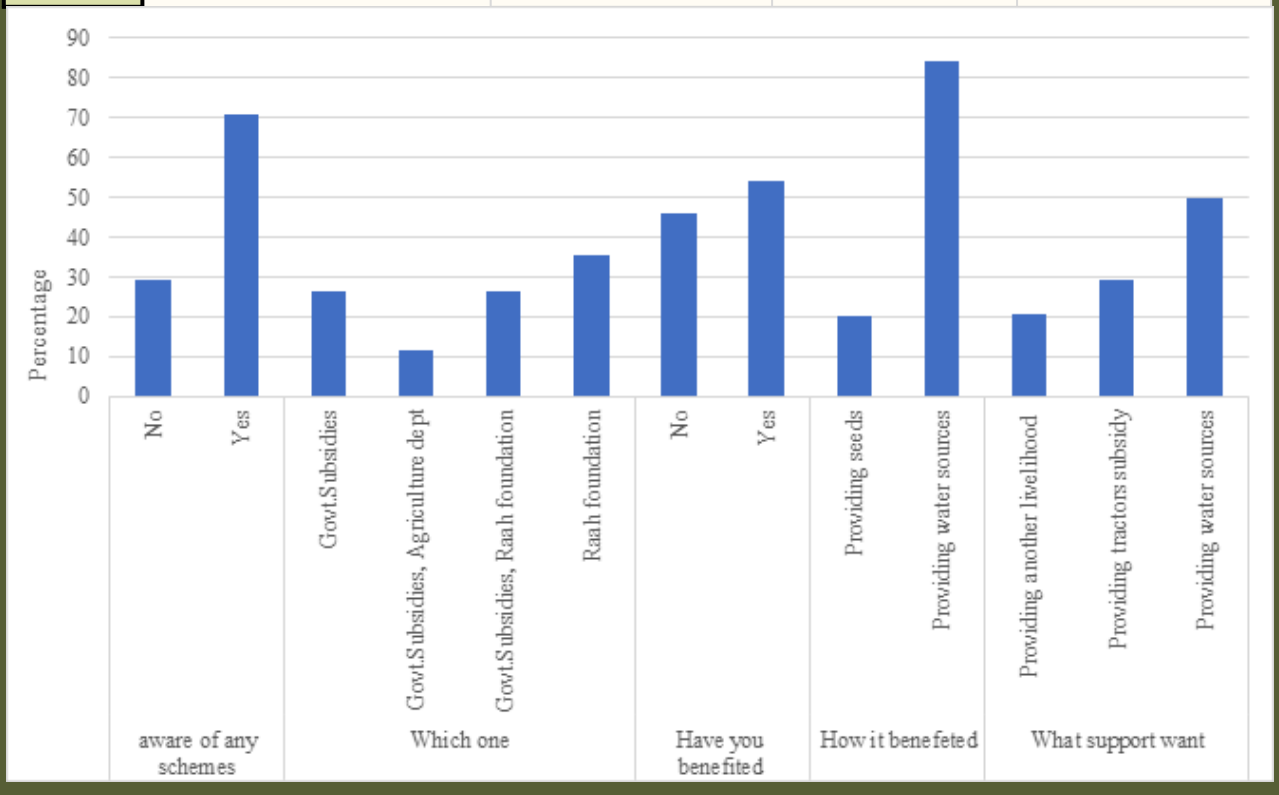

Fig. 8: Access to and Perceived Benefits of External Support and Interventions
(This figure would visually represent data from Table 6)

RESPONDENTS' PERCEPTION ABOUT WEATHER CHANGE AND DEPENDENCY ON TRADITIONAL USES AMONG DIFFERENT AGE GROUPS OF WOMEN

Table 7 has several statistically significant differences across age brackets (30-40, 41-50, and 51-60 years) concerning farming roles, climate change effects, and adaptation tactics. younger women (aged 30 to 40) seem to have involvement in all farming activities, their more inclined to see "less rain" as a major problem with regard to weather challenges, they also tend to see a greater "need for more water." This age group seem to know more and/or have benefitted from external schemes; however, they more often see traditional behavioural techniques as less effective because of "time consumption."

In contrast, older women (51-60 years) are active farming participants "excluding selling," they mainly farm traditional crops such as "Jasmine, Paddy, Cashew," and were more likely to state "pests" were posed as a significant weather issue. They do conform more to holistic traditional practices such as "preserving seeds, bulls and bio fertilizers," and see more value in traditional practices, at least from an "economic" standpoint. However, older women were less aware of, and benefitted less from, government/NGO schemes, as well as reported less access to modern adaptive equipment, more frequently citing "Don't know" when asked about their access. Younger women and middle-aged women varied their level of concern regarding the impact of reduced forest produce, with older women mainly concerned with "food" and younger/middle aged women were primarily concerned with "medicine".

Many factors: irrigation /agricultural practices, overall shifts in weather patterns, soil quality shifts, overall dependence on agriculture, overall reasons for change in primary needs etc. were apparently not associated with age which might give proofs of overall similar experiences between generations in this area. The difference in age analysis particularly illustrates distinct vulnerabilities, systems of knowledge, and needs that girls and women have in relation to their life stages and communities.

Table 6: Cross-Tabulation of Perceptions on Weather Change and Traditional Resource Dependency by Age Group (This table would typically not have a direct corresponding figure as it's a statistical summary of associations, but specific findings could be visualized in other figures if desired).

Variables	Category	Age class			
		30-40	41-50	51-60	
Main role in Farming	All above	17(58.6)	8(27.6)	4(13.8)	14.528(<0.05)
	Except selling, all	2(12.5)	5(31.3)	9(56.3)	
	Planting	0(0.0)	2(66.7)	1(33.3)	
Irrigation for farming	fully rain fed	16(44.4)	11(30.6)	9(25.0)	1.739(>0.05)
	Partially irrigated	3(25.0)	4(33.3)	5(41.7)	

Variables	Category	Age class			
		30-40	41-50	51-60	
Main crop grown in last year	Jasmine, Paddy, Cashew	0(0)	3(37.5)	5(62.5)	**7.577(<0.05)**
	Paddy & Ragi	19(47.5)	12(30.0)	9(22.5)	
Other income sources	Farming	2(50.0)	2(50.0)	0(0.0)	**11.825(>0.05)**
	Horticulture	9(50.0)	3(16.7)	6(33.3)	
	No	2(25.0)	5(62.5)	1(12.5)	
	Poultry	2(40.0)	2(40.0)	1(20)	
	Transportatio n	1(50).0	1(50.)	0(0.0)	
	Wages	3(27.3)	2(18.2)	6(54.5)	
changes in weather pattern	Heavy rain	5(35.7)	2(14.3)	7(50.0)	**7.837(>0.05)**
	Hotter days	7(43.8)	7(43.8)	2(12.5)	
	Timing of rain	5(35.7)	4(28.6)	5(35.7)	
	Unseasonal events	2(50.0)	2(50.0)	0(0.0)	
How weather changes affecting farming	Crop flood out	7(38.9)	3(16.7)	8(44.4)	**13.601(<0.05)**
	Diseases	1(16.7)	1(16.7)	4(66.7)	
	Need of more water	5(62.5)	3(37.5)	0(0.0)	
	Planting times	6(37.5)	8(50.0)	2(12.5)	
Describe the changes in soil	Less fertile	2(50.0)	2(50.0)	0(0.0)	**2.044(>0.05)**
	No	12(37.5)	10(31.3)	10(31.3)	
	Soil erosion	5(41.7)	3(25.0)	4(33.3)	

Variables	Category	Age class			
		30-40	41-50	51-60	
Availability of water for farming from water sources over the years	Bore well	0(0.0)	0(0.0)	4(100.0)	15.229(>0.05)
	Open well	2(50.0)	2(50.0)	0(0.0)	
	Pond	2(50.0)	2(50.0)	0(0.0)	
	Rainfall	13(46.4)	7(25.0)	8(28.6)	
	Water tank	2(25.0)	4(50.0)	2(25.0)	
Changes in reliance on farming	About the same	7(43.8)	3(18.8)	6(37.5)	1.877(>0.05)
	More reliant	12(37.5)	12(37.5)	8(25.0)	
Reason for changes in reliance on farming	Agriculture facilities	4(33.3)	4(33.3)	4(33.3)	5.311(>0.05)
	For food	13(43.3)	7(23.3)	10(33.3)	
	Income	2(33.3)	4(66.70	0(0.0)	
Do you collect produce from the forest	No	6(50.0)	5(41.7)	1(8.3)	3.375(>0.05))
	Yes	13(36.1)	10(27.8)	13(36.1)	
Changes in availability of forest produce	About the same	4(50.0)	4(50.0)	0(0.0)	4.143(>0.05)
	Less available	15(37.5)	11(27.5)	14(35.0)	
If forest produce is less, how it has affected your family	Food	11(34.4)	8(25.0)	13(40.6)	6.179(<0.05)
	Medicine	8(50.0)	7(43.8)	1(6.3)	
Changes in ability to meet basic needs	Much easier	13(36.1)	10(27.8)	13(36.1)	3.375(>0.05)
	Slightly easier	6(50.0)	5(41.7)	1(8.3)	
Reason behind the changes in basic needs	Agriculture	13(39.4)	9(27.3)	11(33.3)	1.164(>0.05)
	More livelihood	6(40.0)	6(40.0)	3(20.0)	

Variables	Category	Age class			
		30-40	41-50	51-60	
When weather challenges are faced	Less rain	11(61.11)	5(27.78)	2(11.1)	10.616(<0.05)
	Pests	0(0.0)	3(37.5)	5(62.5)	
	Too much rain	8(36.3)	7(31.8)	7(31.8)	
Traditional practices	Preserving seeds, Bulls, Bio fertilizers	2(14.2)	0(0.0)	12(85.7)	31.281(<0.05)
	Using bulls	13(50.0)	11(42.3)	2(7.6)	
	Using Bulls, Bio fertilizers	4(50.0)	4(50.0)	0(0.0)	
Whether traditional methods are effective	No	8(66.6)	4(33.3)	0(0.0)	7.654(<0.05)
	Yes	11(30.5)	11(30.5)	14(38.8)	
If yes, reason	Economic	3(15.79)	4(21.0)	12(63.16)	20.039(<0.05)
	Favourable to work	4(57.1)	3(42.8)	0(0.0)	
	Suitable for landscape	4(40.0)	4(40.0)	2(20.)	
Are you aware of any schemes	No	2(14.3)	4(28.6)	8(57.1)	8.545(<0.05)
	Yes	17(50.0)	11(32.4)	6(17.6)	
If yes, which one	Govt.Subsidies	3(33.3)	4(44.4)	2(22.2)	11.340(>0.05)
	Govt.Subsidies, Agriculture dept	2(50.0)	2(50.0)	0(0.)	
	Govt.Subsidies, Raah foundation	5(55.6)	2(22.2)	2(22.2)	
	No	2(14.3)	4(28.6)	8(57.1)	
	Raah foundation	7(58.3)	3(25.0)	2(16.7)	

Variables	Category	Age class			
		30-40	41-50	51-60	
Have you benefited from any known schemes	No	5(22.7)	7(31.8)	10(45.5)	**6.614(<0.05)**
	Yes	14(53.8)	8(30.8)	4(15.4)	
If yes, how it helped	Providing seeds	2(50.0)	2(50.0)	0(0.0)	**8.029(>0.05)**
	Providing water	12(57.1)	5(23.8)	4(19.0)	
Do you have access to things like climate reliant seeds, better irrigation methods	Don't know	4(21.1)	6(31.6)	9(47.4)	**6.301(<0.05)**
	Yes, with some difficulty	15(51.7)	9(31.0)	5(17.2)	
What kind of support that useful for women farmers to cope with challenges	Providing another livelihood	5(50.0)	5(50.0)	0(0.0)	**19.828(<0.05)**
	Providing tractors	4(28.6)	0(0.0)	10(71.4)	
	Providing water sources	10(41.7)	10(41.7)	4(16.7)	

LIMITATIONS AND FUTURE RESEARCH

Although this research offers crucial information on the gendered effects of climate change and adaptation strategies embraced by Palghar tribal women, a number of limitations must be considered. First, the fieldwork period was limited to 15 days, thus limiting the scope for developing in-depth rapport, capturing seasonally based trends, and monitoring longitudinal patterns of change. Second, data analysis time available to conduct intensive data analysis was also limited, which could have limited the complexity and size of pattern identification, particularly in the qualitative data.

Second, although the 48 respondents are highly illuminating, they cannot necessarily be assumed to be representative of the varied experiences which can be found in each of the taluks within the Palghar district, or more generally, the Western Ghats.

drawing on self-reported data increases the potential for recall bias, and the focus on women directly engaged in farming has potentially excluded the experiences of those individuals indirectly affected by environmental change. Third, the study relied largely on a cross-section design, which does not allow it to record long-term trends of the impacts of climate and adaptations across different generations.

Follow-up studies would embrace longitudinal ethnographies to track the changing and intergenerational processes of indigenous knowledge transmission, migration patterns, and water governance customs. Expanding the study to different tribal zones with different ecological and social conditions would enable cross-national examination of gender-specific results in different geographies. Additionally, coupling participatory mapping with geospatial hydrologic modelling, and with indigenous ecological indicators, could provide strong hybrid methodologies to policy-making that respect scientific rigor as well as cultural roots.

CONCLUSION

This study has made significant advances towards the connection between climate change, gender relations, and indigenous resilience of tribal women of the Palghar district in Maharashtra. Based on a carefully considered survey covering 48 respondents from seven villages, this study highlighted the contributions of tribal women, who are structurally marginalized categorical actors, who by nature are the first defendants for agricultural sustainability, traditional knowledge and climate change adaptive strategies.

For the study, a significant finding was heavy dependence on agriculture, as a subsistence activity. Almost 92% of our interviewees claimed farming as their sole means of livelihood, with horticultural activities and wage work as the add-ons. Importantly, agriculture in Palghar is hyper-dependent on rain, with 75% of the practitioners citing rain as their sole means of watering their crops, thus, creating a climate-sensitive case study. All respondents stated the last decade's weather caused doubts in regards to the reliability of weather conditions, citing rising temperatures, irregular rainfall, and heavy rain showers as critical, leading to dislocation of planting schedules, crop loss, and water demand. Interestingly, the respondents vie in various degrees that the cropland revenue generated by agriculture, while affected by the problems mentioned earlier, had nevertheless increased from agricultural practices, due largely to the marketed demand, showing their potential to adapt to climatic and changing external conditions.

Traditionally, farming was in usage with the remaining all participants adopting some traditional knowledge, such as bull-powered ploughing; methods of seed preservation; and bio-fertilizer. The methods were appreciated, not only because they were cost-efficient, but also, because they were appropriate to the landscape. However, 25% of the women also indicated their worry as these are often labour-intensive methods for instance, among the younger farmers—possibly indicating an inter-generational change in preference for adaptation. The study found that men's migration regarded by 35.4% of the sample household population, added on to the workload burden of women. Men's migration resulted in an increase to women's workload (64.7%), and responsibility burden dealing with the decision-making responsibilities in the household and farm domains. Climate change related losses, including food shortage (41%), and economic hardship (39.6%), and climate change—already compounded— had implications for the workload burden of tribal women. Although knowledge of government programs was fairly high at 70.8%, only 54.2% of respondents identified themselves as having benefited from programs, usually in the form of water provision. The majority of women still did not have access to better seeds, irrigation methods, or technical assistance. When asked to identify types of assistance useful, women overwhelmingly pointed to access to better sources of water (50%), subsidy on tractors (29.2%), and diversification of livelihoods (20.8%).

REFERENCES

- Adger, W. N. (2006). Vulnerability. Global Environmental Change, 16(3), 268–281.
- Agarwal, B. (1992). The gender and environment debate: Lessons from India. Feminist Studies, 18(1), 119–158.
- Agarwal, B. (2010). Gender and Green Governance. Oxford University Press.
- Agrawal, A. (2002). Indigenous knowledge and the politics of classification. International Social Science Journal, 54(173), 287–297.
- Alston, M. (2014). Gender mainstreaming and climate change. Women's Studies International Forum, 47, 287–294.
- Armitage, D., Berkes, F., & Doubleday, N. (2011). Adaptive Co-management: Collaboration, Learning, and Multi-Level Governance. UBC Press.
- Barnett, J., & Adger, W. N. (2007). Climate change, human security and violent conflict. Political Geography, 26(6), 639–655.
- Berkes, F., Colding, J., & Folke, C. (2000). Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications, 10(5), 1251–1262.
- Carney, J. (1992). Peasant women and economic transformation in The Gambia. Development and Change, 23(4), 67–90.
- Chambers, R. (1997). Whose Reality Counts? Putting the First Last. Intermediate Technology Publications.
- Dankelman, I., & Davidson, J. (1988). Women and Environment in the Third World. Earthscan.
- Denton, F. (2002). Climate change vulnerability, impacts, and adaptation: Why does gender matter? Gender and Development, 10(2), 10–20.
- Ford, J. D., & Smit, B. (2004). A framework for assessing the vulnerability of communities in the Canadian Arctic to risks associated with climate change. Arctic, 57(4), 389–400.
- Gadgil, M., & Guha, R. (1995). Ecology and Equity: The Use and Abuse of Nature in Contemporary India. Routledge.
- Goldman, M. (2005). Imperial Nature: The World Bank and Struggles for Social Justice in the Age of Globalization. Yale University Press.
- Gupta, A. K. (1998). Post-liberalization and the search for balance: The case of India's grassroots innovations. Futures, 30(5), 433–450.
- IPCC. (2023). Sixth Assessment Report. Intergovernmental Panel on Climate Change.
- Jackson, C. (1993). Doing what comes naturally? Women and environment in development. World Development, 21(12), 1947–1963.
- Joshi, S., Kumar, M., & Patil, M. (2019). Water, women, and well-being. Indian Journal of Gender Studies, 26(1-2), 1–20.
- Kothari, A. (2006). Building bridges: Community-based conservation and natural resource management. Parks, 16(1), 13–20.
- Krishnaswamy, J., & Sreerekha, K. (2010). Climate change in the Western Ghats: A review. Indian Journal of Ecology, 37, 1–12.

- Lambrou, Y., & Nelson, S. (2010). Farmers in a changing climate: Does gender matter? FAO.
- Lebel, L., Garden, P., & Imamura, M. (2010). The politics of scale, position, and place in the governance of water resources in the Mekong region. Ecology and Society, 15(4), 24.
- Mehta, L. (2005). The Politics and Poetics of Water: Naturalising Scarcity in Western India. Orient Blackswan.
- Mishra, V., & Singh, V. P. (2011). Drought modeling – A review. Journal of Hydrology, 403(3-4), 157–175.
- MoEFCC. (2010). India: State of Environment Report 2010. Ministry of Environment, Forests and Climate Change, Government of India.
- Momsen, J. H. (2004). Gender and Development. Routledge.
- Myers, N., Mittermeier, R. A., et al. (2000). Biodiversity hotspots for conservation priorities. Nature, 403, 853–858.
- Nazarea, V. D. (1999). Ethnoecology: Situated Knowledge/Located Lives. University of Arizona Press.
- Nazarea, V., Rhoades, R., & Andrews-Swann, J. (2013). Seeds of Resistance, Seeds of Hope. University of Arizona Press.
- Nightingale, A. (2011). Bounding difference: Intersectionality and the material production of gender, caste, class, and environment in Nepal. Geoforum, 42(2), 153–162.
- Pretty, J. (1995). Participatory learning for sustainable agriculture. World Development, 23(8), 1247–1263.
- Rajasekaran, B. (1993). Indigenous technical knowledge: A framework for research and development. Indigenous Knowledge and Development Monitor, 1(1), 13–17.
- Ray, I., & Reddy, V. R. (2009). “Failing” groundwater institutions. Water Policy, 11(4), 491–512.
- Reid, H., Alam, M., Berger, R., Cannon, T., & Milligan, A. (2014). Community-based adaptation. In Adapting to Climate Change (pp. 69–88). Routledge.
- Resurreccion, B. P. (2008). Gender, legitimacy and patronage-driven participation. International Journal of Public Administration, 31(12), 1479–1495.
- Rocheleau, D., Thomas-Slayter, B., & Wangari, E. (1996). Feminist Political Ecology. Routledge.
- Scott, J. C. (1998). Seeing Like a State. Yale University Press.
- Sen, A., & Srivastava, R. (2019). Climate vulnerability in India’s western ghats. Indian Journal of Ecology, 46(2), 220–228.
- Shiva, V. (1989). Staying Alive: Women, Ecology, and Development. Zed Books.
- Singh, A., Panda, S. N., & Arora, M. (2002). Groundwater modelling for sustainable development. Journal of Hydrology, 259(1-4), 218–231.
- Stern, N. (2007). The Economics of Climate Change: The Stern Review. Cambridge University Press.
- Sultana, F. (2011). Suffering for water, suffering from water. Gender, Place & Culture, 18(1), 23–44.
- Sultana, F. (2013). Gendering climate change. Geoforum, 45, 135–142.
- TERI. (2009). Climate Change and India: A 4X4 Assessment. The Energy and Resources Institute.

- Terry, G. (2009). No climate justice without gender justice. Gender & Development, 17(1), 5–18.
- UNDP. (2011). Gender and Climate Change: Asia and the Pacific Policy Brief.
- UNICEF. (2019). Water, Sanitation and Hygiene Annual Report.
- Vorosmarty, C. J., Green, P., et al. (2000). Global water resources: Vulnerability from climate change and population growth. Science, 289(5477), 284–288.
- Warren, D. M., Slikkerveer, L. J., & Brokensha, D. (1995). The Cultural Dimension of Development: Indigenous Knowledge Systems. Intermediate Technology Publications.
- Wheeler, T., & von Braun, J. (2013). Climate change impacts on global food security. Science, 341(6145), 508–51.