LOCALLY-LED GENDER-RESPONSIVE CLIMATE ACTION AND SDG LOCALIZATION IN RAIGAD DISTRICT, MAHARASHTRA

Scoping phase report

A scoping report on Vulnerability Mapping through a Gender Analysis Frameworks (Harvard, Naila Kabeer and Moser) in Raigad prepared by Students of MA/MSc. Environment, Climate Change and Sustainability Studies Batch of 2024-26 as part of the course Gender, Social Vulnerability and Climate Change under the guidance of Prof. Manjula Bharathy, School of Habitat Studies

In partnership with

Supported by

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This report represents the culmination of a collaborative, multi-institutional research effort undertaken as part of the *Locally-led Gender-Responsive Climate Action and Localization of the Sustainable Development Goals (SDGs)* in Raigad District, Maharashtra. The scoping phase findings presented here are the outcome of sustained engagement across academic institutions, government bodies, civil society organizations, and local communities, whose collective contributions made this work both possible and meaningful.

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EXECUTIVE SUMMARY

Over the past three decades, gender has emerged as a central pillar of sustainable development and climate governance. The 1995 Beijing Declaration marked a critical turning point by explicitly linking gender equality, poverty reduction, and environmental sustainability. This recognition has since been institutionalized within global climate governance, particularly under the United Nations Framework Convention on Climate Change (UNFCCC). Since 2014, initiatives such as the Lima Work Programme on Gender and the subsequent Gender Action Plan (GAP) have sought to advance women's leadership, participation, and gender-responsive climate action.

At the national level, India is among the countries most vulnerable to the impacts of climate change. Between 1901 and 2018, the country's mean annual surface air temperature increased by approximately 0.7°C, contributing to more frequent heatwaves, erratic monsoon patterns, and increased climate variability. These impacts are not socially neutral. Instead, they interact with pre-existing inequalities related to gender, caste, class, livelihood dependence, and spatial location, thereby shaping differentiated vulnerability and adaptive capacity across communities.

Structural Drivers of Gendered Vulnerability

Findings from the reviewed sources and field-based scoping exercises indicate that women's heightened vulnerability to climate change is not rooted in biological factors, but is structurally produced through unequal power relations and institutional exclusion. Three interrelated drivers are particularly significant.

First, **time poverty and the disproportionate care burden** play a central role. Women often work between 14 and 16 hours per day, balancing agricultural labour, water and fuel collection, caregiving, and community responsibilities. Climate-induced resource scarcity, especially of water and biomass, intensifies this "triple burden," leaving women with limited time for rest, education, or income diversification.

Second, **land and asset insecurity** significantly constrain women's adaptive capacity. Although women constitute a substantial share of India's agricultural workforce, they rarely hold formal land titles. This exclusion restricts access to institutional credit, crop insurance, government compensation schemes, and climate-resilient agricultural inputs, reinforcing cycles of vulnerability.

Third, **institutional exclusion from governance structures** further marginalizes women's voices. Despite possessing extensive traditional ecological knowledge, women are often underrepresented or excluded from formal decision-making bodies such as water user associations, forest management committees, and local climate planning processes.

Localized Insights: Roha and Sudhagad Talukas

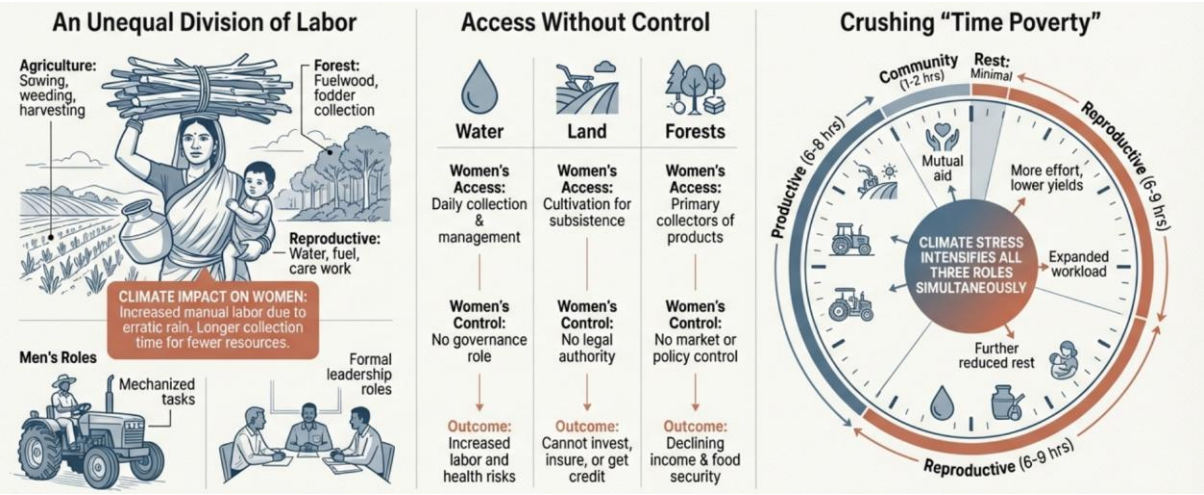
The scoping studies highlight how gendered vulnerability manifests differently across ecological and socio-economic contexts. In **Roha**, a peri-urban and industrializing riverine area, vulnerability is shaped by the collapse of canal-based irrigation systems and the feminization of agriculture. Male outmigration to industrial employment has increased women's responsibility for farming and household management, without a corresponding increase in decision-making authority or access to productive resources.

In contrast, **Sudhagad**, a forest-dependent and predominantly tribal region, faces vulnerability driven by geographic isolation and historical marginalization. Tribal women from Katkari and Thakur communities experience extreme time poverty, often spending up to five hours daily collecting water from receding springs and fuelwood from degraded forests. These conditions significantly limit their adaptive capacity and well-being.

SDGs, Justice, and Policy Implications

The findings underscore that progress on **SDG 13 (Climate Action)** is closely linked to **SDG 5 (Gender Equality)**, **SDG 6 (Clean Water and Sanitation)**, and **SDG 15 (Life on Land)**. Applying Nancy Fraser's Triadic Justice Framework reveals three critical gaps: failures in the redistribution of material resources, a lack of recognition of women's labour and ecological knowledge, and inadequate representation of women in local governance and decision-making forums.

Methodologically, the use of Participatory Rural Appraisal (PRA) tools, such as time-use analysis, problem tree mapping, and resource mapping, proved essential in capturing the lived experiences that are often overlooked by technocratic planning approaches. These tools consistently identified water insecurity as the primary systemic constraint affecting women's lives.



1.
A GLOBAL OVERVIEW OF GENDER AND CLIMATE CHANGE

1.1 HISTORICAL BACKGROUND

The recognition of gender as a critical dimension of sustainable development and environmental governance has evolved over several decades, shaped by global political commitments, international environmental negotiations, and feminist development discourse. A defining milestone in this trajectory was the Fourth World Conference on Women held in Beijing in 1995, which culminated in the adoption of the Beijing Declaration and Platform for Action (BDPfA) by 189 governments. This landmark framework advanced the goals of equality, development, and peace for all women, positioning gender equality not merely as a social justice issue but as a prerequisite for sustainable development and global stability.

For the first time in international policy history, the Beijing Platform explicitly linked women, poverty, and environmental sustainability, acknowledging that women—particularly those living in poverty—are disproportionately dependent on natural resources and therefore disproportionately affected by environmental degradation. It emphasized that equitable social development and sustainable environmental resource use are mutually reinforcing and constitute a necessary foundation for sustainable development. Importantly, the Declaration recognized that broad-based and sustained economic growth within ecological limits is essential to sustain social development and social justice, thus embedding gender within the emerging sustainable development paradigm (UNCC, 2022).

In the year 2000, a five-year review of the Beijing Platform for Action was conducted during the twenty-third special session of the United Nations General Assembly, titled *"Women 2000: Gender Equality, Development and Peace for the Twenty-first Century."* This review assessed global progress and persistent gaps, leading to the adoption of a political declaration and outcome document that reaffirmed state commitments. However, while gender equality was gaining rhetorical prominence in development discourse, its integration into climate governance remained limited at this stage.

A significant shift occurred in 2001 at the Seventh Conference of Parties (COP 7) to the United Nations Framework Convention on Climate Change (UNFCCC), where parties adopted decisions explicitly calling for the enhancement of women's participation at all levels of climate-related decision-making. This marked the formal entry of gender considerations into multilateral climate negotiations, acknowledging that climate policies and actions were not gender-neutral and that women's exclusion from decision-making undermined effective climate responses (UNFCCC, 2001).

Despite this recognition, progress remained incremental for more than a decade. It was only in 2014, at COP 20 in Lima, that gender was institutionally embedded within the UNFCCC architecture through the launch of the Lima Work Programme on Gender (LWPG). The LWPG aimed to advance gender balance and integrate gender considerations across climate policy, implementation, and capacity-building. This initiative laid the groundwork for a more systematic engagement with gender in climate governance.

The momentum continued in 2015, when the Paris Agreement explicitly incorporated gender equality and women's empowerment as guiding principles in its preamble. While the Agreement did not establish binding gender-specific obligations, its recognition of gender-responsive climate action signalled a normative shift—affirming that adaptation, mitigation, capacity-building, and technology transfer must be pursued in ways that respect and promote gender equality (UNFCCC, 2015).

A major institutional advancement occurred at COP 23 in 2017, where Parties adopted the UNFCCC Gender Action Plan (GAP). The GAP operationalized earlier commitments by outlining concrete priority areas to mainstream gender across climate processes. The overarching aim of the GAP was to ensure that women could meaningfully influence climate decisions and be equally represented in all aspects of the UNFCCC process. The five priority areas identified under the GAP were:

1. **Capacity-building, knowledge sharing, and communication**, aimed at strengthening understanding and expertise on gender integration across thematic areas under the Convention and the Paris Agreement.
2. **Gender balance, participation, and women's leadership**, focused on achieving full, equal, and meaningful participation of women in UNFCCC processes.
3. **Coherence, to strengthen the integration of gender considerations** across UNFCCC bodies, the secretariat, and other United Nations entities.
4. **Gender-responsive implementation** and means of implementation, ensuring that climate actions respect, promote, and consider gender equality and women's empowerment.
5. **Monitoring and reporting**, to improve tracking and accountability for gender-related mandates under the UNFCCC (UNFCCC, 2017).

In 2019, at COP 25, Parties adopted an enhanced five-year Lima Work Programme on Gender and its updated Gender Action Plan, intended to strengthen implementation and improve accountability. Decisions taken at COP 25 sought to promote gender balance in climate governance, encourage gender-responsive climate policies, and empower women to cope with climate impacts through improved access to resources, knowledge, and decision-making platforms. However, despite these expanded commitments, implementation gaps persisted, with limited evidence of systematic integration of gender at national and sub-national levels post-COP 25.

The period following COP 25 was further complicated by the COVID-19 pandemic, which disproportionately impacted women and diverted political attention away from gender-responsive climate action. At COP 26 in Glasgow (2021), the most notable gender-related outcome was the Glasgow Women's Leadership Statement on Gender Equality and Climate Change, which acknowledged that women and girls are disproportionately affected by climate change and committed signatory countries to strengthening gender-responsive climate action. However, the statement was voluntary and signed by only a limited number of

countries, highlighting ongoing challenges in translating political recognition into binding commitments (CT, 2022).

At COP 27 in Sharm el-Sheikh (2022), Parties concluded the intermediate review of the Gender Action Plan, introducing amendments to selected deliverables to enhance effectiveness. Discussions emphasized the need to move beyond participation metrics towards measurable outcomes, including access to finance, leadership in adaptation planning, and protection against climate-induced gender-based vulnerabilities. Nonetheless, civil society assessments continued to note a gap between commitments and ground-level impact.

The most recent developments at COP 28 in Dubai (2023) further reinforced gender considerations within climate finance, adaptation, and loss and damage discourse. Gender-responsive approaches were increasingly referenced in discussions on the Loss and Damage Fund, recognizing that climate-induced losses disproportionately affect women through unpaid care burdens, livelihood disruption, and displacement. However, critiques remain that gender language continues to be largely instrumental rather than transformative, with insufficient attention to structural inequalities, unpaid labour, and power relations shaping climate vulnerability.

1.2 Gender, Climate Change, and the Sustainable Development Goals

The 2030 Agenda for Sustainable Development, adopted in 2015, provides a unifying framework linking gender equality, climate action, and environmental sustainability. The agenda comprises 17 Sustainable Development Goals (SDGs) and 169 targets, integrating economic, social, and environmental dimensions to eradicate poverty, promote peace, and secure a resilient future (UNEP et al., 2020).

Gender equality and climate action emerge as cross-cutting priorities within the SDGs. SDG 5 (Gender Equality) recognizes women's rights, agency, and access to resources as central to sustainable development, while SDG 13 (Climate Action) calls for urgent action to combat climate change and its impacts. These goals are deeply interconnected with SDG 6 (Clean Water and Sanitation) and SDG 15 (Life on Land), which address natural resource governance, ecosystem integrity, and climate resilience.

Despite this integrated vision, global evidence suggests that gender-blind climate policies often exacerbate existing inequalities, while gender-responsive approaches enhance adaptation effectiveness, ecosystem stewardship, and community resilience. The SDGs thus provide not only a policy framework but also a normative mandate to embed gender justice at the core of climate action.

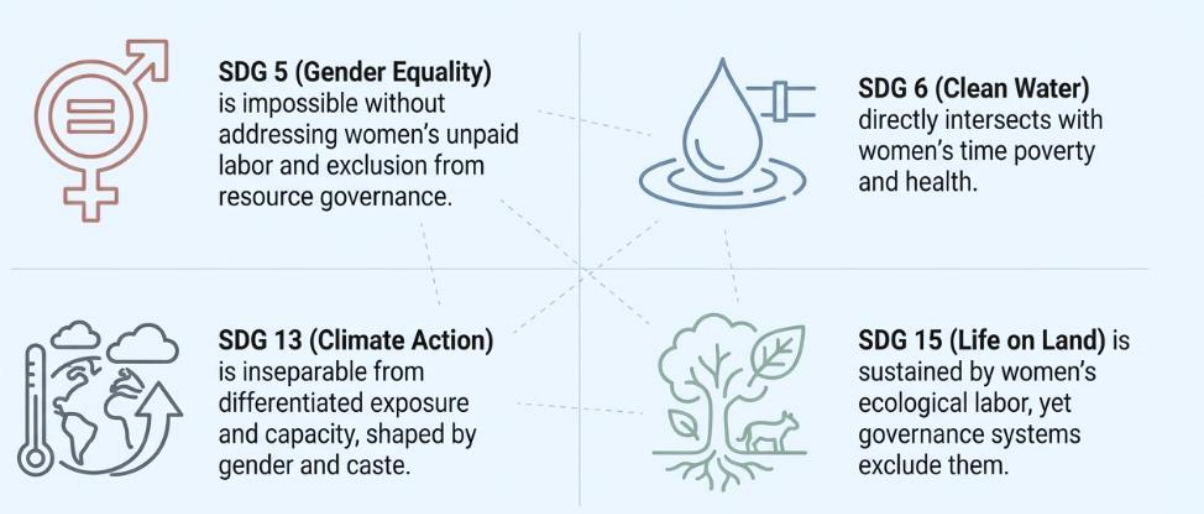


Table 1.1: Sustainable Development Goals and Key Targets Relevant to Gender, Climate Change, Water and Ecosystems

SDG	KEY TARGETS
GOAL 5: Achieve gender equality and empower all women and girls	**5.5** Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life. **5.A** Undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources, in accordance with national laws. **5.4** Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies, and the promotion of shared responsibility within the household and the family.
GOAL 6: Ensure availability and sustainable management of water and sanitation for all	**6.1** Achieve universal and equitable access to safe and affordable drinking water for all, with specific relevance to women and girls as primary water managers. **6.2** Achieve access to adequate and equitable sanitation and hygiene for all, paying special attention to the needs of women and girls and those in vulnerable situations. **6.B** Support and strengthen the participation of local

	communities in improving water and sanitation management, including women-led and community-based institutions.
GOAL 13: Take urgent action to combat climate change and its impacts	**13.1** Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries, with particular emphasis on socially and gender-differentiated vulnerabilities. **13.B** Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and vulnerable contexts, including a focus on women, youth, local and marginalized communities. **13.2** Integrate climate change measures into national policies, strategies and planning processes, including gender-responsive climate action frameworks.
GOAL 15: Protect, restore and promote sustainable use of terrestrial ecosystems	**15.1** Ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, particularly forests, wetlands and agricultural landscapes critical to rural livelihoods. **15.3** Combat desertification, restore degraded land and soil, including land affected by droughts, floods and climate variability, with implications for women's agrarian and care work. **15.9** Integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts, including indigenous and women's ecological knowledge systems.

Source: UNEP et al., 2020; UN DESA, 2021; UNFCCC, 2017.

1.3 Differentiated Impacts of Climate Change on Gender

Contemporary climate science and development research increasingly recognise that climate change impacts are **not socially neutral**, but are mediated by pre-existing inequalities related to gender, class, caste, ethnicity, age, disability, and spatial location. The **Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6)** explicitly reiterates that climate risks are **socially differentiated**, with gender norms, power relations, and institutional exclusions shaping exposure, sensitivity, and adaptive capacity (IPCC, 2022).

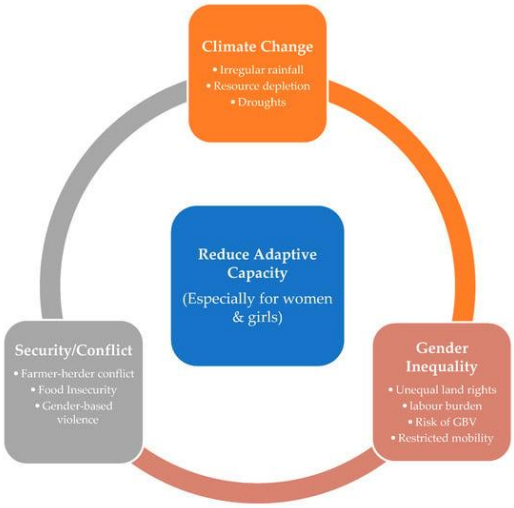


Fig 1.1: Gendered Impacts of Climate Change (Ishola et. al, 2025)

The IPCC emphasises that gender-differentiated impacts arise not only because of biological differences, but primarily due to **structural discrimination**, unequal access to resources, and gendered divisions of labour. It further recommends that **sex-disaggregated data collection, intersectional gender analysis, participatory planning, and gender-responsive budgeting** should be mainstreamed across all climate policies, programmes, and finance mechanisms to ensure just and effective climate action (IPCC, 2022). Integrating gender considerations is now recognised as essential across **adaptation, mitigation, capacity-building, technology transfer, and climate finance**, rather than being confined to social safeguards or vulnerability assessments.

1.3.1 Gender and Climate-Induced Disasters

Climate-related disasters—such as floods, cyclones, droughts, heatwaves, and wildfires—expose and intensify existing gender inequalities. Global evidence consistently shows that **women face higher mortality, morbidity, and long-term socio-economic losses during and after disasters**, particularly in contexts where gender norms restrict mobility, access to information, and decision-making power.

Empirical studies demonstrate that women are more likely to die in extreme climate events when early warning systems, evacuation protocols, and emergency responses fail to account for gendered constraints. For instance, research analysing disaster mortality across multiple countries found that women's death rates increase significantly in societies with higher levels of gender inequality, due to limited access to resources, social norms restricting movement, and caregiving responsibilities that delay evacuation (Neumayer & Plümper, 2007; UNDRR, 2022). Heatwaves also reveal stark gendered outcomes; elderly women living alone, particularly in low-income urban or rural settings, face heightened mortality due to social isolation, poverty, and inadequate access to cooling infrastructure.

Beyond immediate mortality, disasters produce **gender-specific secondary impacts**. Post-disaster contexts are associated with increased levels of **gender-based violence (GBV)**, psychological distress, and economic precarity among women and girls. Studies following

floods and cyclones in South Asia and Sub-Saharan Africa document spikes in domestic violence, early marriage, and trafficking, as households adopt harmful coping strategies under economic stress (UN Women, 2023). Women's caregiving burden also expands disproportionately, as they assume responsibility for injured family members, displaced households, and community recovery, often without recognition or compensation.

At the same time, climate disasters also generate **complex and sometimes contradictory gender dynamics**. Temporary shifts in household labour and income patterns—such as women entering paid work when male livelihoods are disrupted—can increase women's bargaining power in the short term. However, evidence suggests that these shifts frequently provoke backlash in strongly patriarchal contexts, exposing women to heightened risks of violence and social sanctioning (UNEP et al., 2020). These dynamics underscore the need for an **intersectional approach** that recognises gender not as a homogeneous category, but as intersecting with class, caste, ethnicity, and location.

1.3.2 Gender and Food Security under Climate Stress

Climate change poses a profound threat to global food systems, with **gendered implications for food security, nutrition, and livelihoods**. Women account for a substantial share of the agricultural labour force globally, yet continue to face systemic barriers in access to land, credit, inputs, technology, extension services, and markets. These inequalities directly shape differential vulnerability to climate-induced crop failure, price volatility, and livelihood loss.

Recent analyses by the **Food and Agriculture Organization (FAO)** reveal that women are significantly less likely than men to own or control agricultural land, despite their central role in food production. This lack of land tenure security restricts women's access to institutional credit, crop insurance, and climate adaptation programmes, increasing their vulnerability during droughts, floods, and pest outbreaks (FAO, 2022). Climate variability further intensifies women's unpaid labour, as declining agricultural productivity compels them to spend more time securing food, water, and supplementary income.

Evidence suggests that **closing gender gaps in agriculture could substantially improve food security outcomes**. FAO estimates indicate that if women farmers had equal access to productive resources, farm yields could increase by up to 30 percent, potentially reducing the number of food-insecure people by over 100 million globally (FAO, 2023). However, climate change threatens to reverse these gains by exacerbating structural inequalities unless adaptation strategies explicitly address gendered constraints.

Climate-induced food insecurity also has **intergenerational and nutritional consequences**. Women often reduce their own food intake during periods of scarcity to prioritise children and other household members, increasing risks of anaemia, malnutrition, and adverse maternal health outcomes. These patterns demonstrate how climate change operates through existing gender norms to produce **hidden hunger and chronic vulnerability** rather than only episodic crises.

1.3.3 Gender, Ecosystems, and Natural Resource Governance

Ecosystems such as forests, wetlands, rangelands, and coastal commons form the backbone of climate resilience for millions of rural and indigenous communities. Women's livelihoods are often closely tied to these ecosystems through activities such as fuelwood collection, water harvesting, fodder gathering, seed saving, and non-timber forest product (NTFP) collection. Climate change-induced ecosystem degradation therefore has **direct gendered impacts on livelihoods, health, and time poverty**.

Despite women's extensive ecological knowledge, they remain underrepresented in formal natural resource governance institutions. Studies show that exclusion of women from forest management committees, water user associations, and land governance bodies leads to poorer ecological outcomes and reduced community resilience (Agarwal, 2018; IPBES, 2022). Climate change further intensifies these governance gaps, as ecosystem stress increases competition over shrinking resources, often marginalising women and indigenous groups.

Conversely, evidence from community forestry and co-management regimes indicates that **women's leadership improves conservation outcomes**, enhances rule compliance, and strengthens adaptive capacity. Integrating women's traditional ecological knowledge into climate adaptation strategies is therefore increasingly recognised as both a justice imperative and a practical necessity (UNEP, 2023).

1.3.4 Gender, Health, and Climate Change

Climate change is increasingly recognised as a **public health crisis**, with gendered pathways of exposure and impact. Heat stress, air pollution, waterborne diseases, and climate-related malnutrition disproportionately affect women due to biological, social, and economic factors. Pregnant women, elderly women, and women engaged in physically demanding outdoor labour face heightened risks during heatwaves and extreme weather events (WHO, 2023).

Indoor air pollution from biomass cooking fuels continues to be a major health burden, particularly in low-income contexts. Women and girls, who spend longer hours near cooking areas, experience higher exposure to particulate matter, increasing risks of respiratory and cardiovascular diseases. Climate mitigation efforts promoting clean cooking technologies thus have **direct co-benefits for women's health**, yet adoption remains uneven due to affordability, cultural norms, and lack of gender-sensitive programme design.

Mental health impacts of climate change are also gendered. Women experience higher levels of anxiety, depression, and trauma following climate disasters, compounded by caregiving responsibilities and economic insecurity. These health dimensions are often overlooked in climate policy, reinforcing the invisibility of women's lived experiences.

1.3.5 Gender, Water, Sanitation, and Climate Change

Water insecurity is one of the most immediate and gendered consequences of climate change. Women and girls remain the primary collectors, managers, and users of household water in many regions, making them acutely sensitive to climate-induced water scarcity, flooding, and contamination. Climate variability increases the time and physical burden of water collection,

exacerbating **time poverty, musculoskeletal health issues, and safety risks** (UNICEF & WHO, 2022).

Sanitation systems are similarly affected by climate stress, with floods damaging toilets, contaminating water sources, and undermining hygiene practices. Inadequate sanitation disproportionately affects women's dignity, safety, and health, particularly during menstruation, pregnancy, and post-disaster displacement. Gender-blind water and sanitation infrastructure thus risks reinforcing vulnerability rather than reducing it.

1.3.6 Gender and Climate Change

While women and girls are often portrayed primarily as victims of climate change, growing evidence highlights their role as **agents of adaptation, resilience, and transformation**. Women-led initiatives in sustainable agriculture, water governance, ecosystem restoration, and disaster preparedness demonstrate that empowering women enhances climate outcomes for entire communities (UNFCCC, 2019; UN Women, 2023).

However, realising this potential requires moving beyond tokenistic inclusion towards **structural transformation**. Effective gender-responsive climate action demands coordinated interventions across sectors, improved data systems, meaningful participation, accountability mechanisms, and the redistribution of power and resources. Without addressing the underlying social relations that produce vulnerability, climate action risks reproducing the very inequalities it seeks to address.

1.4 Laws and Policies for Gender Resilience and Inclusivity

Building gender resilience to climate change requires more than the presence of isolated climate or gender policies. While the proliferation of gender-focused climate commitments over the past two decades marks significant progress, evidence is increasingly showing that **fragmented and siloed legal frameworks fail to address the structural drivers of vulnerability**. Gendered climate risks are deeply rooted in constitutional guarantees, property regimes, labour markets, natural resource governance, social protection systems, and legal responses to violence and discrimination. Without an integrated legal and policy framework, climate interventions risk reinforcing existing inequalities rather than addressing and transforming them.

Recent policy assessments highlight that gender-responsive climate governance must be integrated across all **legal domains**, rather than confined to environmental or disaster-specific instruments alone. This includes constitutional protections of equality and non-discrimination; laws governing land, inheritance, forests, water, fisheries, and housing; labour and workplace safety regulations; and national frameworks addressing violence against women and girls. An integrated approach ensures that climate resilience policies do not merely manage risk, but actively dismantle the institutional barriers that constrain women's adaptive capacity (ADB, 2023).

Internationally, a growing body of legal instruments now recognises that **gender equality is both a human rights obligation and a prerequisite for effective climate action**. These frameworks increasingly call for sex-disaggregated data, gender analysis, participatory governance, and accountability mechanisms to ensure that women are not only protected from climate impacts but are empowered as agents of change.

Key international legal and policy instruments shaping the gender–climate nexus include:

- **The Convention on the Elimination of All Forms of Discrimination against Women (CEDAW)**, particularly its interpretive guidance on disaster risk reduction and climate change.
- **The 2030 Agenda for Sustainable Development**, which mandates sex-disaggregated data and gender-responsive implementation across all goals, notably SDG 5, SDG 6, SDG 13, and SDG 15.
- **The United Nations Framework Convention on Climate Change (UNFCCC)** and the **Paris Agreement** increasingly incorporate gender equality through mechanisms such as the Gender Action Plan (GAP) and enhanced commitments to women's participation and leadership in climate governance.

1.4.1 Gender Dimensions within Disaster Risk Reduction Frameworks

The **Sendai Framework for Disaster Risk Reduction (2015–2030)** serves as a critical global instrument, linking disaster risk governance with social inclusion and gender equity. Unlike earlier disaster frameworks that focused predominantly on hazard management, the Sendai Framework explicitly recognises that risk is socially constructed, and that vulnerability is shaped by factors such as gender, age, disability, poverty, and marginalisation.

The framework calls for the systematic integration of **gender-responsive, age-sensitive, disability-inclusive, and culturally appropriate perspectives** across all disaster risk reduction policies and practices. It emphasises the promotion of women's leadership and meaningful participation, particularly among populations that are disproportionately affected by disasters, including the poorest and most socially excluded groups.

Sendai further highlights the need to strengthen **inclusive social protection systems**, livelihood security mechanisms, and access to basic services—such as health care, nutrition, housing, water, sanitation, and education—as integral components of disaster resilience. These provisions recognise that recovery and reconstruction phases often reproduce pre-existing inequalities unless deliberate corrective measures are embedded in policy design.

Importantly, the framework stresses that **women's leadership is central to effective disaster risk governance**, including preparedness, response, recovery, rehabilitation, and reconstruction. Capacity-building initiatives are therefore encouraged to support women's roles not only as beneficiaries of relief, but as planners, decision-makers, and leaders capable of shaping resilient livelihoods in post-disaster contexts (ADB, 2021).

However, despite these progressive principles, the Sendai Framework has been critiqued for its **limited operational guidance on gender mainstreaming**, particularly in relation to representation targets, accountability mechanisms, and outcome-based monitoring. The absence of robust sex-disaggregated data and systematic gender analysis continues to hinder the identification of differentiated needs and vulnerabilities among women, men, girls, and boys, limiting the transformative potential of disaster risk reduction policies.

1.4.2 CEDAW General Recommendation No. 37

CEDAW General Recommendation No. 37 provides a comprehensive normative framework linking climate change, disaster risk reduction, and environmental governance with women's human rights. Unlike sector-specific climate instruments, this recommendation adopts a **holistic national framework approach**, addressing not only climate and disaster laws but also gender equality legislation, political participation, labour rights, access to justice, social protection, health, housing, and freedom from violence.

The Recommendation underscores that women's vulnerability to climate change and disasters is not accidental but is produced through **systemic discrimination and unequal power relations**. It therefore calls on states to address both (a) baseline gender inequality and (b) its exacerbation under climate stress. Crucially, it advocates the use of **temporary special measures and affirmative action** to achieve substantive equality—defined not as equal treatment, but as **equal outcomes and results** for women and men.

CEDAW GR 37 also places strong emphasis on **data, monitoring, and accountability**, urging states to collect sex-disaggregated and intersectional data, conduct gender-responsive risk assessments, and evaluate the gendered impacts of climate and disaster policies. Without such mechanisms, gender equality commitments risk remaining rhetorical rather than transformative.

1.5 Mainstreaming Gender into Climate Action

Gender mainstreaming has emerged as a central strategy for translating commitments on gender equality into tangible outcomes within climate governance. According to **UN Women (2021)**, gender mainstreaming refers to the systematic integration of gender perspectives into the **design, implementation, monitoring, and evaluation of policies, programmes, and institutions**, so that gender equality becomes an integral part of all decision-making processes rather than an isolated objective. This approach aligns with the definition adopted by the **United Nations Economic and Social Council**, which emphasises that gender equality must be embedded across all sectors, levels, and stages of policymaking.

In the context of climate action, gender mainstreaming involves three interrelated dimensions. First, it requires **gender-balanced representation**, ensuring that women participate meaningfully in climate decision-making spaces, including policy formulation, planning bodies, technical committees, and implementation institutions. Second, it necessitates **gender-responsive policy content**, whereby climate strategies explicitly address gender-differentiated vulnerabilities, roles, and capacities rather than assuming a gender-

neutral population. Third, it depends on an **enabling institutional environment**, including organisational cultures, accountability mechanisms, data systems, and financial allocations that support gender equality in practice.

Taken together, these dimensions underscore that gender mainstreaming is not merely a procedural requirement, but a **transformative process** aimed at restructuring unequal social and institutional arrangements. In climate governance, this means challenging entrenched norms that marginalise women's knowledge, exclude them from resource governance, and disproportionately burden them with unpaid care and adaptation labour. Effective mainstreaming therefore requires recognising women not only as vulnerable groups, but as **knowledge holders, decision-makers, and agents of climate resilience**.

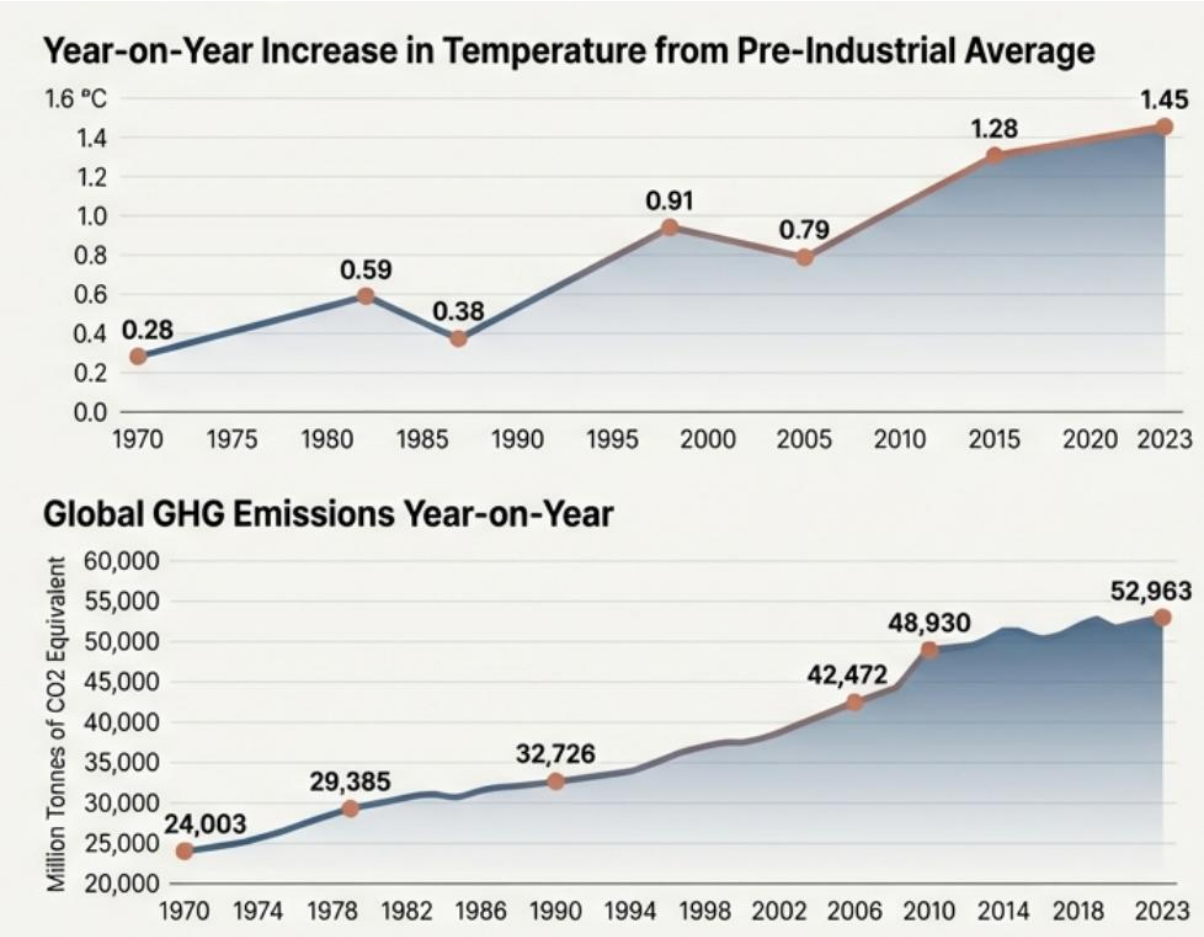
Despite increasing rhetorical commitment, global assessments indicate that progress in mainstreaming gender into climate action remains uneven. Many national climate policies reference gender equality in principle but fail to operationalise it through concrete targets, budgets, or monitoring frameworks. In particular, **adaptation and disaster risk reduction policies often emphasise women's vulnerability without addressing the structural drivers of that vulnerability**, such as land insecurity, labour market discrimination, or exclusion from governance institutions. As a result, gender considerations are frequently treated as add-ons rather than core elements of climate strategy.

In the Asia and Pacific region, several initiatives demonstrate early progress in integrating gender into climate and disaster frameworks, particularly through participatory planning, community-based adaptation, and women-led resilience initiatives. However, evaluations consistently show that mainstreaming efforts fall short of the expectations set by **CEDAW, the UNFCCC and Paris Agreement, and the Sendai Framework**, especially with respect to accountability, outcome measurement, and institutional transformation. These gaps highlight the need to move from **formal inclusion to substantive equality**, where gender mainstreaming actively reshapes power relations within climate governance systems.

2.
GENDER AND CLIMATE CHANGE: INDIAN OVERVIEW

2.1 CHANGING CLIMATE TRENDS IN INDIA

India's climate is demonstrably warming and becoming more variable, with significant implications for temperature extremes, the monsoon system, and the frequency and intensity of climate-related hazards. This overview synthesises **long-term observations**, **near-term research updates**, and **recent empirical evidence up to 2025**, situating India's changing climate within broader global and regional trends (Dhara et al., 2025).



2.1.1 Temperature Trends

India has warmed substantially over the past century, with a significant portion of this warming attributed to human-induced increases in greenhouse gas concentrations. According to the **Ministry of Earth Sciences (MoES)**, mean annual surface air temperature over India rose by **about 0.7 °C between 1901 and 2018**, with accelerated warming observed since the 1950s. Between 1986 and 2015, maximum daytime temperatures and minimum nighttime temperatures increased by approximately 0.63 °C and 0.4 °C, respectively, indicating both rising heat extremes and warmer nights. Projected warming by the end of the twenty-first century ranges from **2.4°C to 4.4°C** under high-emission scenarios relative to the **1976–2005 baseline**.

Recent research confirms the persistence and amplification of these trends. A **2025 update to post-AR6 observational analyses** indicates that India continues to experience significant

warming in both mean temperatures and extremes, consistent with CMIP6-based projections. These observed trends include an increase in heatwave frequency, longer warm seasons, and a decline in cold events in many regions.

Near-term evidence from 2025 meteorological monitoring indicates the early onset of heatwaves and above-normal temperatures across large parts of the country, with heat alerts issued by the India Meteorological Department (IMD) as early as April 2025, signaling an intensification of seasonal warming patterns.

Such warming is compounded in urban centers due to the urban heat island effect, where rapid urbanization and land–use change intensify localized heating. Cities in India are now warming faster than surrounding rural areas, contributing to more frequent extreme heat exposures in densely populated zones.

2.1.2 Monsoon Variability and Extremes

The Indian monsoon a key driver of India's hydrology, agriculture, and livelihood systems has exhibited complex responses to climate change. Historically, monsoon rainfall declined, with studies showing a reduction in summer monsoon precipitation over much of the country from **1951 to 2015**. This trend has been linked to the cooling influence of anthropogenic aerosols offsetting greenhouse gas-induced warming.

However, recent rainfall data indicate year-to-year variability and extremes are intensifying:

- **Southwest monsoon rainfall in 2024 was recorded at 108 % of the long-period average**, suggesting variability rather than a unidirectional decline in total rainfall.
- Climate research shows an increase in **short-duration, high-intensity rainfall events**, particularly over central India and parts of the west coast, increasing flash flood risks.
- Analyses of spatial rainfall patterns over recent decades indicate both increases and decreases in rainfall in different regions: over **55 % of districts** experienced increases in rainfall, while about **11 % experienced declines**, highlighting regional heterogeneity in monsoon responses.

Near-term projections indicate rising interannual **variability, heavier rainfall extremes, and increased dry spells** during the monsoon season under continued warming. These changes are expected to amplify climate risks for agriculture and water resources.

2.1.3 Heatwaves, Dry Spells, and Other Extremes

Heatwaves in India have become more frequent, intense, and longer in duration. Observational and modelling studies indicate an increase in **heatwave days, including both dry and oppressive heat events**, which pose serious health and livelihood risks, especially for vulnerable groups in rural and urban settings. Government meteorological data for 2025 reflect repeated warnings of **heatwave to severe heatwave conditions** across broad regions, underscoring the elevated risk profile for temperature extremes.

Projections indicate that the intensity and frequency of extreme heatwave days are likely to increase substantially by mid-century, posing a threat to public health, labour productivity, and water demand.

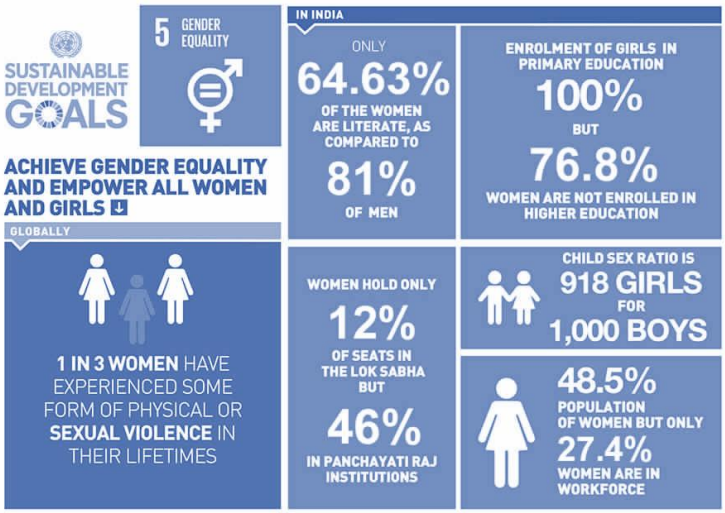
2.1.4 Implications of Climate Change for India

Recent assessments of climate risk place India among the most climate-vulnerable nations globally. The **Climate Risk Index 2026** ranks India within the top ten countries most affected by extreme weather events over the period **1995–2024**, with significant human and economic losses reported.

Other indicators of climate stress in 2025 include delayed monsoon onset, groundwater depletion, and agricultural impacts from compounded heat and rainfall extremes, reflecting emergent climate risks with direct implications for food, water, health, and livelihoods.

2.2 Policies and Laws in India

India's engagement with gender-responsive climate governance has evolved primarily through its participation in multilateral climate processes, complemented by selected national programmes that address gendered vulnerabilities indirectly. While the Government of India has formally endorsed global frameworks such as the UNFCCC Gender Action Plan, the translation of these commitments into **coherent domestic climate law, policy, and implementation mechanisms remains uneven**. Gender considerations in Indian climate governance are often embedded within sectoral development schemes rather than articulated as a standalone, cross-cutting climate justice agenda.



2.2.1 India's Position on Gender and Climate Change

The **Government of India** has expressed formal support for the **Gender Action Plan (GAP)** under the Lima Work Programme on Gender, adopted within the UNFCCC process through the Subsidiary Body for Implementation (SBI). India welcomed the GAP as an instrument to advance **women's full, equal, and meaningful participation**, promote gender-responsive

climate policy, and mainstream gender across mitigation, adaptation, finance, technology, and capacity-building under the Convention and the Paris Agreement (United Nations Framework Convention on Climate Change).

India has acknowledged the priority areas, timelines, responsible actors, and indicative resource requirements identified under the GAP, and has supported SBI-led calls for submissions focusing on:

- **Systematic integration of gender-sensitive and participatory education, training, public awareness, and access to information**, from national to local levels, across all mitigation and adaptation actions, including Nationally Determined Contributions (NDCs) and long-term low-emission development strategies.
- **Sex-disaggregated data and gender analysis**, particularly in relation to:
    - Differentiated climate impacts on women and men, with specific attention to indigenous peoples and local communities;
    - Integration of gender considerations into adaptation, mitigation, climate finance, technology transfer, capacity-building, and Action for Climate Empowerment (ACE);
    - Policies and progress related to gender balance in national climate delegations.

At the policy narrative level, India explicitly recognises that **women face higher climate risks**, especially in conditions of poverty, informal employment, and dependence on natural resources. The Government has repeatedly stated that women's participation and empowerment are mutually reinforcing and critical for effective climate action. However, this recognition has largely translated into **development-oriented gender schemes with climate co-benefits**, rather than climate policies explicitly designed through a gender lens.

One of the most frequently cited gender-sensitive interventions is the **Pradhan Mantri Ujjwala Yojana (PMUY)**, which aims to reduce women's exposure to indoor air pollution by providing Liquefied Petroleum Gas (LPG) connections to households below the poverty line. The scheme is explicitly gendered, as connections are issued in the name of women, and it has significant co-benefits in terms of climate, health, and time poverty. By 2024, the scheme had expanded well beyond its initial targets, contributing to reductions in biomass dependence and associated health burdens among rural women. However, recent evaluations highlight challenges related to the **affordability of refills**, sustained usage, and energy transition pathways, indicating that access to clean energy alone does not automatically translate into long-term resilience.

India has also incorporated gender considerations into its evolving REDD+ (Reducing Emissions from Deforestation and Forest Degradation) strategy, emphasizing community participation and the compulsory representation of women. Nevertheless, scholars and civil society assessments note that **women's roles in forest governance remain largely instrumental**, with

limited decision-making power over benefit sharing, land tenure, or carbon finance mechanisms.

Overall, India's official stance reflects **normative alignment with global gender–climate frameworks**, but with **limited institutionalisation of gender mainstreaming within domestic climate governance structures**. Gender remains more visible in social sector programmes than in core climate planning instruments such as NDCs, climate finance frameworks, or sectoral mitigation strategies.

2.2.2 Gender and Climate Adaptation in India

Empirical research consistently shows that gender is acknowledged in India's climate adaptation discourse but **weakly operationalised in practice**. Of the twenty-eight SAPCCs reviewed, **nearly half did not meaningfully acknowledge gender**, while others referenced gender primarily as a marker of vulnerability rather than as a source of agency. In many cases, gender inclusion was reduced to **women's increased work burdens**, such as longer hours spent collecting water, fuelwood, or fodder under climate stress. While these indicators capture important dimensions of vulnerability, they fail to address **structural drivers**, including land ownership, labour markets, institutional access, and decision-making power.

Only a small number of states most notably **Kerala, Uttarakhand, and Tripura** demonstrated a more nuanced understanding of gender by recognising women's ecological knowledge, community leadership, and adaptive strategies. Even fewer states such as **Bihar, Chhattisgarh, Gujarat, and Uttarakhand** explicitly framed women as **agents of climate adaptation**, capable of shaping local responses through collective action, governance participation, and livelihood innovation.

More recent assessments (2022–2025) suggest that while SAPCC revisions have improved alignment with climate science and sectoral priorities, **gender integration remains inconsistent and largely symbolic**. Gender is often confined to cross-cutting sections without corresponding budgetary allocations, monitoring indicators, or institutional responsibility. As a result, adaptation interventions risk reinforcing women's unpaid labour and caregiving roles rather than enhancing their adaptive capacity or agency.

A critical limitation identified in recent literature is the **absence of intersectional analysis**. Most SAPCCs treat women as a homogeneous group, overlooking how caste, tribe, class, landlessness, disability, age, and spatial marginalisation shape differentiated climate vulnerability. This gap is particularly significant in tribal, forest-dependent, and agrarian regions, where women's adaptation strategies are closely tied to access to land, commons, and informal institutions.

Furthermore, climate adaptation in India continues to be dominated by **technocratic and sector-driven approaches**, with limited engagement with gendered power relations at household and community levels. Without institutional mechanisms to ensure women's

participation in planning, implementation, and monitoring, adaptation initiatives risk remaining **gender-aware but not gender-transformative**.

2.3 Gendered Impacts of Climate Change in India

India's climate impacts are increasingly shaped by the interaction between **biophysical stressors** such as rising temperatures, erratic monsoons, droughts, floods, and extreme events and **deep-rooted social inequalities**. While climate risks affect all populations, their impacts are **unevenly distributed along lines of gender, caste, class, land ownership, livelihood type, age, and location**. Women, particularly those from marginalized socio-economic groups, face **disproportionately higher exposure, sensitivity, and lower adaptive capacity**, making climate change a significant driver of gendered vulnerability in India.

National and sub-national studies consistently demonstrate that climate change exacerbates pre-existing gender inequalities by intensifying unpaid care work, reducing livelihood security, worsening health outcomes, constraining mobility, and weakening women's access to natural resources and institutions. The following sections outline key domains through which gendered climate impacts manifest in India.

2.3.1 Livelihoods

Livelihood systems in India, particularly agriculture, fisheries, forest-based livelihoods, and informal labour, are highly climate-sensitive and deeply gendered. Women constitute a substantial proportion of the agricultural workforce and are increasingly **farmers**, especially in rain-fed and drought-prone regions. However, their contributions remain structurally undervalued due to limited land ownership, insecure tenure, poor access to institutional credit, crop insurance, extension services, and climate finance.

Climate stressors such as delayed monsoons, crop failures, pest outbreaks, and declining soil moisture disproportionately increase women's workload. Women are often responsible for seed preservation, fodder collection, livestock care, post-harvest processing, and household food security, all of which become more labour-intensive under climate variability. In periods of drought or flood, women commonly adopt **erosive coping strategies**, including reducing their own food intake, engaging in distress labour, selling productive assets, or taking high-risk informal work.

Research across drought-affected regions of Odisha, Maharashtra, Telangana, and Rajasthan shows that women are often the **first to absorb livelihood shocks**, experiencing declining nutrition, chronic fatigue, and health deterioration. Women farmers and agricultural labourers are also less likely to receive compensation during crop loss events due to land titles being held by male relatives, reinforcing economic insecurity. Widows of farmers affected by climate-induced agrarian distress frequently inherit debt without inheriting land, further entrenching vulnerability.

Despite these constraints, evidence also highlights women's adaptive strategies, including crop diversification, kitchen gardens, livestock rearing, and community-based savings groups. However, these adaptive actions often occur **without institutional support**, placing the burden of resilience disproportionately on women's unpaid labour.

2.3.2 Migration

Climate change is an increasingly significant driver of **both distress migration and livelihood-seeking migration** in India. Floods, droughts, coastal erosion, declining agricultural returns, and ecosystem degradation have accelerated rural-to-urban and rural-to-rural migration, with distinctly gendered patterns.

Male out-migration from climate-stressed regions is widespread, particularly from rain-fed agrarian zones, coastal districts, and mountainous areas. While migration can function as an adaptation strategy through remittances, it frequently results in the **feminisation of responsibility** rather than empowerment. Women left behind assume responsibility for agriculture, household management, care work, debt repayment, and interaction with state institutions often without commensurate rights or resources.

Women's migration pathways are more constrained due to social norms, safety concerns, caregiving responsibilities, and limited access to social networks. When women do migrate, they are more likely to enter **low-paid, informal, and precarious employment**, such as construction, domestic work, brick kilns, sugarcane cutting, and informal manufacturing. These jobs often lack legal protection, expose women to occupational hazards, and increase vulnerability to exploitation and violence.

Studies from Maharashtra, Bihar, Odisha, and West Bengal document extreme coping strategies among migrant women, including hazardous labour practices, health-compromising decisions, and separation from children. Climate-induced displacement also disrupts social networks and informal safety nets, increasing women's exposure to trafficking, early marriage, and gender-based violence, particularly in post-disaster contexts.

Thus, while migration is frequently framed as an adaptive response, for many women it represents a **forced, gendered survival strategy** rather than a pathway to resilience.

2.3.3 Health

Climate change poses significant risks to physical and mental health in India, with **gender-differentiated pathways of impact**. Rising temperatures, heatwaves, water scarcity, floods, and changing disease ecologies disproportionately affect women due to biological factors, nutritional status, occupational exposure, and caregiving roles.

Heat stress has emerged as a major public health concern, particularly for women engaged in outdoor agricultural labour, informal work, and domestic tasks in poorly ventilated housing. Evidence from urban and rural heatwave studies indicates higher mortality and morbidity among women, especially elderly women, pregnant women, and those with pre-existing health conditions. Climate stress also increases risks for newborns and maternal health, particularly in regions with limited healthcare access.

Nutritional insecurity linked to climate variability further exacerbates health risks. In food-insecure households, women and girls are often the first to reduce food intake, leading to high levels of anaemia, malnutrition, and weakened immunity. Climate-related disruptions to agriculture, fisheries, and forest foods disproportionately affect women's dietary diversity and nutritional outcomes.

Mental health impacts remain under-recognised but are increasingly documented. Women affected by floods, cyclones, droughts, and displacement report elevated levels of anxiety, depression, trauma, and psychosocial stress, compounded by increased care burdens and exposure to domestic violence. Post-disaster relief systems often fail to address women's specific health needs, including reproductive health, menstrual hygiene, and mental health support.

2.3.4 Water and Sanitation

Water insecurity is one of the most immediate and gendered impacts of climate change in India. Women and girls are the primary collectors, managers, and users of household water in both rural and peri-urban settings. Climate-induced changes in rainfall patterns, groundwater depletion, and contamination of water sources significantly increase the **time, physical effort, and health risks** associated with water collection.

In drought-prone regions, women spend several additional hours daily fetching water from distant or unsafe sources, often at the cost of education, income-generating work, and rest. Studies indicate that women may spend **months each year solely on water collection**, a burden that has intensified over time due to declining water availability.

Floods and extreme rainfall events disrupt sanitation infrastructure, contaminate drinking water, and increase exposure to waterborne diseases. Women face heightened risks due to inadequate sanitation facilities, lack of privacy, and cultural taboos surrounding menstruation. Relief camps and temporary shelters frequently lack gender-responsive sanitation, compromising women's dignity, safety, and health.

Water stress also reinforces gender-based inequalities within households and communities, as women bear the primary responsibility for ensuring water security without decision-making authority over water governance or infrastructure investments.

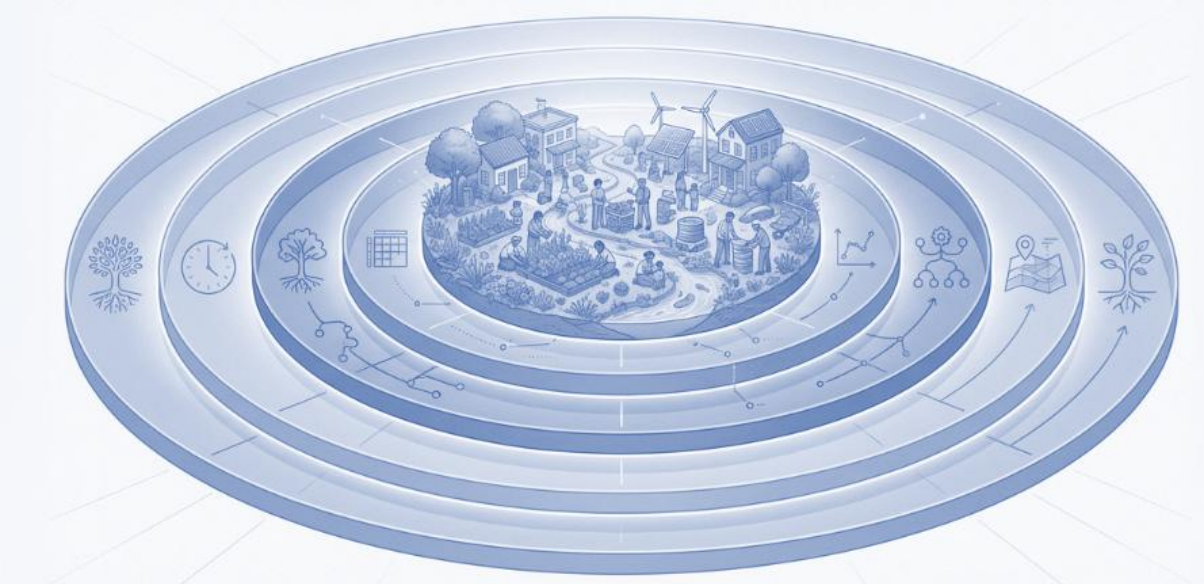
2.3.5 Ecosystems and Natural Resource Dependence

India's ecosystems forests, wetlands, rivers, coastal zones, and commons are central to rural livelihoods and climate resilience, particularly for women. Women's everyday work is closely tied to ecosystem services through fuelwood collection, fodder gathering, non-timber forest products, fisheries, and subsistence agriculture. Climate-induced ecosystem degradation, therefore, has **direct gendered impacts on livelihoods, health, and time poverty**.

Deforestation, declining forest productivity, invasive species, and changing rainfall patterns increase the distance women must travel to access natural resources, heightening physical strain and safety risks. Despite their extensive ecological knowledge, women are often excluded from formal natural resource governance institutions, limiting their ability to influence adaptation strategies and benefit-sharing mechanisms.

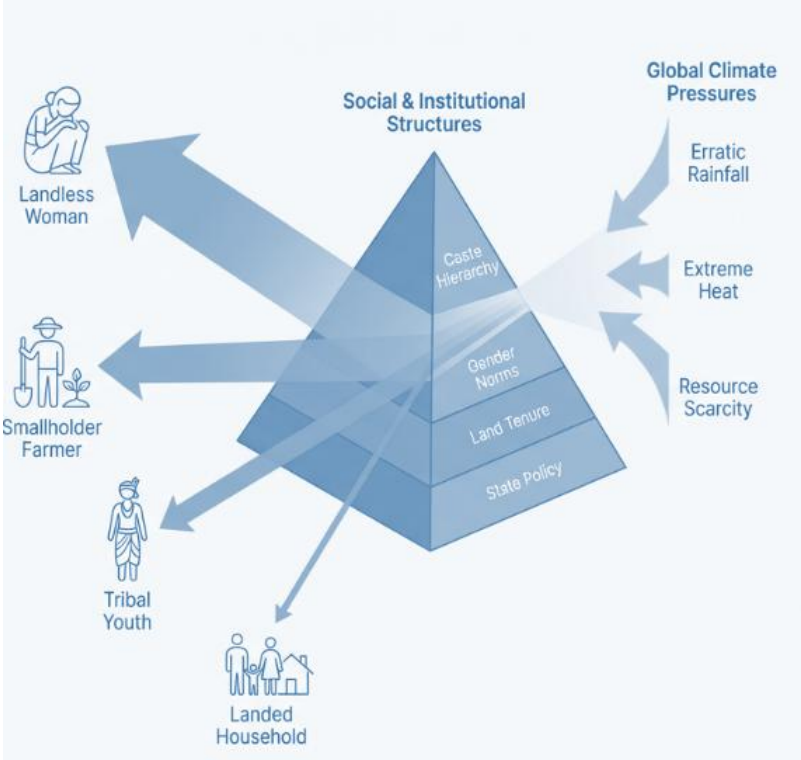
Evidence from community forestry and watershed management initiatives shows that women's participation improves ecological outcomes and collective resilience. However, climate change intensifies competition over scarce resources, often marginalising women further unless governance structures are explicitly gender-inclusive.

3. METHODOLOGY AND THEOROTICAL FRAMEWORKS USED IN THE STUDY



*This chapter outlines the methodological and theoretical foundations of the pilot scoping study undertaken to assess **gendered climate vulnerability** in Roha and Sudhagad. As a scoping exercise, the study is explicitly exploratory and diagnostic in nature. It does not aim to produce exhaustive vulnerability indices or predictive models; rather, its purpose is to **map vulnerability pathways**, identify **structural drivers of risk**, and test the relevance and adequacy of gender-responsive analytical frameworks in real-world rural contexts. The chapter, therefore, explains how the study was designed, why particular methods and frameworks were chosen, and what kind of knowledge this approach is intended to generate.*

*Conventional climate vulnerability assessments in India have largely relied on technocratic approaches that prioritise biophysical exposure, infrastructure deficits, or sectoral impacts. While such approaches are useful, they often obscure the social relations through which climate risks are experienced, negotiated, and reproduced. Gender, caste, age, and livelihood status tend to appear as secondary variables rather than as **constitutive elements of vulnerability itself**. This scoping study responds to this limitation by adopting a **qualitative, people-centred, and justice-oriented methodology**, grounded in participatory inquiry and feminist political ecology.*



*The study is framed around the understanding that climate vulnerability is **socially produced**. Climatic hazards such as erratic rainfall, floods, droughts, or heat stress do not affect all people equally; their impacts are mediated through historically embedded inequalities in land ownership, labour relations, governance structures, and access to resources. Women, Scheduled Caste (SC) and Scheduled Tribe (ST) communities, widows, elderly persons, and*

landless households are not inherently vulnerable; rather, they are made vulnerable through institutional arrangements and social norms that systematically exclude them from decision-making, assets, and recognition. Capturing these dynamics requires methods that go beyond household surveys or secondary data analysis.

Accordingly, this scoping study adopts ***Participatory Rural Appraisal (PRA)*** *and allied qualitative tools as its primary methodological approach. PRA tools enable communities to articulate their own perceptions of change, risk, and coping, while also revealing power relations within and between social groups. They are particularly suited for gender analysis because they make visible unpaid labour, everyday practices, seasonal stress cycles, and informal institutions that are often invisible in official data. The emphasis on participation does not imply an uncritical acceptance of all local narratives; rather, it allows for a grounded analysis of how vulnerability is experienced differently across gender, caste, and life stages.*

The methodological design is also shaped by the fact that this is a ***pilot scoping study****, intended to inform future, larger-scale assessments and action planning. As such, the study prioritises* ***breadth of insight over statistical representativeness****. It seeks to identify key vulnerability domains, test analytical frameworks, and generate hypotheses that can guide subsequent interventions, policy design, and funding proposals. The selection of Roha and Sudhagad as study areas reflects this logic: both represent ecologically sensitive, socially stratified rural contexts, yet differ in terrain, forest dependence, and livelihood systems, allowing for comparative learning.*

The chapter further situates the methodology within a set of ***interlinked theoretical frameworks****. These include feminist and justice-based approaches to climate vulnerability, Nancy Fraser's triadic justice framework (redistribution, recognition, representation), and three established gender analysis frameworks the Gendered Division of Labour framework, the Harvard Framework of Access, Control, and Benefits, and Moser's Triple Role framework. These are synthesised into an* ***Integrated Gendered Vulnerability and Agency Framework****, which is explicitly aligned with SDG 5 (Gender Equality), SDG 6 (Clean Water and Sanitation), SDG 13 (Climate Action), and SDG 15 (Life on Land). The methodological choices and analytical lenses are therefore mutually reinforcing: participation grounds theory, and theory structures interpretation.*

3.1 Research Questions

This pilot scoping study is guided by the following research questions, designed to capture the **gendered, social, and institutional dimensions of climate vulnerability** in Roha and Sudhagad.

- **How are climate-related stresses and environmental changes experienced differently by women and men across caste, tribal status, age, and livelihood groups in Roha and Sudhagad?**
- **How do existing gendered divisions of labour, unpaid care responsibilities, and livelihood roles shape vulnerability and adaptive capacity under climate stress?**
- **What patterns of access, control, and benefit-sharing over land, water, forests, and climate-related schemes influence gendered vulnerability in the study areas?**
- **How do local governance structures, informal institutions, and policy implementation practices mediate climate vulnerability and adaptation outcomes?**
- **What forms of agency, knowledge, and collective action currently exist among women and marginalized groups, and how can these be strengthened to support gender-just climate adaptation?**

3.2 Study Area

This pilot scoping study is situated in **Raigad district of Maharashtra**, focusing on two ecologically and socio-economically distinct but climatically vulnerable talukas: **Roha** and **Sudhagad**. The selection of these two locations is intentional, enabling a comparative understanding of gendered climate vulnerability across **coastal–industrial–agrarian** and **hilly–forest–tribal** landscapes within the same district and governance context.

Raigad District

Raigad district lies in the **Konkan region**, characterised by high monsoonal rainfall, complex topography, rich forest ecosystems, and rapid socio-economic transitions driven by industrialisation, urban proximity, and infrastructure expansion. The district is highly exposed to climate variability, including erratic monsoons, intense rainfall events, flooding, landslides, drought-like summer water scarcity, and ecosystem degradation. These climatic stresses interact with entrenched **gender, caste, and tribal inequalities**, producing differentiated vulnerability outcomes.

1. Roha Taluka

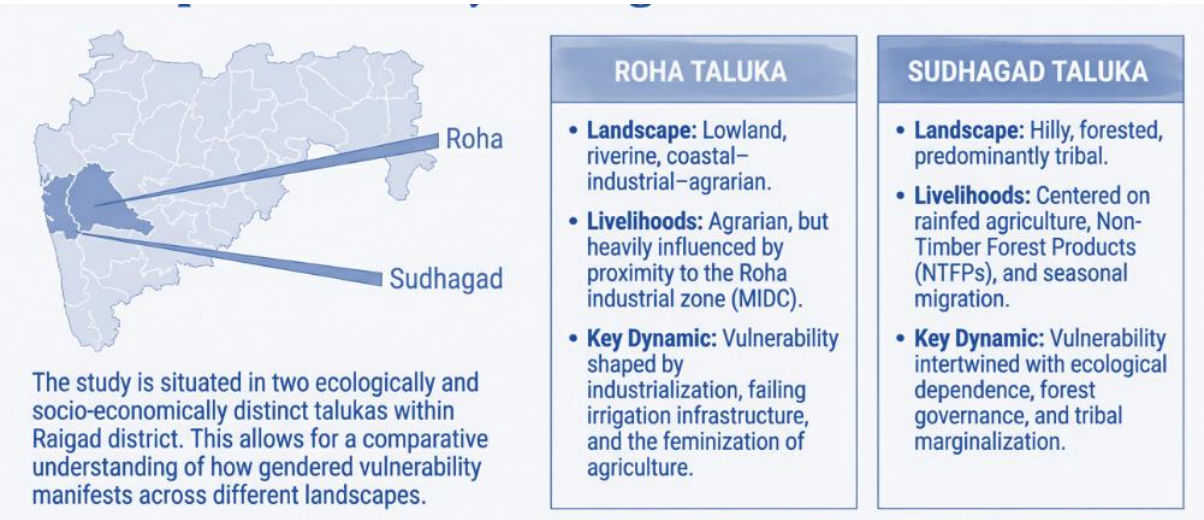
Roha taluka represents a **lowland, riverine, and industrial-adjacent landscape**, located along the Kundalika River basin. The study villages **Pale Budruk, Pale Khurd, and Sambhe** are primarily agrarian but deeply influenced by proximity to the **Roha Maharashtra Industrial Development Corporation (MIDC)** and transport corridors connecting Mumbai–Goa.

Roha receives **2000–2500 mm of annual rainfall**, but rainfall has become increasingly erratic, with delayed onset, prolonged monsoon duration, and high-intensity precipitation events. The Kundalika River and its canal system historically supported multi-season agriculture, but

prolonged infrastructure neglect has rendered irrigation systems largely non-functional. Seasonal springs and groundwater sources are drying earlier each year, creating acute summer water stress.

Agriculture remains the backbone of livelihoods, dominated by paddy cultivation, millets, pulses, and vegetables. However, declining irrigation, rising input costs, pest outbreaks, and labour shortages have reduced agricultural viability. Male out-migration to industrial and urban centres has increased, leading to a feminisation of agricultural and household responsibilities. Social composition includes OBC landholding communities, Scheduled Caste wage labour households, and Scheduled Tribe populations living in forest-adjacent hamlets.

Women in Roha bear primary responsibility for agriculture, water management, fuel collection, and care work, yet have limited control over land, water governance, and climate-related schemes. Industrial employment has created gendered labour segmentation, with men accessing higher-paid formal work and women confined to informal, low-paid roles. Roha thus illustrates how **industrialisation does not automatically reduce gendered climate vulnerability**, and may in fact intensify it.



2. Sudhagad Taluka

Sudhagad taluka represents a **predominantly hilly, forested, and tribal-dominated region** located in the Sahyadri foothills. The area is characterised by dispersed settlements, steep terrain, dense forest cover, and limited infrastructure connectivity. The study villages in Sudhagad (as detailed in the Sudhagad field reports) are largely dependent on agriculture, forests, and seasonal migration.

Sudhagad receives high rainfall but experiences pronounced **spatial and temporal variability**. Steep slopes and shallow soils make the area highly susceptible to soil erosion, landslides, and runoff during heavy rains, while summer months are marked by severe water scarcity as springs dry up early. Forest ecosystems are under pressure from invasive species, degradation, and restrictive governance regimes.

The population is predominantly **Scheduled Tribe**, with livelihoods centred on rainfed agriculture, Non-Timber Forest Products (NTFPs), livestock, and wage labour. Landholdings are small and often insecure despite Forest Rights Act provisions. Seasonal and distress migration is common, particularly among men, leaving women, children, and the elderly to manage farms, forests, and households under increasingly difficult climatic conditions.

Women in Sudhagad play a central role in forest-based livelihoods, water collection, and subsistence agriculture. However, they face severe mobility constraints, limited access to markets and services, low literacy, and exclusion from forest and water governance institutions. Traditional ecological knowledge remains strong but is systematically marginalised by formal institutions. Sudhagad thus represents a context where **climate vulnerability is deeply intertwined with ecological dependence and tribal marginalisation**.

3.3 Stakeholders Interviewed

Table 3.1: Stakeholders Interviewed in Roha Taluka

Stakeholder Category	Specific Stakeholders Interviewed	Role in Local System	Key Insights Generated for the Study
Tribal Women (Katkari)	Elderly women, middle-aged collectors of fuelwood and NTFPs	Primary forest users, caregivers, subsistence managers	Reported declining availability of fuelwood, wild foods, and medicinal plants; increased walking distance and time burden; limited awareness and control over Forest Rights Act entitlements despite formal titles
Tribal Men (Katkari)	Wage labourers, seasonal migrants	Wage earners, forest labourers, FRA claimants	Highlighted erosion of forest-based livelihoods, reliance on migration, degraded quality of

			FRA land, and inability to cultivate due to water scarcity
Scheduled Caste Women	Agricultural labourers, widows	Wage labourers, household managers	Described spatial marginalisation of SC hamlets, irregular employment, wage discrimination, and exclusion from water and sanitation decision-making
Small and Marginal Farmers (OBC)	Kunbi and Agri cultivators	Crop producers, landholders	Identified collapse of canal irrigation, shift to rainfed agriculture, increased crop loss from erratic rainfall and pests, rising input costs
Women Farmers	Women managing farms due to male migration	De facto farm managers	Reported responsibility without authority: managing fields but lacking control over crop decisions, insurance, or compensation
ASHA Workers	Accredited Social Health Activists	Frontline health intermediaries	Noted rise in anaemia, waterborne diseases post-monsoon, increased care burden on women, and difficulty accessing elderly healthcare
Anganwadi Workers	ICDS functionaries	Child nutrition and maternal care	Observed malnutrition in poorest households, seasonal attendance fluctuations, and sanitation-linked health issues
Self-Help Group Members	Women SHG leaders and members	Financial collectivisation actors	Shared experiences of credit access, loan diversion for consumption, limited market access, and dependence on male family members for banking
Gram Panchayat Members	Elected representatives (mostly men)	Local governance	Focused on infrastructure gaps (water, roads), but limited recognition of women's unpaid labour and gendered impacts

Village Water Committee Members	Male-dominated committee members	Water governance	Discussed supply schedules and infrastructure issues; women's experiential knowledge largely absent from decision processes
Elderly Men and Women	Pension recipients, dependents	Knowledge holders, dependents	Highlighted pension delays, mobility constraints, health neglect, and reliance on women caregivers
Government Officials	Extension officers, Tribal officer, Forest officers, Agricultural officer	Extension and community development	Officials recognise increasing climate variability, erratic monsoons, pest outbreaks, groundwater stress, and declining farm reliability. Services are routed through male landholders; women farmers, tenants, and landless households are largely excluded. Titles issued, but plots are often marginal; weak livelihood outcomes due to poor convergence and follow-up. Women are identified as primary users, but their ecological knowledge is not integrated; participation remains consultative.

Table 3.2: Stakeholders Interviewed in Sudhagad

Stakeholder Category	Specific Stakeholders Interviewed	Role in Local System	Key Insights Generated for the Study
Katkari Tribal Women	Women from Katkari wadis (Aptavane Adivasiwadi, Bhavshet Thakurwadi, Vargawne)	Forest-dependent livelihood managers, caregivers	Reported heavy dependence on forests for fuelwood and subsistence; criminalisation of traditional collection practices; long distances to water and services; limited institutional voice

Thakur Adivasi Women	Women cultivators and SHG participants	Small farmers, community organisers	Shared experiences of combining agriculture, livestock, and SHG work; noted uneven access to schemes despite proximity to GP offices
Tribal Men	Wage labourers, trained masons	Skilled and unskilled workers	Highlighted shift from forest and agricultural labour to masonry and construction through skill training; seasonal migration remains common
Village Development Committee Members	Male and female members (Bhavshet Thakurwadi)	Local planning and governance	Described participatory planning processes, crisis response during floods, and community-led infrastructure management
Gram Panchayat Representatives	Sarpanch, ward members (Aptavane)	Administrative governance	Emphasised scheme implementation and infrastructure delivery; acknowledged uneven reach to remote wadis
ASHA Workers	Health workers covering multiple wadis	Health outreach	Identified high burden of maternal anaemia, childcare gaps in hamlets without Anganwadis, and access challenges during monsoon
Anganwadi Workers	ICDS staff (where present)	Childcare and nutrition	Reported service gaps in hamlets lacking centres; dependence on women's unpaid care work
Teachers	Primary school teachers	Education providers	Noted dropout beyond primary level due to distance, terrain, and household labour demands

Elderly Tribal Women	Widows, pension recipients	Dependents, knowledge holders	Highlighted pension irregularities, food insecurity, immobility, and dependence on family support
Youth (Male and Female)	Students, unemployed youth	Aspirants, future labour force	Expressed aspirations for education and stable jobs; cited lack of access to training, connectivity, and resources
Forest Department Interface (Indirect)	Through community accounts	Regulatory authority	Communities reported exclusion from decision-making, fear of fines, and lack of recognition of traditional ecological knowledge

3.4 Theoretical Anchors of the Study

Table 3.3: Social, Political, and Justice Theories Framing Gendered Climate Vulnerability

Theoretical Framework	Core Argument of the Theory	Relevance to Gendered Climate Vulnerability
Marxist Political Economy	Society is structured by relations of production, where control over means of production determines power, class, and surplus extraction. Labour is unevenly valued, with unpaid and reproductive labour rendered invisible.	Women's unpaid reproductive labour (water collection, care work, subsistence agriculture) subsidises both household survival and ecological reproduction, yet remains unrecognised in climate policy. Climate shocks intensify labour extraction without redistribution of assets.
Neoliberalism	Prioritises markets, privatisation, individual responsibility, and reduced state intervention. Social risks are transferred from institutions to individuals and households.	Climate adaptation is framed as individual "resilience" rather than structural justice. Women absorb risks through unpaid care, debt, and self-help mechanisms, while public infrastructure (water, irrigation, forests) deteriorates.

Foucault (Governmentality)	Power operates through institutions, knowledge systems, and everyday practices that shape compliant subjects rather than through coercion alone.	Climate and development programs produce "responsible women beneficiaries" who manage scarcity but lack decision-making power. Gender inclusion becomes procedural rather than transformative.
Gramsci (Hegemony)	Dominant groups maintain power through consent, cultural norms, and common sense rather than force. Inequality becomes normalised.	Women's sacrifice, unpaid care, and ecological labour are culturally naturalised as duty. Climate vulnerability is framed as fate rather than injustice, limiting resistance and collective action.
Partha Chatterjee (Political Society)	Marginalised groups negotiate survival through informal, ad hoc engagement with the state rather than formal citizenship rights.	SC/ST women access water, land, relief, and forest resources through informal negotiations rather than entitlements. Climate vulnerability is managed politically, not institutionally.
Nancy Fraser – 3Rs of Justice	Justice requires **Redistribution** (material resources), **Recognition** (social value), and **Representation** (political voice).	Climate vulnerability persists because women lack assets (land, water), their labour and knowledge are devalued, and they are excluded from governance institutions shaping adaptation.

Table 3.4: Gender Analysis Frameworks for Integrated Climate and SDG Assessment

Gender Framework	What the Framework States	How it Captures Gendered Climate Vulnerability
Harvard Framework (Access, Control, Benefits)	Distinguishes between who *uses* resources and who *controls* them, and who ultimately *benefits*.	Women access land, water, forests, and schemes through labour and use, but lack ownership and decision power. Climate shocks therefore translate into loss without compensation.
Moser Framework (Triple Role)	Women perform **productive**, **reproductive**, and **community management** roles simultaneously.	Climate change intensifies all three roles at once more farm labour, more care work, more community crisis response creating cumulative time poverty and health decline.
Naila Kabeer – Social Relations Framework	Gender inequality is produced through institutions (household, community, market, state) and assessed via **resources, agency, and achievements**.	Climate vulnerability reflects institutional exclusion: women lack agency in land, water, forest, and climate governance despite being central actors in survival and adaptation.
Integrated Gendered Vulnerability & Agency Framework (IGVAF)	Synthesises Harvard, Moser, and Kabeer with spatial, temporal, and ecological analysis.	Shows how gendered labour, asset control, and institutional exclusion interact with climate variability and ecosystem degradation to produce cumulative vulnerability.

3.5 Sustainable Development Goals considered for the Study

Table 3.5: SDG 5: Achieve Gender Equality and Empower All Women and Girls

Target	Sub-Indicator	What the Target Seeks to Achieve	Interpretation
5.1	5.1.1	Eliminate discrimination against women in laws,	Climate and land laws may be formally gender-neutral but operate through male land titles, excluding women from climate

		policies, and institutions	finance, insurance, and compensation. Discrimination is institutional, not explicit.
5.2	5.2.1 / 5.2.2	Eliminate violence against women in public and private spheres	Climate stress increases domestic violence, early marriage, and harassment during water/fuel collection. Violence is a climate-induced social outcome, not a separate issue.
5.4	5.4.1	Recognize and value unpaid care and domestic work	Water scarcity, health crises, and ecosystem degradation expand women's unpaid labour. Climate adaptation relies on this labour but does not compensate or reduce it.
5.5	5.5.1 / 5.5.2	Ensure women's participation and leadership in decision-making	Women are present in Panchayats and committees but lack real power. Climate decisions are made without women's experiential knowledge.
5.a	5.a.1 / 5.a.2	Secure women's equal rights to land and productive resources	Without land titles, women cannot access irrigation, credit, insurance, or disaster compensation, directly undermining adaptive capacity.
5.c	5.c.1	Adopt policies and budgets for gender equality	Climate and water budgets rarely include gender-responsive allocations. Gender mainstreaming remains procedural, not transformative.

Table 3.6 - SDG 6: Ensure Availability and Sustainable Management of Water and Sanitation for All

Target	Sub-Indicator	What the Target Seeks to Achieve	Gendered Climate-Relevant Interpretation
6.1	6.1.1	Universal access to safe and affordable drinking water	Intermittent supply under Jal Jeevan Mission increases women's time poverty and exposure to unsafe sources during climate extremes.
6.2	6.2.1	Access to adequate sanitation and hygiene	Toilets without water are unusable. Women's dignity, menstrual health, and

			safety are compromised during floods and droughts.
6.3	6.3.1 / 6.3.2	Improve water quality and wastewater treatment	Flooding and runoff increase contamination. Women bear care burdens for waterborne diseases caused by ecosystem degradation.
6.4	6.4.1 / 6.4.2	Increase water-use efficiency and reduce scarcity	Efficiency gains often benefit agriculture and industry, not household water users primarily women.
6.5	6.5.1 / 6.5.2	Implement Integrated Water Resources Management (IWRM)	Women are excluded from water governance institutions despite being primary water managers.
6.b	6.b.1	Support community participation in water management	Participation is tokenistic. Women's lived knowledge is excluded from decision-making on timing, distribution, and maintenance.

Table 3.7- SDG 13: Take Urgent Action to Combat Climate Change and Its Impacts

Target	Sub-Indicator	What the Target Seeks to Achieve	Gendered Climate-Relevant Interpretation
13.1	13.1.1 / 13.1.2	Strengthen resilience and adaptive capacity	Adaptive capacity is shaped by land rights, time availability, health, and institutional access all gendered.
13.2	13.2.1	Integrate climate measures into policies and planning	SAPCCs mention gender but fail to operationalize it. Women are framed as vulnerable, not as decision-makers.
13.3	13.3.1	Improve education, awareness, and capacity	Climate information flows to male landholders. Women lack access to forecasts, training, and early warnings.
13.a	13.a.1	Mobilize climate finance	Climate finance is inaccessible to women due to land title requirements and digital barriers.

13.b	13.b.1	Support local planning in vulnerable communities	Local planning excludes women, SC/ST groups, and elderly, reproducing maladaptive interventions.

Table 3.8- SDG 15: Protect, Restore and Promote Sustainable Use of Terrestrial Ecosystems

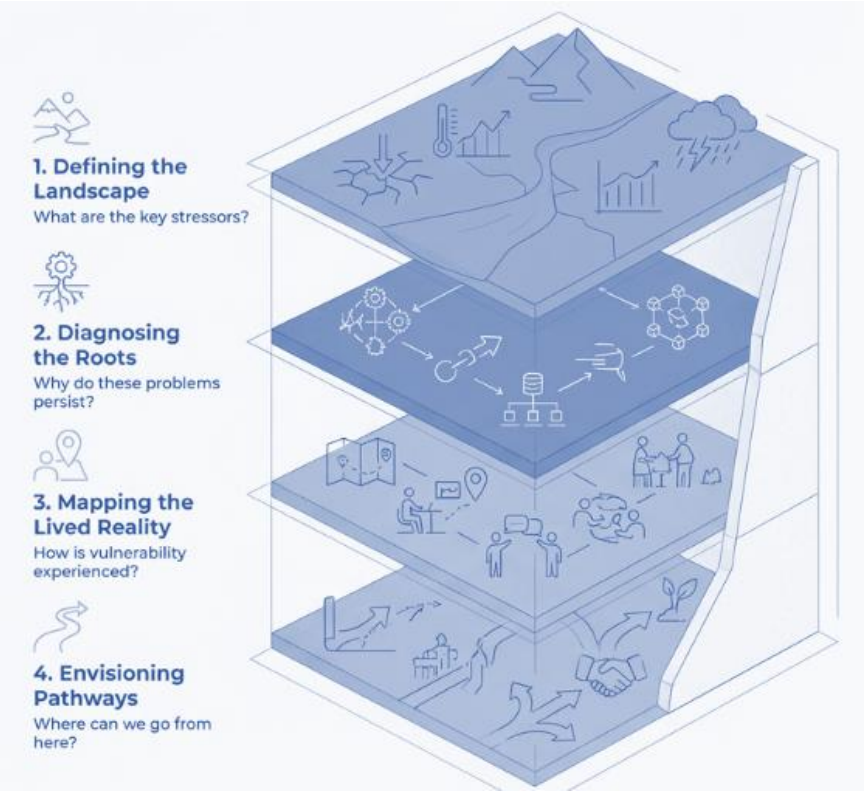
15.1	15.1.1 / 15.1.2	Conservation of terrestrial ecosystems	Women and tribal communities sustain forests daily but are excluded from governance and benefits.
15.2	15.2.1	Sustainable forest management	Joint Forest Management exists on paper; women and ST groups lack decision-making authority.
15.3	15.3.1	Combat land degradation and desertification	Land degradation increases women's labour and reduces food security, especially on marginal lands.
15.5	15.5.1	Halt biodiversity loss	Loss of biodiversity undermines women's nutrition, medicine, and NTFP-based livelihoods.
15.9	15.9.1	Integrate ecosystem values into planning	Women's ecological knowledge is excluded from planning, leading to ineffective restoration.
15.c	15.c.1	Support community-based forest management	Criminalization of traditional practices undermines women's livelihoods and adaptive strategies.

3.6 Participatory Research Methods

Participatory Rural Appraisal (PRA) is a qualitative, people-centred research approach designed to enable local communities to analyse their own realities, articulate priorities, and generate knowledge grounded in lived experience. **Robert Chambers** defines PRA as *"a family of approaches and methods to enable rural people to share, enhance, and analyse their knowledge of life and conditions, to plan and to act."* Central to PRA is a reversal of conventional research hierarchies: external researchers act as facilitators rather than experts, while community members become co-producers of knowledge.

This study focuses on a four-layered PRA approach for assessing climate vulnerability and sustainability.

a) **Defining the landscape:** Problem Matrix, Historical timeline
b) **Diagnosing the structural roots:** Problem Tree analysis, Genealogy mapping
c) **Mapping the living reality:** Time-use analysis, Resource mapping, Mobility mapping
d) **Aspirational Mapping:** Solution tree analysis

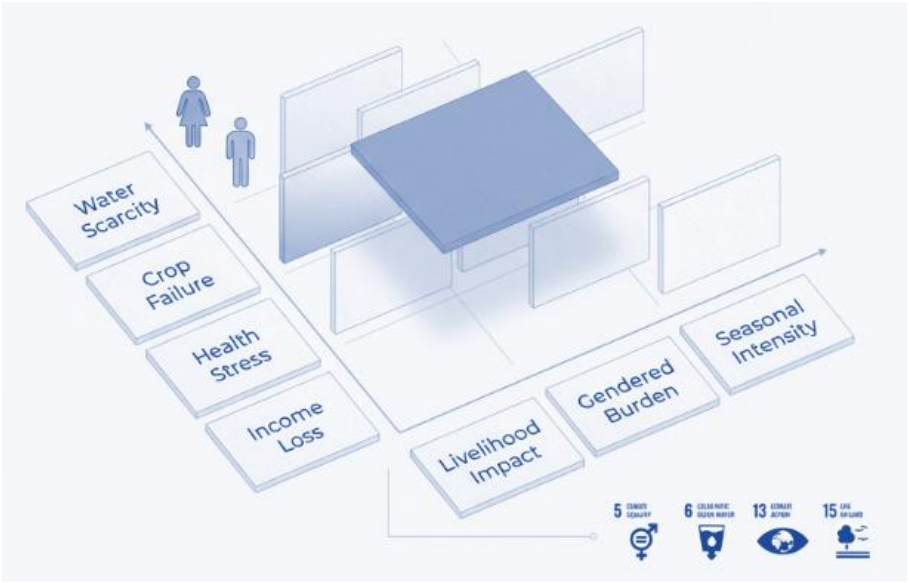


In the context of this pilot scoping study on **gendered climate vulnerability** in Roha and Sudhagad, PRA is particularly relevant because climate impacts are mediated through social relations, informal institutions, and everyday practices that are poorly captured by surveys or secondary data. PRA allows the study to surface **intersectional vulnerabilities** especially those of women, SC/ST households, widows, the elderly, and landless labourers by foregrounding experiential knowledge related to labour, resource access, care burdens, and ecological change. The method aligns with a justice-oriented framework by making visible unpaid care work, informal governance, spatial exclusion, and local ecological knowledge, all of which are critical to SDGs **5 (Gender Equality), 6 (Water and Sanitation), 13 (Climate Action), and 15 (Life on Land)**.

1. Problem Matrix

The Problem Matrix is a participatory prioritisation tool used to identify, compare, and rank key problems affecting a community based on criteria defined by participants themselves. Unlike externally imposed ranking exercises, the Problem Matrix enables community members to collectively articulate what constitutes a “problem,” whose problem it is, and how

severe it is across different social groups. In this study, the tool was used in mixed and women-only group discussions to identify climate-related and socio-economic stressors such as water scarcity, crop failure, health burdens, labour shortages, forest degradation, and institutional exclusion. Participants then assessed these problems against criteria including frequency, seasonal intensity, gendered burden, livelihood impact, and coping capacity.



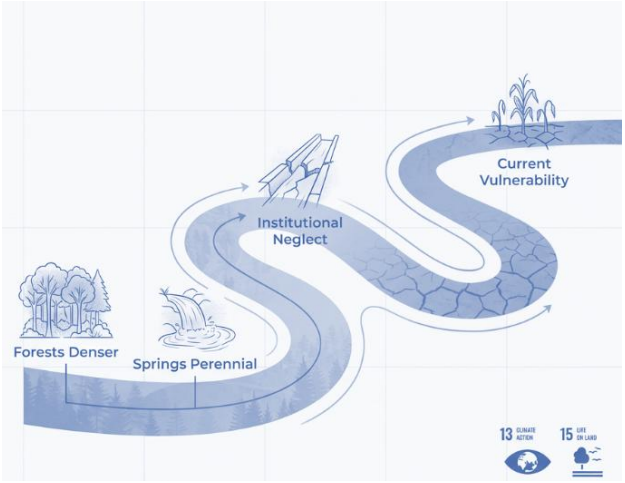
The methodological strength of the Problem Matrix lies in its ability to surface **gender-differentiated perceptions of severity**. While men often prioritised income loss or irrigation failure, women consistently ranked water scarcity, health stress, and care burdens as more severe due to their daily responsibilities. This divergence revealed how climate vulnerability is socially mediated rather than uniformly experienced. The matrix format also facilitated discussion on **trade-offs**, such as choosing between paid work and water collection, or between forest access and risk of harassment.

In the context of SDG-aligned analysis, the Problem Matrix directly linked SDG 13 (Climate Action) to SDG 5 (Gender Equality) by demonstrating how climate stress amplifies unpaid labour and time poverty. It also revealed connections to SDG 6 through water-related burdens and SDG 15 through declining forest resources. As a scoping tool, the Problem Matrix helped establish **community-defined vulnerability priorities**, ensuring that subsequent analysis was grounded in lived realities rather than predefined indicators.

2. Historical Timeline

The Historical Timeline is a participatory tool that reconstructs major social, ecological, and infrastructural changes over time. In this study, community members collectively mapped key events over the past three to four decades, including changes in rainfall patterns, spring behaviour, forest cover, agricultural practices, infrastructure development, migration trends, and policy interventions. This tool was critical for establishing that climate vulnerability is **historically produced**, not sudden. Participants recalled periods when springs were perennial,

forests denser, and canal irrigation functional. The gradual erosion of these systems through neglect, deforestation, and institutional withdrawal was identified as a precursor to current vulnerability. Women and elders provided particularly detailed accounts of ecological change, highlighting the loss of traditional indicators used for farming decisions.



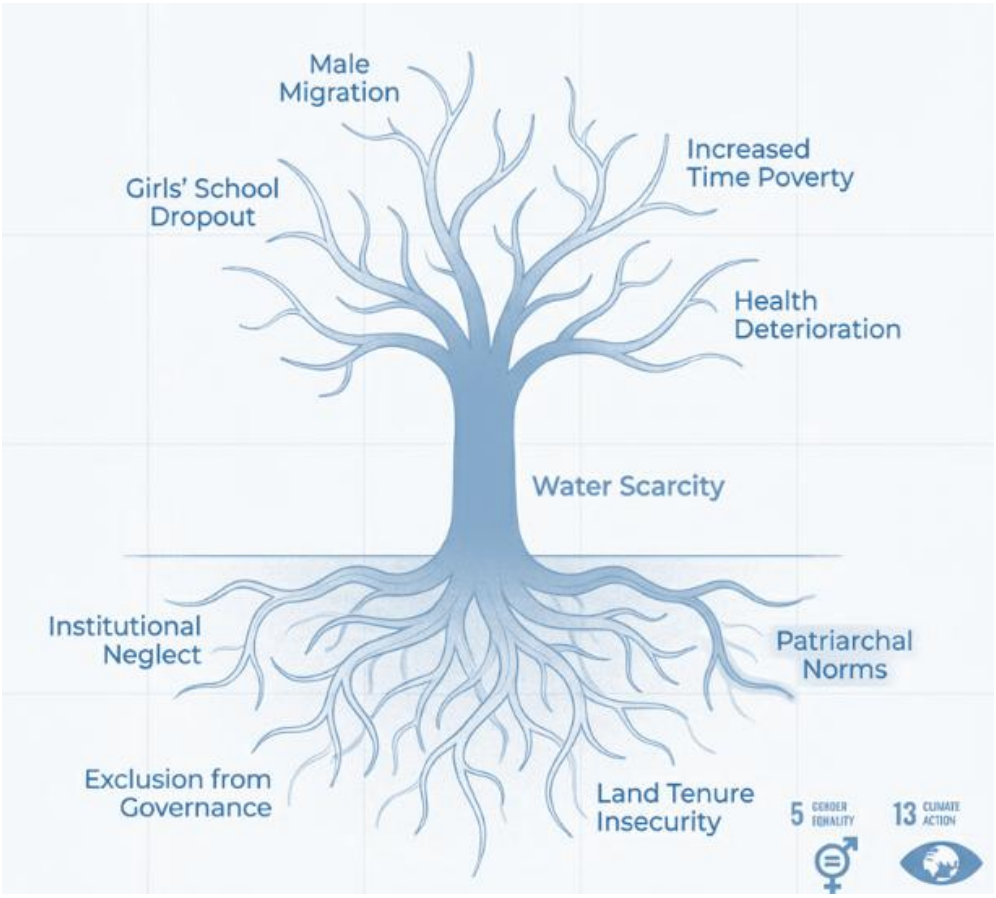
The timeline also revealed **policy discontinuities**, such as infrastructure projects that were initiated but not maintained, and schemes that altered livelihoods without providing long-term security. These narratives helped situate present vulnerabilities within broader political and institutional histories. Methodologically, the Historical Timeline enabled triangulation between local memory and secondary climate data, strengthening the validity of the assessment. It also linked SDG 13 and SDG 15 by showing how ecological degradation and climate variability interact over time, while highlighting gendered memory and knowledge as critical analytical resources.

3. Problem Tree Analysis

The Problem Tree is a causal analysis tool that visually represents a central problem, its underlying causes, and its cascading effects. In this study, the Problem Tree was used to unpack complex climate-related issues such as “increasing livelihood insecurity” or “water scarcity” and trace them back to structural, institutional, and ecological roots. Community members collectively identified the main problem (the trunk), its immediate and underlying causes (roots), and its social, economic, and gendered consequences (branches).

This tool was particularly effective in moving discussions beyond surface-level climate hazards toward **structural drivers of vulnerability**. For example, water scarcity was not treated merely as a rainfall issue, but traced to canal breakdown, lack of maintenance, exclusion of women from water governance, forest degradation, and land tenure insecurity. The branches of the tree highlighted consequences such as women’s time poverty, girls’ school dropout, health deterioration, male migration, and increased dependence on informal credit. From a gendered analysis perspective, the Problem Tree enabled participants to articulate how **power relations** shape vulnerability. Women’s groups often identified patriarchal norms, lack of land titles, and institutional neglect as root causes, while these factors were less visible in mixed-

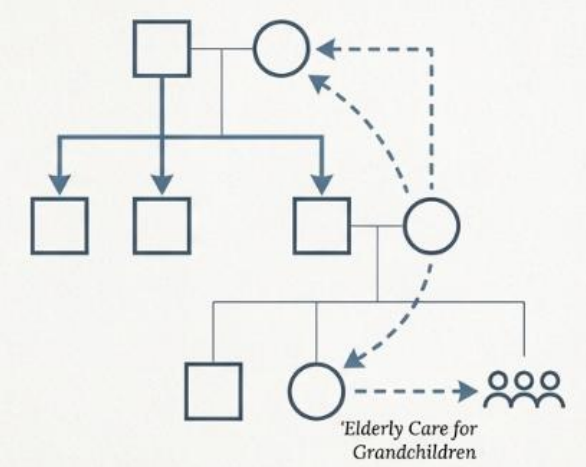
group discussions. This divergence itself became analytical data, revealing silences and exclusions in dominant narratives.



Methodologically, the Problem Tree aligns with justice-oriented frameworks by linking material deprivation (redistribution), social devaluation (recognition), and political exclusion (representation). It also provided a conceptual bridge between local narratives and broader SDG frameworks, showing how failures in governance and social relations translate climate stress into long-term vulnerability. As a scoping exercise, the Problem Tree established a **causal map** that guided subsequent vulnerability and institutional analysis.

4. Genealogy Mapping

Genealogy mapping documents household composition, kinship relations, inheritance patterns, and care responsibilities across generations. In this study, it was used to understand how gender, age, and marital status shape vulnerability, particularly for widows, elderly women, and female-headed households. The tool revealed persistent **patrilineal inheritance systems**, where land and assets pass through male lines, leaving women dependent on sons or brothers. Widows' narratives highlighted how loss of a spouse often results in loss of control over land, income, and decision-making. Genealogy mapping also showed how migration reshapes care burdens, with elderly women caring for grandchildren while adult children work elsewhere.



From a climate perspective, genealogy mapping demonstrated how vulnerability accumulates across life stages. Elderly women face mobility constraints during floods and water scarcity, while younger women inherit both care responsibilities and insecure asset positions. This intergenerational transmission of vulnerability is invisible in household-level surveys.

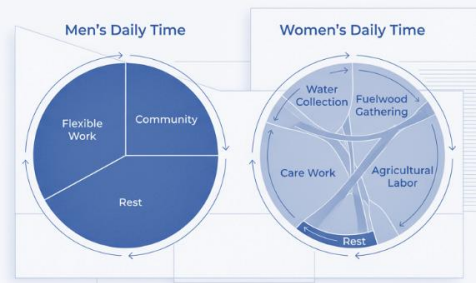
Methodologically, genealogy mapping connected gender analysis with demographic and institutional dimensions, linking SDG 5 with long-term adaptive capacity under SDG 13. It reinforced the need to view vulnerability as cumulative and relational rather than individual.

3.6. Time-Use Analysis

Time-use analysis is a PRA tool that documents how different social groups allocate their time across daily and seasonal activities. In this study, it was used to map men's and women's time across productive work, reproductive labour, community activities, and rest. Participants constructed daily schedules and seasonal calendars, highlighting variations during pre-monsoon scarcity, monsoon cultivation, and post-monsoon recovery periods. This tool was central to uncovering **time poverty as a hidden dimension of climate vulnerability**. Women consistently reported workdays extending to 14–16 hours during peak stress periods, with minimal rest. Climate variability intensified time burdens through longer water collection trips, increased care work during disease outbreaks, and repeated agricultural labour due to crop failure. Men's time, by contrast, showed greater flexibility, with options for migration or rest during extreme heat.

Time-use analysis made visible the **opportunity costs of adaptation**. Women's inability to attend training, meetings, or livelihood programs was not due to lack of interest, but to inflexible care responsibilities. This insight is critical for understanding why gender-neutral adaptation programs often fail to reach women. From an SDG perspective, the tool directly links SDG 5 (recognition of unpaid care work) with SDG 13 (climate stress) and SDG 6 (water-related labour).

Methodologically, time-use analysis provided quantitative-qualitative evidence that gendered vulnerability is produced through everyday labour regimes rather than episodic disasters, making it indispensable for a justice-oriented climate assessment.



7. Resource Mapping

Resource mapping is a spatial PRA tool that identifies the location, access, and condition of natural and built resources. Participants mapped water sources, forests, fields, roads, schools, health facilities, and sanitation infrastructure, highlighting differences in access across hamlets and social groups. This tool revealed stark **spatial inequalities**. SC and ST hamlets were often located farther from reliable water sources, roads, and services. Women's maps emphasised everyday resources springs, fuelwood areas, washing sites that were absent from official maps. Seasonal variability was also highlighted, with certain resources becoming inaccessible during monsoon or summer.

Resource mapping linked ecological degradation to social exclusion. Declining forest resources increased women's labour, while lack of participation in governance prevented corrective action. Methodologically, the tool integrated SDG 6 and SDG 15 concerns with gendered access patterns, grounding vulnerability in physical space.

8. Transect Walk

The Transect Walk involves systematic observation across different ecological and social zones with community members. In this study, walks were conducted across upland, lowland, forest-adjacent, and settlement areas with women, farmers, and elders. This tool allowed direct observation of soil erosion, waterlogging, invasive species, infrastructure decay, and housing vulnerability, while integrating local interpretations of change. Women provided insights into safety risks, water quality, and labour demands that were not visible through maps alone.

Methodologically, the Transect Walk bridged experiential knowledge and physical evidence, reinforcing the study's integrated socio-ecological approach and strengthening analysis of SDG 13 and SDG 15 through a gender lens.

9. Mobility Mapping

Mobility mapping documents daily and seasonal movement patterns of different social groups. In this study, it revealed gendered constraints on movement, distances travelled for water and fuel, and risks during climate extremes.

Women's mobility was highly local but intensive, involving repeated trips under unsafe conditions. Men's mobility was broader and more flexible, including migration. This tool highlighted how mobility itself is a vulnerability determinant, linking climate exposure with safety, health, and time poverty. Methodologically, mobility mapping connected spatial, gender, and climate analysis, reinforcing the study's justice-oriented framing and its relevance to SDGs 5, 6, and 13.

10. Solution Tree Analysis

The Solution Tree is a forward-looking participatory tool that mirrors the Problem Tree by transforming identified problems and causes into desired outcomes and pathways for change. In this study, the Solution Tree was not used to generate recommendations, but rather to understand **community perceptions of feasible adaptation pathways** and the conditions required for reducing vulnerability. Participants were asked to imagine what would change if root causes were addressed and to identify intermediate steps necessary for such transformation. This tool was particularly valuable in distinguishing between **practical coping mechanisms** and **structural solutions**. Women frequently identified immediate needs, such as a reliable water supply, closer fuel sources, and access to health services, while also articulating longer-term changes, including women's participation in water committees, land rights, and recognition of care work. The Solution Tree thus revealed latent strategic aspirations that are often absent from formal planning documents.

Analytically, the Solution Tree exposed institutional bottlenecks. Many proposed solutions required changes beyond the village level such as canal repair, land title reform, or forest governance which highlighted the limits of community agency under current governance arrangements. This insight was crucial for a scoping study, as it clarified where vulnerability

reduction is constrained by **structural and policy-level barriers** rather than local capacity deficits.

The Solution Tree also helped assess adaptive capacity not as an abstract concept but as a socially negotiated possibility shaped by power, access, and recognition. Its relevance to SDGs lies in showing that progress on SDG 13 depends on enabling conditions linked to SDG 5, SDG 6, and SDG 15. Methodologically, the tool ensured that vulnerability assessment remained grounded in community-defined pathways rather than externally imposed adaptation narratives.

4. ANALYSIS OF PRA TOOLS

PROBLEM RANKING : ROHA

Problems

1. Improper drainage
2. Open Defaecation
3. No Agriculture during rainfall
4. Poor Participation in Gram Sabha
5. Lack of clean drinking water
6. Burning of Sanitary pads

Problem	Score
1	0
2	6
3	2
4	8
5	10
6	12

	1	2	3	4	5	6
1	x	x	x	x	x	x
2	2	x	x	x	x	x
3	3	2	x	x	x	x
4	4	4	4	x	x	x
5	5	5	5	5	x	x
6	6	2	6	4	5	x

The problem matrix represents a participatory prioritisation of six interlinked issues affecting everyday life in the village. Rather than ranking problems in isolation, the matrix captures how villagers perceive the relative severity and interdependence of problems through pairwise comparison. This method reveals not only which issues are most critical, but also which ones structurally condition the others.

The results clearly indicate that Problem 6 (Burning of sanitary pads) receives the highest cumulative score (12), followed closely by Problem 5 (Lack of clean drinking water) with a score of 10. These high scores suggest that villagers perceive these issues as the most pervasive and cross-cutting, influencing health, dignity, labour burden, and environmental conditions. The prominence of sanitary pad burning highlights an often-invisible gendered concern. It signals inadequate waste management infrastructure, lack of menstrual hygiene alternatives, and social taboos that push women toward unsafe and environmentally harmful disposal practices. Its dominance in the matrix suggests that women's everyday bodily needs are acutely felt and widely acknowledged as a serious problem.

Problem 4 (Poor participation in Gram Sabha) ranks third with a score of 8, revealing strong recognition that institutional exclusion underpins many material problems. Limited participation weakens accountability for water, sanitation, and drainage systems, allowing technical failures to persist. The matrix thus implicitly identifies governance failure as a structural driver rather than a secondary concern.

Problem 2 (Open defecation), with a score of 6, occupies a middle position. While significant, it is not perceived as the root problem but as a symptom of deeper issues particularly lack of

water, drainage failure, and unusable toilets. This perception aligns with field realities where sanitation infrastructure exists but cannot be effectively used due to water scarcity and maintenance gaps.

Lower scores for Problem 3 (No agriculture during rainfall) and Problem 1 (Improper drainage) indicate that these issues, while important, are seen as either seasonal or contributory rather than primary. Improper drainage scoring zero suggests it is so normalized that it is no longer perceived as a distinct problem, despite its role in flooding, contamination, and disease. This normalization reflects how chronic infrastructural neglect becomes embedded in everyday life.

Overall, the matrix demonstrates that villagers prioritise gendered health and dignity issues and basic water security over purely economic or technical concerns. It also reveals a clear understanding that institutional participation is central to resolving multiple problems simultaneously. The problem matrix therefore functions not merely as a ranking tool, but as a diagnostic of structural vulnerability, showing how gender, governance, and infrastructure intersect to shape lived experience.

PROBLEM RANKING: SUDHAGAD

Problems	P1 – Water scarcity	P2 – Crop Loss	P3 – Labor Issue	P4 –Migration	P5 – Waste Management	P6 – Political resistance to NGO intervention	Score
P1 – Water scarcity	- X	P1	P1	P1	P1	P1	5
P2- Crop Loss	X	- X	P3	P4	P2	P6	1
P3 – Labor Issue	X	X	- X	P3	P3	P3	4
P4 –Migration	X	X	X	- X	P5	P6	1
P5 – Waste Management	X	X	X	X	X	P5	2
P6 – Political resistance to NGO intervention	X	X	X	X	X	- X	2

This problem matrix captures villagers' perceptions of six interrelated livelihood and governance challenges through pairwise comparison, revealing not only priority issues but also the direction of causality and dependency among them. Unlike linear ranking, the matrix exposes how certain problems are understood as *drivers* while others are treated as *outcomes* or *secondary effects*.

The results clearly position P1 – Water scarcity as the most structurally dominant problem, with the highest cumulative score of 5. Water scarcity consistently outweighs crop loss, labour issues, migration, waste management, and political resistance in pairwise comparisons. This indicates a shared understanding that water scarcity is the primary systemic constraint, shaping agricultural productivity, labour availability, sanitation practices, and even the success or failure of external interventions. In a climate-affected agrarian context, water scarcity is perceived not as an isolated environmental issue but as the foundational stressor upon which multiple vulnerabilities accumulate.

P3 – Labour issue emerges as the second most significant concern with a score of 4. Its relatively high ranking reflects the feminisation of agricultural and care labour under climate stress. Labour shortages driven by migration, increased work intensity during erratic rainfall, and declining returns from agriculture are seen as critical constraints on household resilience. Importantly, labour issues are positioned as both a consequence of water scarcity and a driver of further vulnerability, particularly for women who absorb unpaid and underpaid work.

P5 – Waste management and P6 – Political resistance to NGO intervention, each with a score of 2, occupy an intermediate position. Their placement suggests that these are not viewed as root causes but as institutional and social bottlenecks that exacerbate existing problems. Poor waste management reflects governance gaps and weak service delivery, while resistance to NGO intervention signals local power dynamics, mistrust, and political gatekeeping that hinder adaptive responses. These issues highlight how non-climatic factors can constrain climate adaptation even when solutions are available.

At the lower end, P2 – Crop loss and P4 – Migration both score 1, indicating that villagers perceive them largely as outcomes rather than primary drivers. Crop loss is understood as a symptom of water scarcity and climate variability rather than an independent problem. Similarly, migration is seen as a coping response to declining agricultural viability and labour stress, not as a standalone issue requiring isolated intervention.

Overall, the matrix demonstrates a sophisticated local diagnosis of vulnerability. Climate stress (water scarcity) is recognised as the core driver, but its impacts are mediated through labour relations and governance structures. The findings underscore that effective intervention must address water security and labour burdens simultaneously, while also navigating political resistance and institutional fragmentation. The matrix thus reinforces the need for integrated, gender-sensitive, and governance-aware climate adaptation strategies rather than sector-specific solutions.

HISTORICAL TIMELINE: ROHA

Category	PRE 2010	POST 2010
Cooking Fuel / Energy	No LPG access in most households; heavy dependence on firewood, cow dung, and agricultural residues; women spent long hours collecting fuel from forests and commons	LPG connections widely available under PMUY; refill affordability uneven, continued fuelwood use as backup
Food Security	Chronic seasonal food insecurity; dependence on rainfed paddy, forest foods, and wage labour; irregular ration supply	PDS functioning more consistently; food grain access improved; nutrition security still weak, especially for women and children
Housing	Predominantly kutcha and semi-pucca houses; high vulnerability to monsoon flooding and wind damage	Increase in pucca houses under PMAY-G; asbestos/cement roofing common; peripheral SC/ST hamlets still have semi-pucca housing
Road Connectivity	Kuccha internal roads; seasonal inaccessibility during heavy monsoon; poor connectivity to hamlets	Concrete internal roads improved; peripheral hamlets still experience drainage and flooding issues
Electricity	Electricity coverage limited and unreliable; frequent outages; kerosene lamps common	Near-universal electricity access; reliability improved; voltage fluctuation persists during monsoon
Drinking Water	Dependence on springs, wells, handpumps, and canal sources; women walked long distances in summer	Piped water connections under Jal Jeevan Mission; supply intermittent and quality variable, women still manage storage and fallback sources
Sanitation	Open defecation common; lack of water limited toilet use; high dignity and safety risks for women	Toilets constructed under SBM; functional use constrained by water scarcity and flooding
Education	Primary schooling available locally; high dropout after primary, especially among girls	Primary enrollment near universal; secondary education access constrained by distance, cost, and safety

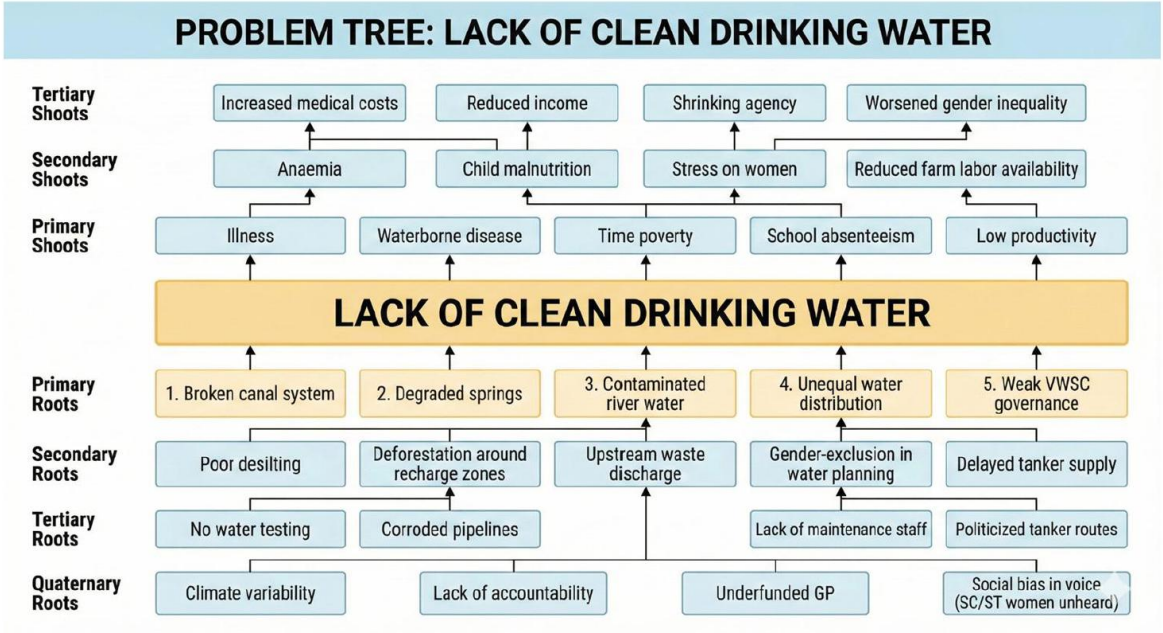
Health Access	Limited health infrastructure; reliance on traditional remedies; delayed institutional care	Sub-centres and ASHA services active; PHC located in Roha town; elderly and chronic care access remains weak
Livelihood Security	Agriculture and forest-based livelihoods dominant; stable canal irrigation earlier supported paddy cultivation	Rain-dependent agriculture due to canal failure; increased migration to Roha MIDC and urban centres; women's unpaid farm labour increases
Women's Time Burden	High but seasonally structured workload aligned with crop calendar	Intensified and fragmented workload due to water scarcity, climate variability, and male migration

HISTORICAL TIMELINE: SUDHAGAD

Category	PRE 2010	POST 2010
Cooking Fuel / Energy	No LPG access; heavy dependence on fuelwood and forest biomass, especially in Katkari and uphill hamlets; women spent 2–4 hours/day collecting fuel	LPG connections available under PMUY (Pradhan Mantri Ujjwala Yojana), **but refill affordability and supply irregularity persist**; forest fuelwood still used as fallback
Food Security	Seasonal food insecurity common; dependence on subsistence crops, forest foods, and wage labour; irregular ration access in remote hamlets	Public Distribution System (PDS) functioning more regularly in mainland villages; **access weaker in uphill hamlets** due to distance and mobility constraints
Housing	Predominantly kutcha or semi-kutcha houses; mud walls, thatch or tin roofing; high vulnerability to monsoon damage	Increase in semi-pucca and pucca houses under PMAY-G (Pradhan Mantri Awas Yojana – Gramin); **upland hamlets still dominated by semi-pucca/kaccha housing due to transport constraints**
Road Connectivity	Kuccha roads or footpaths; uphill hamlets accessible only by long	Concrete internal roads in mainland villages (Aptavane, Bhavshet); **last-**

	treks; seasonal isolation during monsoon	**mile connectivity gap persists** for Vargawne & Umrocha Mal
Electricity	Limited or no electricity in tribal hamlets; kerosene lamps common; unreliable supply	Electricity connections largely universal; **quality and reliability uneven**; solar street lights introduced in some villages
Drinking Water	No household pipelines; dependence on springs, streams, and wells; women walked long distances, especially in summer	Piped water schemes introduced under Jal Jeevan Mission; **supply intermittent**, storage dependent; satellite hamlets rely on shared tanks or mainland sources
Sanitation	Open defecation common due to lack of toilets and water; high dignity and safety risks for women	Toilets constructed under SBM (Swachh Bharat Mission); **functional use constrained by water scarcity**, especially in summer
Education	No local schools in remote hamlets; children walked long distances or dropped out early, especially girls	Primary schools available in main hamlets (e.g., Vargawne); **satellite settlements still dependent on walking access**, secondary education requires travel to Pali or mainland
Health Access	No nearby health facilities; reliance on traditional remedies and delayed care	ASHA services present; PHC remains distant; **emergency access constrained by terrain and transport**
Livelihood Security	Forest-based livelihoods, subsistence farming, and casual labour dominant; high seasonal uncertainty	Increased diversification (migration, construction work, SHGs), but **climate variability and forest degradation increase precarity**, especially for tribal women
Women's Time Burden	High but seasonally predictable workload; forest and water collection structured by stable ecology	**Severely intensified and year-round time poverty**; water, fuel, care, and crisis management overlap

PROBLEM TREE ANALYSIS : ROHA



The problem tree provides a layered and systems-based understanding of lack of clean drinking water as a central development and climate justice issue, rather than a standalone service deficit. By organising causes (roots) and impacts (shoots) across multiple levels, the analysis reveals how water insecurity is structurally produced and how its consequences cascade through health, livelihoods, gender relations, and intergenerational wellbeing.

At the core, lack of clean drinking water emerges as a convergence point of ecological degradation, infrastructure failure, and governance exclusion. The primary roots broken canal systems, degraded springs, contaminated river water, unequal water distribution, and weak Village Water and Sanitation Committee (VWSC) governance represent direct and visible failures in water systems. Importantly, these are not random breakdowns but outcomes of longer-term neglect and uneven investment.

The secondary and tertiary roots deepen this diagnosis. Poor desilting, deforestation around recharge zones, and upstream waste discharge point to environmental mismanagement that undermines local hydrology. Corroded pipelines and absence of water testing reflect technical neglect, while delayed tanker supply and politicised tanker routes highlight how emergency responses are shaped by power relations rather than need. Gender exclusion in water planning and social bias against SC/ST women reveal that governance failure is not neutral it systematically silences those most affected.

At the quaternary root level, climate variability, lack of accountability, underfunded Gram Panchayats, and entrenched social hierarchies form the structural foundation of the crisis. Climate variability accelerates source depletion and contamination, but the problem tree clearly shows that climate change acts as a stress multiplier, not the sole cause. Institutional

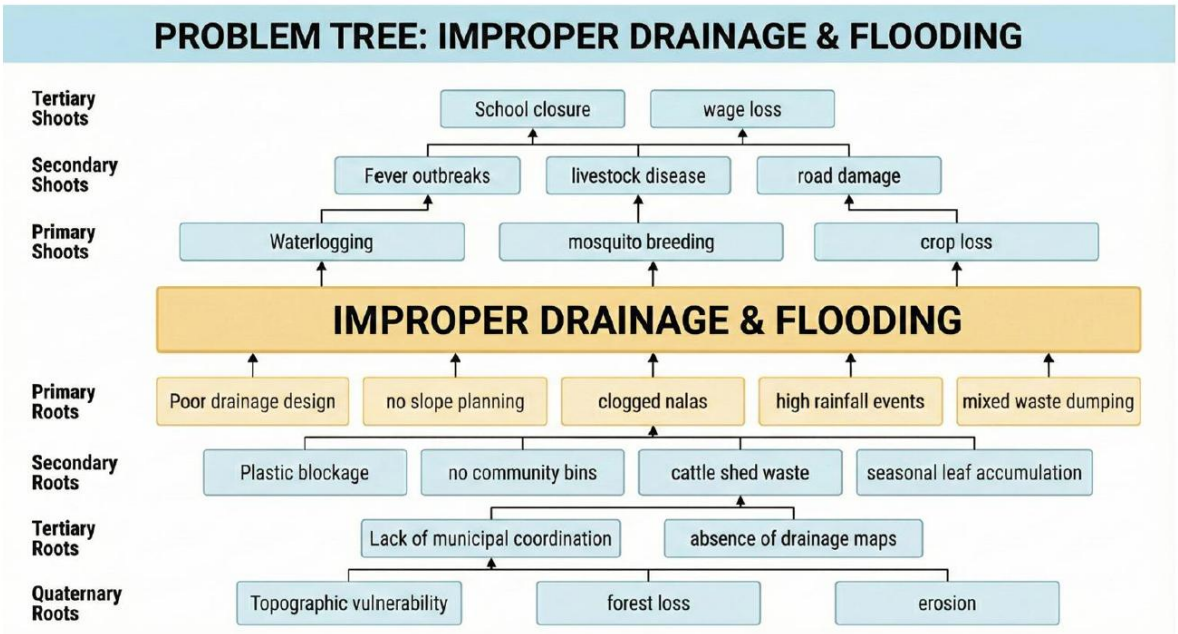
weakness and social exclusion determine who absorbs climate risk and who remains protected.

Moving upward, the primary shoots illness, waterborne disease, time poverty, school absenteeism, and low productivity capture the immediate human costs of unsafe water. These impacts are deeply gendered. Time poverty arises largely from women's expanded water collection labour, while girls' school absenteeism reflects the intergenerational transfer of burden. Low productivity links water insecurity directly to agrarian distress and livelihood fragility.

The secondary shoots anaemia, child malnutrition, stress on women, and reduced farm labour availability demonstrate how water insecurity undermines human capital and household resilience. Women's nutritional depletion and mental stress are not incidental; they are produced by the constant balancing of care, labour, and scarcity. Reduced labour availability feeds back into agricultural decline, reinforcing vulnerability.

At the tertiary shoot level, increased medical costs, reduced income, shrinking agency, and worsened gender inequality reveal the long-term structural consequences. Households divert scarce resources to healthcare, women lose bargaining power and decision-making autonomy, and inequality deepens across gender and caste lines. Water insecurity thus becomes a mechanism through which poverty and injustice are reproduced over time.

Overall, the problem tree powerfully illustrates that lack of clean drinking water is a systemic injustice rooted in ecological degradation, exclusionary governance, and climate stress. Any intervention that focuses only on infrastructure pipes, tanks, or tankers without addressing accountability, gendered voice, and environmental regeneration will treat symptoms rather than causes. The analysis underscores that water security is inseparable from gender equality, climate adaptation, and institutional reform.



The problem tree on **Improper Drainage and Flooding** presents a systemic picture of how hydrological stress, poor planning, and governance gaps interact to generate recurrent socio-economic and health impacts. Rather than framing flooding as a natural or episodic disaster, the structure of the tree clearly shows it to be a **manufactured vulnerability**, produced through accumulated design failures, ecological degradation, and institutional neglect, and intensified by climate variability.

At the **core**, improper drainage and flooding function as a chronic condition rather than an occasional shock. The **primary roots** poor drainage design, absence of slope planning, clogged nalas, high rainfall events, and mixed waste dumping represent immediate technical and behavioural failures. Importantly, rainfall intensity appears alongside governance-related factors, signalling that while climate change contributes through heavier rainfall, it is not the sole or even dominant driver of flooding impacts.

The **secondary roots** plastic blockage, lack of community bins, cattle shed waste, and seasonal leaf accumulation highlight everyday practices and infrastructural absences that convert rainfall into flooding. These are not individual failures alone but outcomes of missing systems for waste segregation, biomass management, and livestock waste disposal. Their persistence indicates weak coordination between sanitation, agriculture, and drainage planning.

At the **tertiary root level**, lack of municipal coordination and the absence of drainage maps expose deeper institutional deficits. Without mapped drainage pathways, maintenance becomes reactive and politically mediated rather than preventive. Fragmented responsibilities between departments mean that drainage, solid waste management, and road construction operate in silos, producing cumulative failure on the ground.

The **quaternary roots** topographic vulnerability, forest loss, and erosion anchor the problem within long-term ecological transformation. Settlements located in low-lying or sloped terrain are inherently vulnerable, but this vulnerability is amplified by deforestation and soil erosion that increase runoff velocity and sediment load. Climate change interacts with these conditions by increasing rainfall intensity, but the tree makes clear that ecological buffering capacity has already been severely weakened.

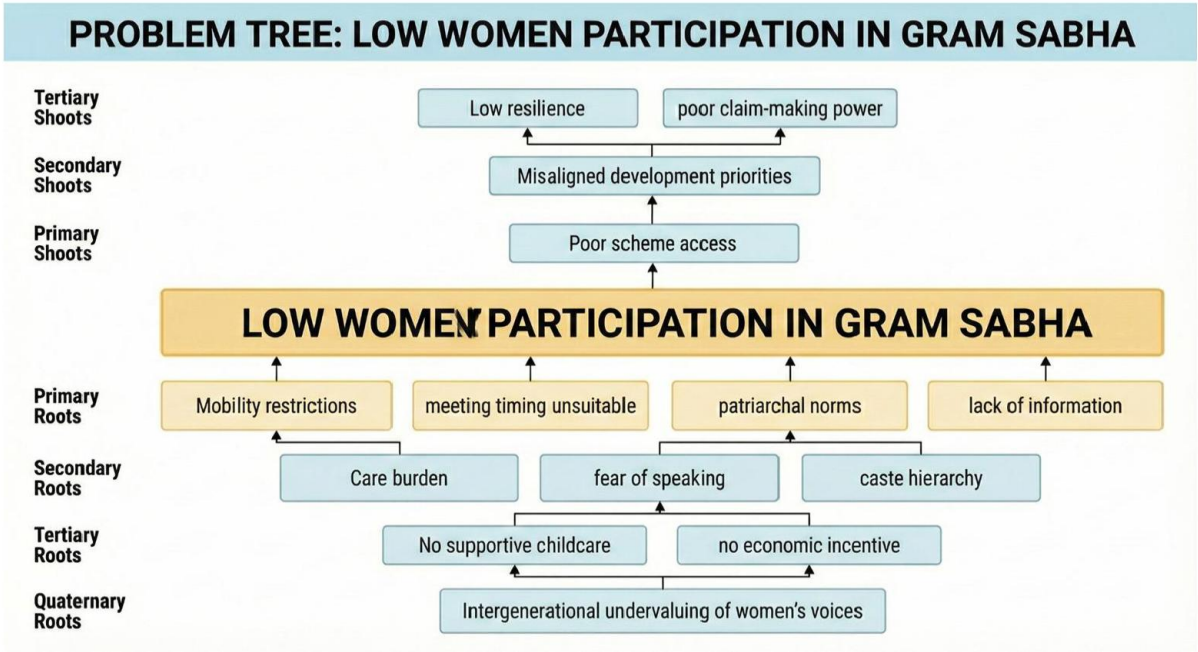
Moving upward, the **primary shoots** waterlogging, mosquito breeding, and crop loss represent the immediate manifestations of drainage failure. These impacts directly affect everyday life and livelihoods. Waterlogging disrupts mobility and housing, mosquito breeding raises disease risk, and crop loss undermines food security and income, particularly for small and marginal farmers.

The **secondary shoots** fever outbreaks, livestock disease, and road damage demonstrate how environmental stress translates into public health crises and economic loss. Stagnant water becomes a vector habitat, while contaminated floodwaters affect animals, reducing milk

production and draft power. Damaged roads isolate communities, delay services, and increase the cost of recovery.

At the **tertiary shoot level**, school closures and wage loss capture the longer-term social consequences of recurring flooding. Children's education is disrupted during flood periods, reinforcing intergenerational vulnerability. Wage loss, especially for daily labourers and women dependent on seasonal agricultural work, deepens household insecurity and indebtedness.

Overall, the problem tree reveals that improper drainage and flooding are not merely engineering issues but **governance and justice failures** embedded in ecological and institutional systems. Climate change acts as an accelerant, but the roots of vulnerability lie in poor planning, exclusion of local knowledge, fragmented governance, and environmental degradation. Effective solutions therefore require integrated watershed-based drainage planning, gender-sensitive waste and sanitation systems, restoration of ecological buffers, and accountable local institutions without which flooding will continue to reproduce health risks, livelihood loss, and social inequality.



The problem tree on Low Women Participation in Gram Sabha reveals that women's political exclusion at the village level is not a matter of apathy or lack of interest, but the outcome of deeply entrenched social, institutional, and intergenerational structures. The diagram clearly situates low participation as a structurally produced governance failure, with cascading consequences for development outcomes, resilience, and justice.

At the core problem, low women participation in Gram Sabha functions as a critical bottleneck in democratic governance. Gram Sabhas are the primary institutional spaces where development priorities, scheme selection, and resource allocation are negotiated. When

women are absent or silenced, governance becomes skewed toward male-dominated interests, reproducing gender-blind planning.

The primary roots mobility restrictions, unsuitable meeting timings, patriarchal norms, and lack of information represent the most immediate barriers. These are not isolated constraints but mutually reinforcing. Meetings are often held at times that clash with women's peak care and livelihood responsibilities, effectively excluding them even when formal participation is "open." Patriarchal norms further normalise men's presence as legitimate decision-makers, while women's absence is treated as natural.

The secondary roots care burden, fear of speaking, and caste hierarchy deepen this exclusion. The care burden ties women physically to the household, making participation costly in time and energy. Fear of speaking reflects not individual insecurity but social sanctioning, ridicule, and the risk of reputational damage, particularly for younger women, widows, and women from Scheduled Caste and Scheduled Tribe communities. Caste hierarchy compounds gender exclusion, as lower-caste women face double marginalisation within public forums.

At the tertiary root level, the absence of supportive childcare and lack of economic incentives reveal institutional design failures. Gram Sabha participation assumes an abstract, unencumbered citizen, ignoring women's reproductive labour. Without childcare, participation requires women to choose between governance and care. Similarly, when participation does not translate into tangible benefits or recognition, the opportunity cost becomes too high for economically marginal women.

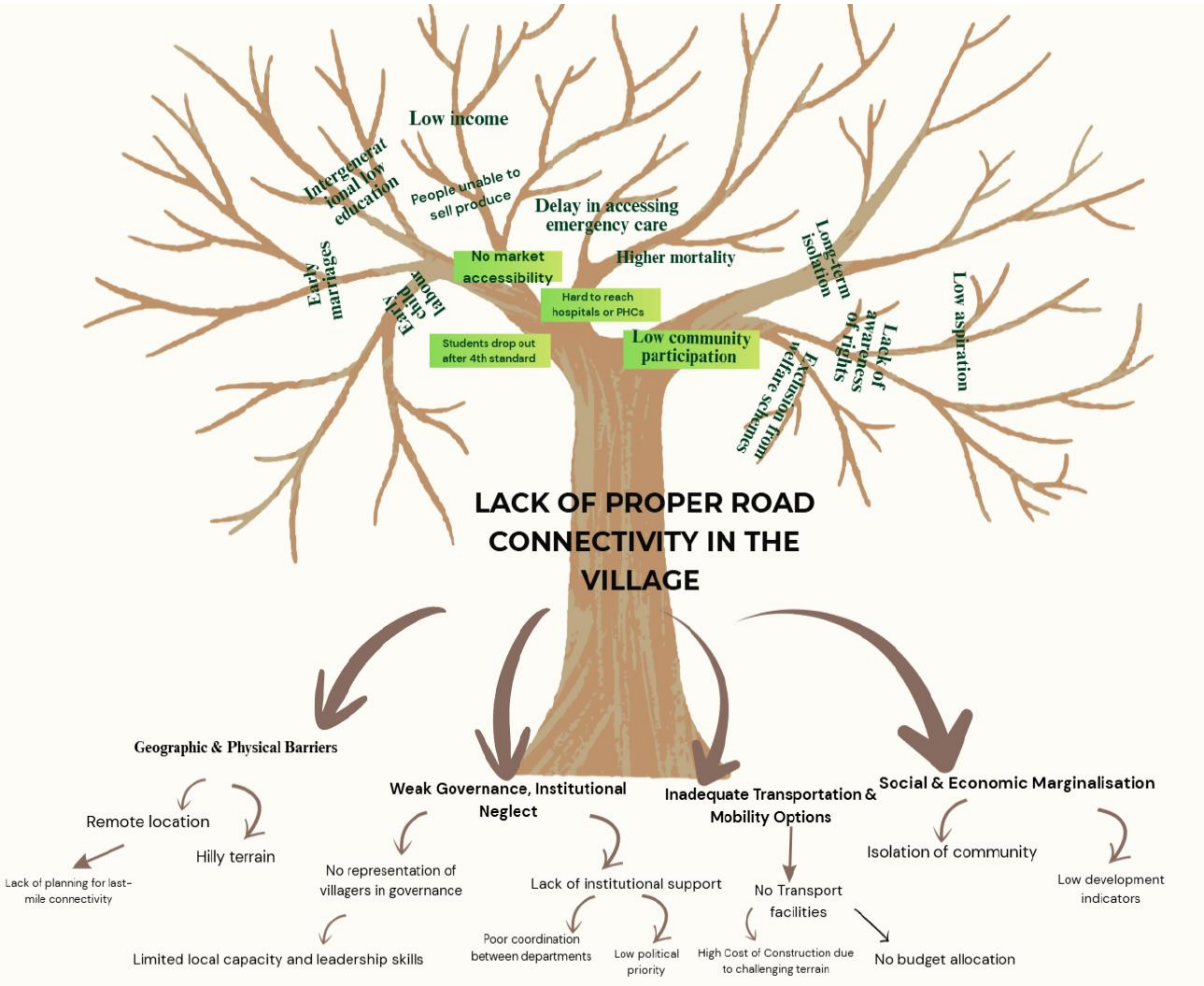
The quaternary root intergenerational undervaluing of women's voices anchors the problem in long-term socialisation. Girls grow up observing women's silence in public forums, while boys learn that authority and speech belong to men. This reproduces exclusion across generations, making low participation appear culturally "normal" rather than politically unjust.

Moving upward, the primary shoot poor scheme access demonstrates the immediate consequence of exclusion. When women are absent from deliberation spaces, schemes related to water, sanitation, nutrition, health, and livelihoods fail to reflect their priorities or lived realities.

The secondary shoot, misaligned development priorities, shows how gender-blind governance produces ineffective and sometimes harmful interventions. Infrastructure may be built, but without addressing care burdens, safety, or access, resulting in low uptake or unintended harm.

At the tertiary shoot level, low resilience and poor claim-making power capture the long-term impacts. Women's exclusion weakens collective adaptive capacity, particularly under climate stress, and undermines their ability to demand entitlements, compensation, or accountability.

PROBLEM TREE ANALYSIS: SUDHAGAD



The problem tree on **Lack of Proper Road Connectivity in the Village** presents road access not as a narrow infrastructure deficit, but as a **structural driver of multidimensional vulnerability** that shapes livelihoods, health, education, and political participation. The diagram clearly demonstrates how physical isolation translates into social, economic, and institutional exclusion, particularly affecting women, children, the elderly, and marginalised communities.

At the **core problem**, poor road connectivity functions as a foundational constraint that mediates nearly every aspect of village life. Roads are not merely transport corridors; they are enabling infrastructures that connect people to markets, schools, health services, governance institutions, and social networks. Their absence therefore produces cascading deprivations rather than a single-sector failure.

The **root causes** are grouped into four interlinked domains. First, **geographic and physical barriers** such as remote location and hilly terrain make road construction technically challenging. However, the diagram importantly shows that geography alone does not explain the problem. The lack of planning for last-mile connectivity and limited local capacity indicate that technical difficulty is compounded by institutional neglect rather than being an unavoidable natural constraint.

Second, **weak governance and institutional neglect** emerge as central structural roots. Villagers have little or no representation in decision-making bodies, resulting in poor prioritisation of road projects. Lack of coordination between departments and weak local leadership capacity prevent even sanctioned projects from being implemented. Roads thus fail not because they are impossible, but because peripheral communities are politically invisible.

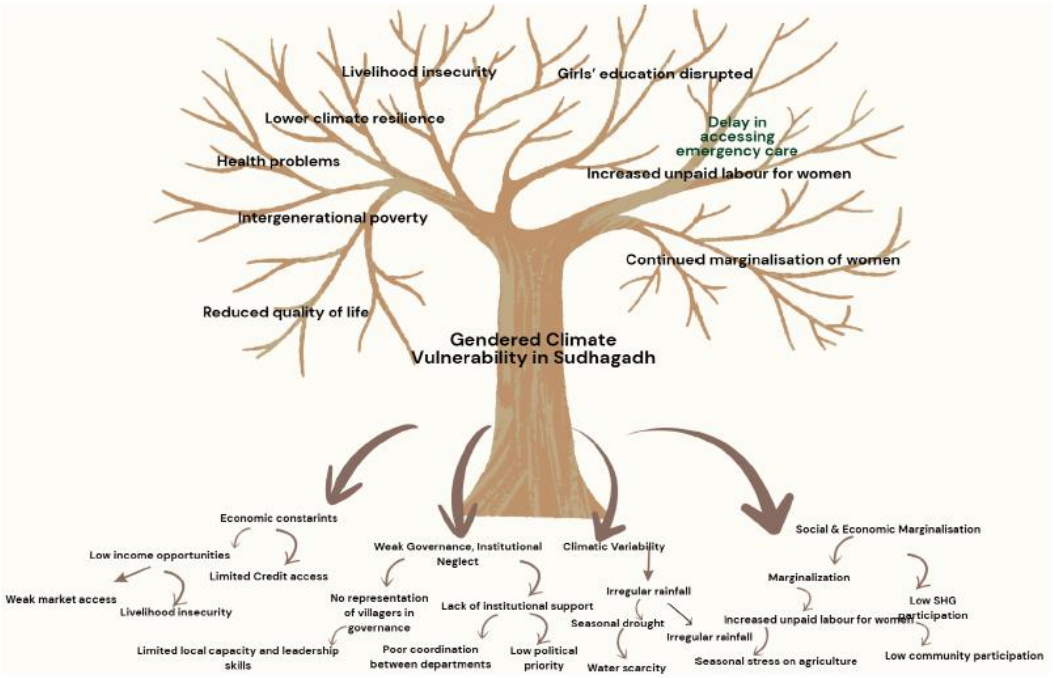
Third, **inadequate transportation and mobility options** amplify physical isolation. The absence of public transport, combined with high construction costs in hilly terrain and lack of budget allocation, ensures that even minimal mobility options remain unavailable. This disproportionately affects women, elderly persons, and those requiring frequent access to services, such as pregnant women or chronically ill individuals.

Fourth, **social and economic marginalisation** operates both as a cause and a consequence of poor connectivity. hamlets remain isolated, development indicators stay low, and the lack of visible “returns” reinforces the perception that these areas are not worth investing in. This circular logic locks communities into long-term neglect.

The **branches (impacts)** of the tree vividly capture how road absence reshapes life chances. Low income and inability to sell produce reflect market exclusion; without roads, agricultural and forest products cannot reach buyers, trapping households in subsistence or distress sales. Educational impacts include early school dropouts and intergenerational loss of educational aspiration, as daily travel becomes unsafe, costly, or impossible. This particularly affects girls, whose mobility is already socially constrained.

Health outcomes are among the most severe. Delays in accessing emergency care, difficulty reaching Primary Health Centres (PHCs), and higher mortality highlight how infrastructure becomes a life-and-death issue. Women’s reproductive health risks are especially acute, as pregnancy and childbirth emergencies cannot be addressed in time.

Social and political impacts are equally profound. Low community participation, low aspiration, and reduced civic engagement emerge not as attitudinal failures, but as rational responses to structural isolation. When accessing the state requires hours of walking or unsafe travel, participation becomes costly and discouraging.



The problem tree on **Gendered Climate Vulnerability in Sudhagad** provides a comprehensive, systems-level representation of how climate variability interacts with entrenched social and institutional inequalities to produce gender-differentiated vulnerability. Rather than depicting climate change as an external shock, the diagram correctly situates it as a **stress multiplier** that amplifies existing economic marginalisation, governance failures, and gender norms. The tree structure makes visible the causal pathways through which climate stress becomes embodied in women's labour, health, and life chances.

At the **core of the tree**, gendered climate vulnerability is framed as a structural condition rather than an episodic crisis. This framing is crucial, as it recognises that women's vulnerability in Sudhagad is not limited to extreme events but is continuously reproduced through everyday interactions between climate variability and unequal social relations. Climate change thus operates through existing systems rather than outside them.

The **root system** reveals four deeply interconnected drivers. First, **economic constraints** such as low income opportunities, weak market access, and limited credit availability restrict households' capacity to adapt. Women are particularly affected because their livelihoods are concentrated in low-return, informal, and climate-sensitive activities. Limited leadership capacity and skills further constrain women's ability to shift into more resilient livelihoods, reinforcing livelihood insecurity.

Second, **weak governance and institutional neglect** emerge as central structural roots. The absence of representation of villagers especially women in governance structures leads to poor coordination between departments, lack of institutional support, and low political priority for climate adaptation in remote areas. This institutional vacuum shifts the burden of adaptation from the state to households, and within households, to women.

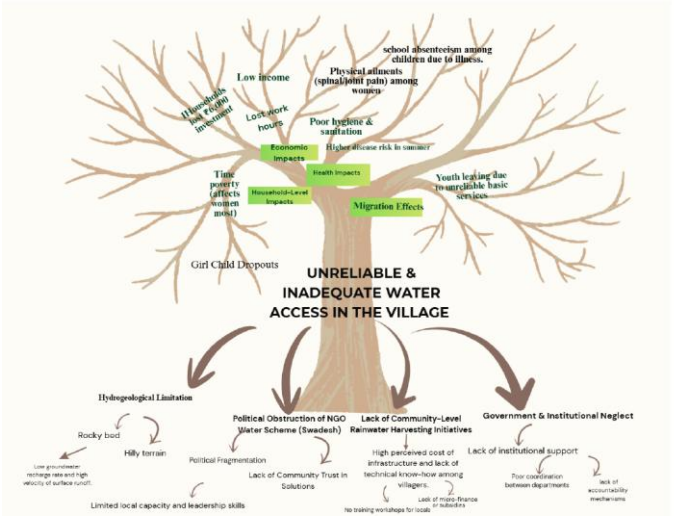
Third, **climatic variability** is shown not as a single factor but as a set of interacting stressors: irregular rainfall, seasonal drought, water scarcity, and climate uncertainty. These stresses directly affect agriculture, water availability, and forest ecosystems. Because women are responsible for water collection, subsistence agriculture, and care work, climatic instability translates into increased unpaid labour and physical exhaustion.

Fourth, **social and economic marginalisation** deepens vulnerability. Marginalisation limits participation in Self-Help Groups (SHGs) and community institutions, reducing access to collective coping mechanisms. Low community participation further weakens social capital, which is a critical buffer during climate stress.

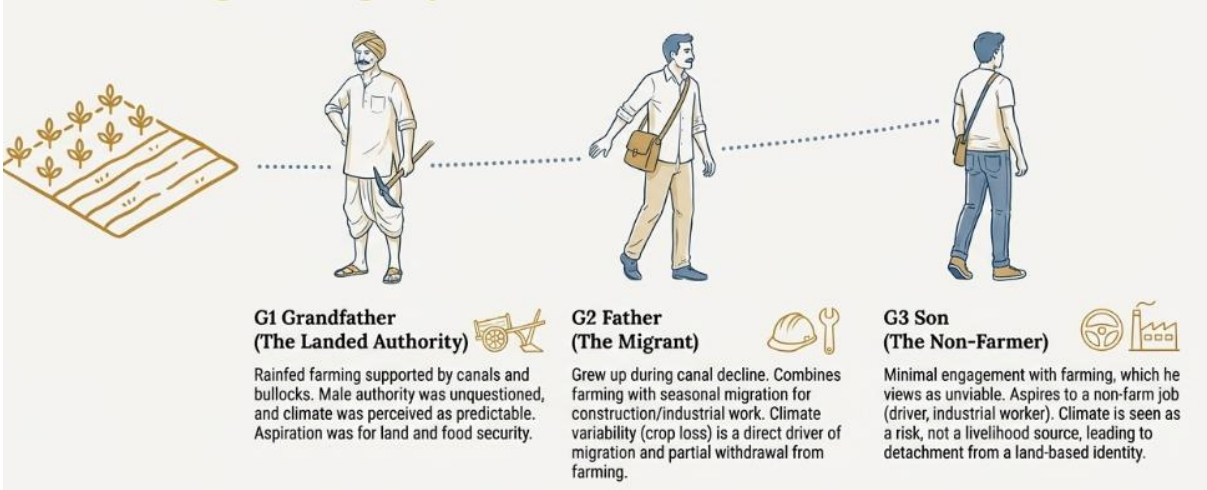
The **branches of the tree** illustrate how these roots manifest as tangible impacts. Increased unpaid labour for women stands out as a central pathway linking climate stress to gender inequality. As water sources dry, crops fail, or health risks increase, women's care responsibilities expand without corresponding reductions elsewhere. This leads directly to **health problems**, reduced quality of life, and declining resilience.

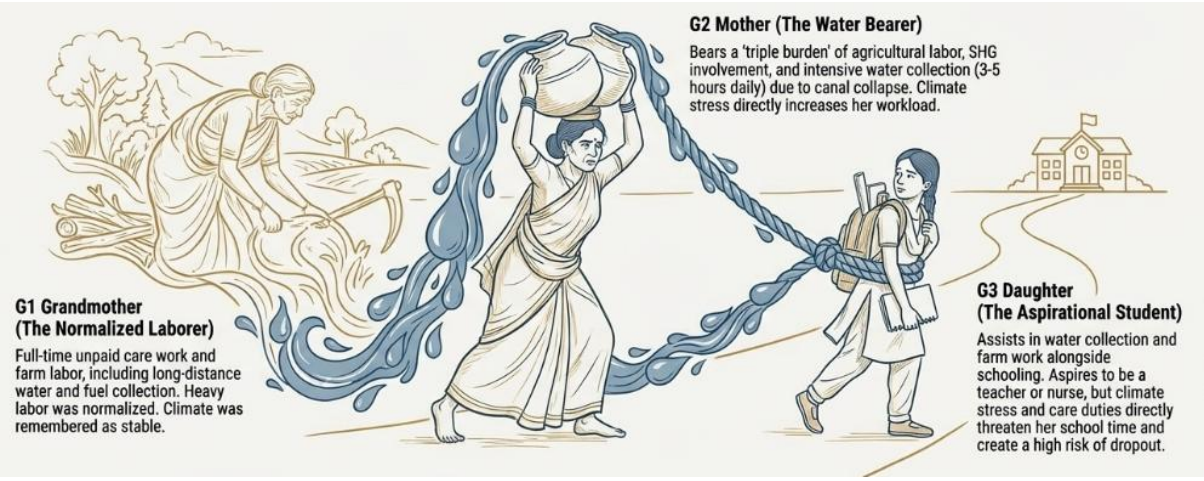
Education-related impacts are particularly significant. Girls' education is disrupted due to increased domestic responsibilities, unsafe travel conditions, or household economic stress. This creates **intergenerational poverty**, where climate vulnerability today undermines adaptive capacity in the future. Delays in accessing emergency healthcare further expose women to life-threatening risks during pregnancy, illness, or disasters.

At the crown of the tree, **reduced climate resilience**, livelihood insecurity, and continued marginalisation of women reflect long-term, systemic outcomes. These are not temporary setbacks but entrenched disadvantages that accumulate over time. The tree clearly demonstrates that without addressing the underlying social and institutional roots, climate adaptation measures will remain superficial and inequitable.



GENEOLOGY MAPPING : ROHA





The genealogical mapping for Roha vividly illustrates how climate change, infrastructural decline, and shifting agrarian economies restructure gendered life trajectories across three generations, producing sharply differentiated outcomes for men and women. The map captures not only occupational change but also the redistribution of labour, authority, and aspiration within households, revealing climate vulnerability as an intergenerational and deeply gendered process rather than a short-term shock.

In the **male lineage**, the grandfather represents a period of relative agrarian stability anchored in canal-supported irrigation and predictable monsoons. Farming was embedded within a functioning hydraulic system, and male authority over land, labour, and decision-making remained largely unquestioned. Climate variability was perceived as manageable and cyclical rather than disruptive. Aspirations were land-based, centred on food security and agrarian continuity. Vulnerability existed but was buffered by irrigation infrastructure, collective farming practices, and masculine control over productive assets.

The father's generation marks a structural rupture. Growing up during the decline of canal irrigation, he experiences the gradual erosion of agricultural reliability. Farming becomes increasingly risky due to rainfall irregularity, crop loss, and rising input costs. In response, he diversifies into casual and seasonal migrant labour, combining unstable non-farm income with

residual farming. Climate stress thus operates as a push factor, transforming agriculture from a primary livelihood into a fallback option. Masculine identity shifts from land-based authority to wage dependence and spatial mobility. While this migration provides short-term income, it weakens long-term agrarian attachment and household stability.

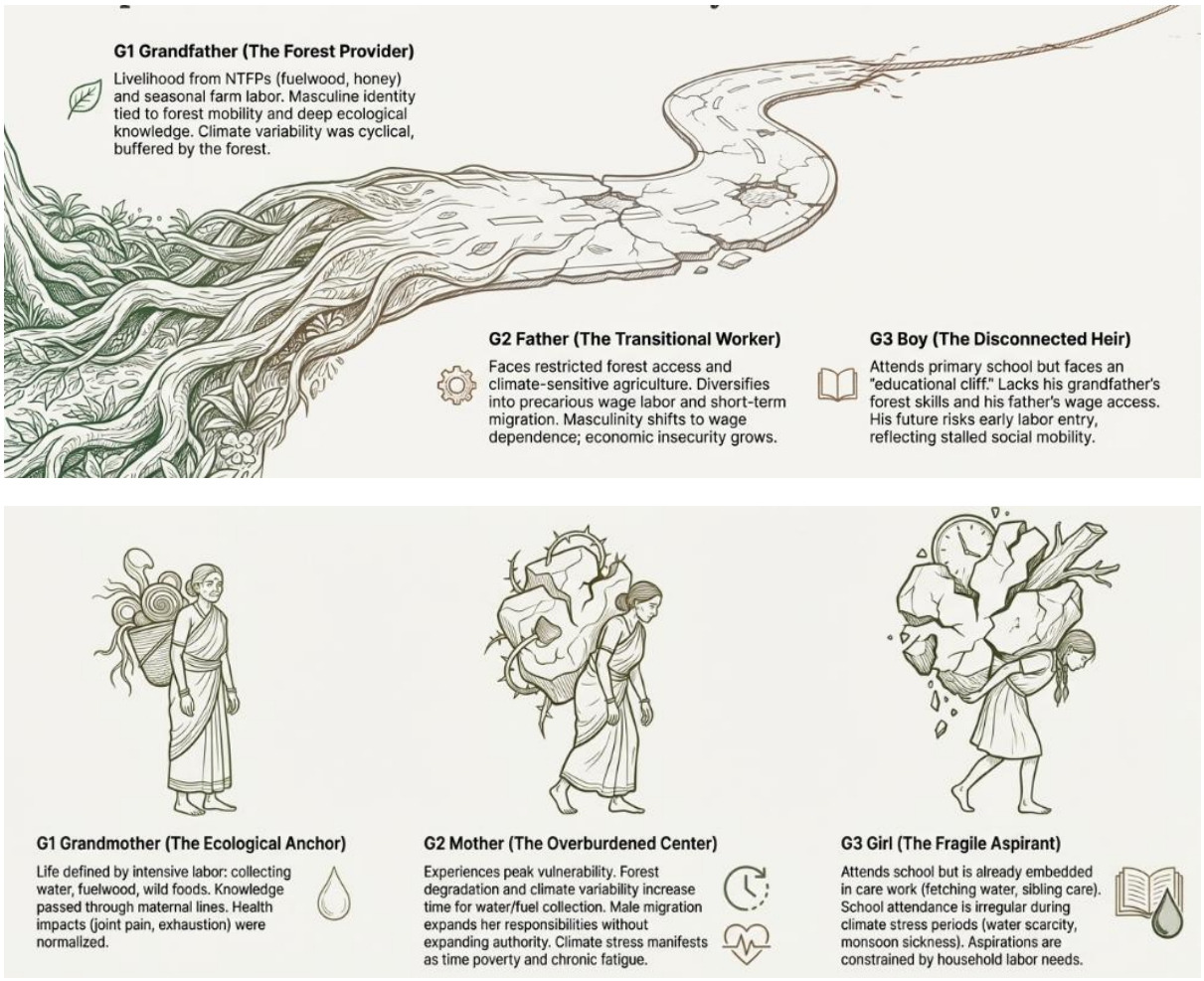
The son's generation reflects detachment rather than transition. With minimal engagement in farming and little confidence in agriculture as a viable livelihood, he views land as unproductive and risky. Aspirations shift decisively towards urban and industrial employment, even though such work is insecure and precarious. Climate vulnerability here is indirect but decisive: the collapse of irrigation and climate-induced agrarian uncertainty have broken the intergenerational transmission of farming knowledge and identity. The son's future is shaped less by ecological engagement and more by exposure to volatile labour markets, signalling stalled mobility rather than transformation.

In contrast, the **female lineage** reveals intensification rather than withdrawal. The grandmother embodies the "normalised labourer," whose life is defined by full-time unpaid agricultural and care work. Her labour fuelwood collection, water fetching, and farm assistance was heavy but socially accepted and rendered invisible. Climate was remembered as stable, and while physical strain existed, it was embedded within functioning ecological and social systems that did not constantly demand crisis-level adjustment.

The mother's generation emerges as the epicentre of gendered climate vulnerability. She bears a triple burden: agricultural labour, Self-Help Group involvement, and intensified domestic and care responsibilities. The collapse of canal irrigation and increasing water scarcity transform her into a "water bearer," spending three to five hours daily fetching water. Climate stress directly reorganises her daily life, converting infrastructural failure into bodily exhaustion and chronic time poverty. Unlike men, she cannot exit agriculture or household labour; instead, she absorbs system failure through unpaid work, without corresponding authority or decision-making power.

The daughter's generation carries aspirational hope but precarious reality. While she attends school and aspires to professional work, her education is continuously interrupted by care duties, farm assistance, and water collection. Climate stress thus threatens not only present wellbeing but future capability formation. Her trajectory illustrates anticipatory vulnerability: even before entering the labour market, climate-induced household pressures undermine educational continuity, increasing the risk of intergenerational poverty reproduction.

GENEOLOGY MAPPING: SUDHAGAD



The genealogical mapping of male and female lineages in Sudhagad provides a powerful longitudinal lens to understand how gendered climate vulnerability is reproduced, transformed, and intensified across generations. Rather than treating vulnerability as an individual or present-day condition, the maps reveal how ecological change, livelihood restructuring, and institutional shifts interact with gender norms to shape life trajectories differently for men and women. The comparison between the male lineage (grandfather–father–son) and the female lineage (grandmother–mother–daughter) highlights not only differentiated exposure to climate stress but also unequal accumulation of agency, assets, and bodily costs over time.

In the **male lineage**, the grandfather represents a relatively stable forest-based livelihood system. His identity as a forest provider was embedded in cyclical ecological rhythms, where access to Non-Timber Forest Products (Non-Timber Forest Products – fuelwood, honey) and seasonal labor provided a degree of livelihood security. Climate variability existed, but it was buffered by forest ecosystems and collective ecological knowledge. Masculine identity was closely tied to mobility, forest mastery, and provisioning, and vulnerability was episodic rather than chronic. This generation experienced climate as variability rather than crisis.

The father's generation marks a critical transition. Restricted forest access, forest degradation, and climate-sensitive agriculture push him into precarious wage labor and short-term migration. Livelihoods become fragmented and insecure, and masculinity shifts from ecological stewardship to wage dependence. Climate stress now intersects with institutional exclusion, creating economic instability rather than subsistence resilience. Importantly, while vulnerability increases, the father retains some mobility and decision-making power, even as household dependence on uncertain incomes grows.

The son's generation reflects disconnection rather than adaptation. Education is accessed, but skill formation remains shallow and poorly aligned with local employment opportunities. Aspirations rise without corresponding structural support, producing frustration and stalled mobility. Climate vulnerability here is indirect but profound: degraded ecosystems no longer provide fallback options, and wage labor pathways remain insecure. The male trajectory thus shifts from buffered ecological engagement to precarious transition to aspirational stagnation.

In contrast, the **female lineage** reveals cumulative and embodied vulnerability. The grandmother's life is anchored in intense ecological labor collecting water, fuelwood, and forest produce supported by deep ecological knowledge. While physically demanding, this labor was socially normalized and integrated into household survival systems. Health impacts such as pain and exhaustion were present but largely invisible and unacknowledged. Climate variability existed, but forests and collective practices provided partial buffers.

The mother's generation represents the peak of gendered vulnerability. Forest degradation, declining water sources, and male migration drastically expand her labor responsibilities without expanding authority or control. She absorbs the combined burden of productive, reproductive, and community labor, experiencing severe time poverty and chronic fatigue. Climate stress water scarcity, heat, and crop failure directly reorganizes her daily life. Unlike men, her mobility and decision-making remain constrained, converting ecological decline into bodily depletion rather than livelihood transition.

The daughter's generation inherits constrained aspirations. While school attendance improves, it is fragile and repeatedly disrupted by climate-related caregiving demands, illness, and household labor needs. Her life is shaped by anticipatory vulnerability: education occurs within an already degraded ecological and social context, limiting future resilience. Climate stress thus becomes intergenerational, shaping not only present labor but future capabilities.

Taken together, the genealogical maps demonstrate that **climate change produces gendered pathways of vulnerability**. Men experience livelihood displacement and identity erosion; women experience labor intensification, health decline, and constrained futures. Vulnerability accumulates across generations not through biological difference but through structural inequalities in labor, authority, and institutional recognition. The analysis underscores that climate justice in Sudhagad cannot be achieved without addressing these deeply embedded, intergenerational gendered processes.

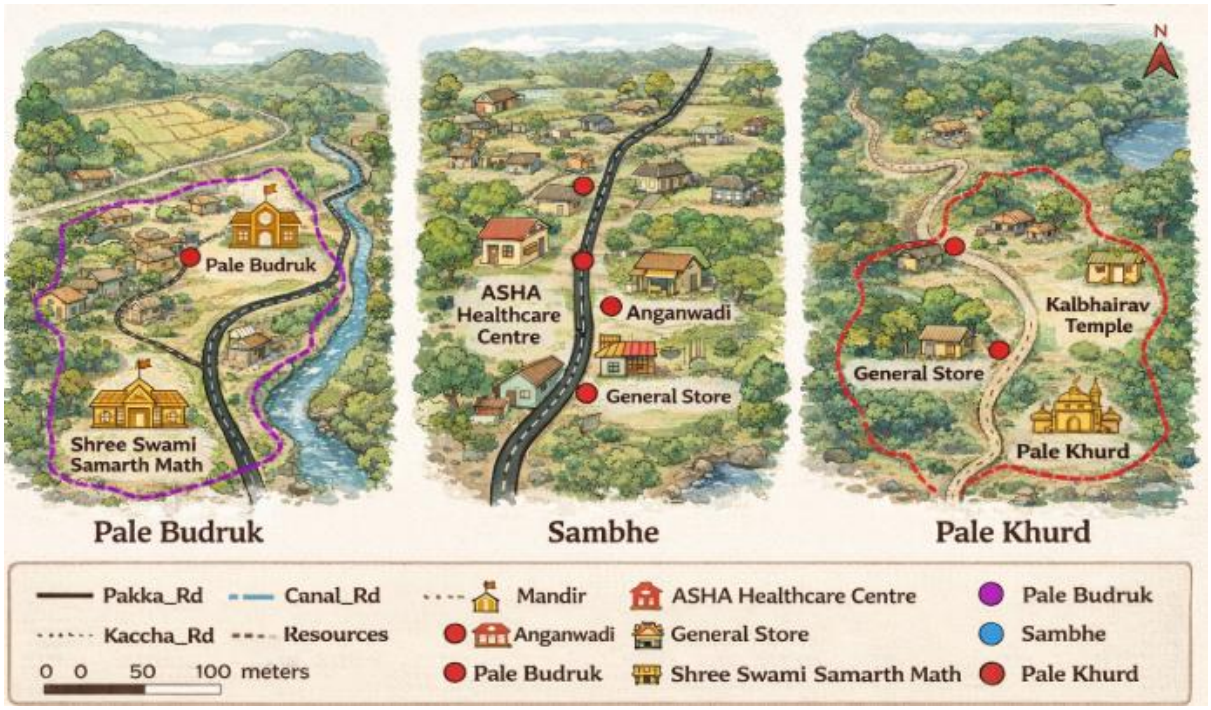
TIME USE ANALYSIS : ROHA

Time	Male Activity	Female Activity	Gender Gap Analysis
04:00 – 05:00	Sleeping	Wakes up, fetches water (queueing at taps / springs)	Women begin the day with sleep deficit due to water insecurity; climate stress shifts labour into early hours.
05:00 – 06:00	Wakes up, routine activities	Fetching water + cooking breakfast	Women pay the "reproductive labour tax" before productive work begins.
06:00 – 07:30	Preparation for field work / migration commute	Household cleaning, childcare, animal care	Care work is gender-exclusive, delaying women's entry into paid labour.
07:30 – 13:00	Agricultural field work / wage labour / industrial work (Roha MIDC)	Agricultural field work (transplanting, weeding, harvesting)	Equal productive contribution, but women perform more labour-intensive tasks under climatic exposure.
13:00 – 14:00	Lunch + rest	Cooking lunch + eating last	Women's nutrition and rest are compromised, increasing health vulnerability.
14:00 – 17:00	Field work / market visits / rest (seasonal)	Field work + water collection + fuelwood gathering	Women juggle productive + reproductive roles simultaneously, unlike men.
17:00 – 18:30	Returns home / social interaction	Fetching evening water + livestock care	Climate variability extends women's workday; men's workday tapers earlier.
18:30 – 20:00	Rest / mobile phone / TV	Cooking dinner + cleaning utensils	Start of the "second shift" for women; unpaid labour intensifies.
20:00 – 21:30	Leisure / rest / sleep	Childcare, schoolwork support, cleaning	Leisure gap: women have almost no discretionary time.
21:30 – 23:00	Sleep	Sleep	Women sleep later despite earlier waking → chronic fatigue.

TIME USE ANALYSIS: SUDHAGAD

Time	Male Activity	Female Activity	The Gender Gap Analysis
04:00 – 05:00	Sleeping	Wakes up, Fetches Water	Women operate on a sleep deficit to secure water.
05:00 – 06:00	Wakes up, Routine	Fetching Water + Cooking	The "reproductive tax" is paid before the workday begins.
06:00 – 18:00	Field Work (Agri)	Field Work (Agri)	Both genders contribute equally to economic production.
18:00 – 19:00	Returns Home	Returns Home	-
19:00 – 20:00	Dinner	Cooking Dinner	Men rest; women start the "second shift."
20:00 – 21:00	Free Time / Sleep	Childcare + Cleaning	No leisure time for women.
21:00+	Sleep	Sleep	-

RESOURCE MAPS: ROHA



The resource maps of Pale Budruk, Pale Khurd, and Sambhe provide a spatially grounded understanding of how infrastructure, services, and natural resources are unevenly distributed across the Roha study villages. By translating detailed GIS layers into simplified, community-readable visual forms, the maps function not merely as inventories of assets but as analytical tools that reveal patterns of accessibility, exclusion, and vulnerability. These representations foreground how everyday life is shaped by proximity to roads, water sources, institutions, and ecological systems.

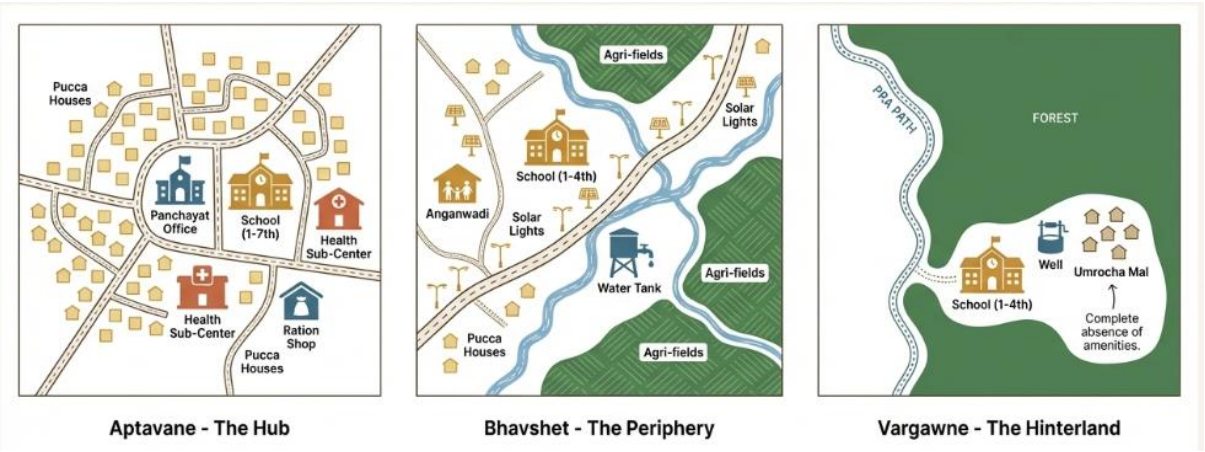
Pale Budruk emerges as a relatively consolidated settlement with higher infrastructure density and institutional presence. The clustering of pucca houses, the Gram Panchayat office, school, ration shop, health sub-centre, temple, and relatively better road connectivity indicates its role as a local administrative and service hub. The canal road and pakka road network enhance mobility and access to markets and services. However, even within Pale Budruk, the map suggests internal gradients: peripheral households remain farther from key services, and dependence on the canal highlights vulnerability to irrigation failure and seasonal water stress. Thus, while comparatively better off, Pale Budruk is not insulated from climate and governance-related risks.

Sambhe presents an intermediate profile, characterised by a linear settlement pattern along the pakka road and canal. Key resources such as the Anganwadi, ASHA health centre, temple,

general store, and water tank are centrally located, making them accessible to most households. Surrounding agricultural fields indicate strong dependence on rainfed farming. The map visually captures Sambhe's dual condition: moderate physical connectivity combined with high livelihood sensitivity to rainfall variability and canal dysfunction. Its resource distribution suggests fewer institutional assets than Pale Budruk, yet better integration than more remote hamlets, placing Sambhe in a zone of transitional vulnerability.

Pale Khurd displays the sharpest spatial inequality. The clear separation between the main village and the Adivasi (Katkari) wadi, connected by kaccha roads and footpaths, illustrates institutional and infrastructural marginalisation. The Adivasi wadi has limited amenities primarily an Anganwadi and small general stores while major services, temples, and pakka roads remain concentrated in the main settlement. Forest adjacency dominates the landscape, signalling both livelihood dependence and ecological vulnerability. Distance from services, poor road quality, and forested terrain collectively intensify risks during monsoon flooding, health emergencies, and water scarcity.

RESOURCE MAPS: SUDHAGAD



Aptavane - The Hub | Bhavshet - The Periphery | Vargawne - The Hinterland

In Sudhagad, resource mapping clearly exposes a sharp divide between centrally located "mainland" settlements dominated by General and Other Backward Class (OBC) households, and remote, uphill, or peripheral hamlets inhabited largely by Scheduled Tribe communities, particularly the Katkari.

At the core of the Panchayat lies **Aptavane hamlet**, which functions as the primary administrative and infrastructural hub. Its proximity to the Pali Road situates it advantageously within the local governance and service delivery network. The resource map of Aptavane shows a high density of built infrastructure, including the Gram Panchayat office, community hall, library, and a primary school catering up to middle grades. This concentration of public assets signifies Aptavane's role as the nodal point for governance, welfare distribution, and

institutional engagement. Housing patterns further reflect relative security and formality, with clear demarcation of pucca and semi-pucca houses, toilets, and cow sheds. Water access is comparatively diversified, with both tap water points and a well marked on the map, although scarcity persists seasonally. The presence of agricultural land, mango plantations, and a ration shop underscores Aptavane's economic stability and its role as a resource distributor for surrounding areas. Overall, the map portrays Aptavane as a space of **institutional visibility and infrastructural prioritisation**, even as it remains vulnerable to broader climatic and water stress.

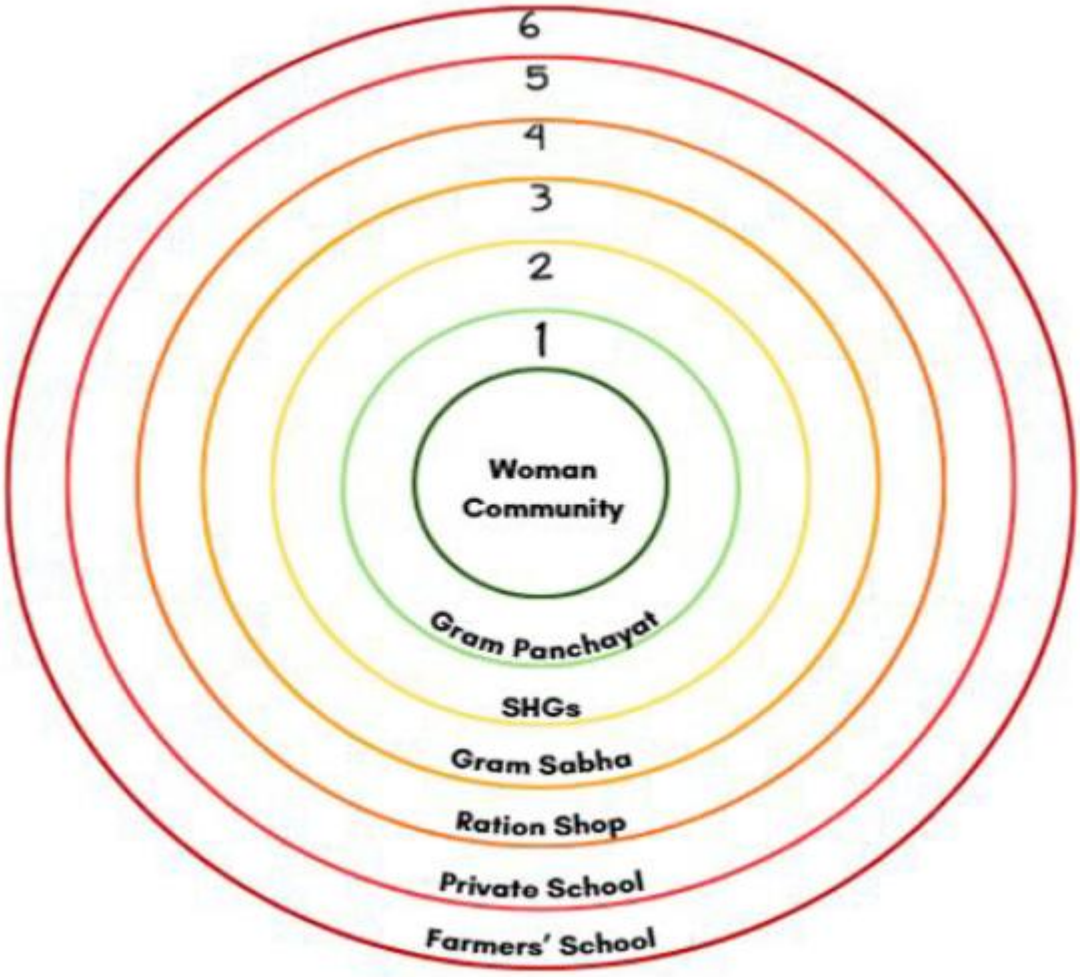
Moving outward from the core, **Bhavshet hamlet** illustrates an intermediate zone within the spatial hierarchy of Sudhagad. The mainland portion of Bhavshet, inhabited largely by Thakur and general caste households, shows moderate civic infrastructure, including a panchayat home, temple, anganwadi, and school. A notable feature of this map is the explicit marking of street lights and solar lights, indicating recent infrastructure interventions aimed at improving safety, mobility, and energy access. The presence of a water tank and a clustered settlement pattern along an access road reflects better connectivity than remote hamlets, though still less infrastructural density than Aptavane. Bhavshet thus occupies a transitional position neither fully central nor fully peripheral benefiting from partial institutional attention.

In sharp contrast, the **Bhavshet Katkari Adiwasi Wadi** reveals how spatial segregation translates into material vulnerability. Physically separated from the mainland village by streams and agricultural fields, the Adiwasi Wadi map prioritises natural features over built infrastructure. Streams, wooded areas, and fields dominate the landscape, highlighting deep dependence on local ecosystems for survival. The identification of a check dam points to attempts at managing runoff and water availability, yet also signals exposure to flooding and seasonal instability. Housing is marked as a mix of pakka and traditional structures, with adjacent barren land reinforcing findings of landlessness or marginal land ownership among Katkari households. The spatial isolation visible in the map is not accidental but reflects long-standing patterns of exclusion, where tribal settlements remain peripheral to formal infrastructure planning.

The most acute spatial vulnerability is captured in the resource map of **Vargawne and its satellite settlement Umrocha Mal**, described as the "green zone" of high vulnerability. Located on steep hilltops and accessible only through a 40–45 minute trek, these settlements lie at the extreme edge of institutional reach. The map illustrates dense forest cover surrounding both hamlets, visually confirming their reliance on forest resources for fuelwood and subsistence crops such as black sesame. While Vargawne itself shows limited but crucial resilience infrastructure including a school, water tank, and solar street light Umrocha Mal appears entirely absent from the formal infrastructure grid. With no public amenities mapped, Umrocha Mal households depend entirely on Vargawne for basic services, despite the physical difficulty of access. Housing remains largely semi-pucca or kaccha, reflecting the logistical barriers to material transport and construction.

Taken together, the resource maps of Sudhagad reveal a **clear infrastructure gradient**, where development thins progressively with distance, elevation, and social marginality. They make visible how geography, caste, and governance intersect to produce zones of institutional concentration and zones of neglect. Peripheral hamlets like Umrocha Mal emerge as blind spots spaces where vulnerability is not only climatic or economic, but deeply institutional. The maps thus underscore that in Sudhagad, vulnerability is spatially produced and politically sustained, offering critical evidence for planning interventions that move beyond uniform coverage toward equity, inclusion, and last-mile justice.

COBB WEB DIAGRAM : ROHA



The cobweb diagram presents a layered institutional proximity analysis centred on women in the community, visually capturing how different institutions are positioned in relation to women's everyday lives, agency, and access. Unlike conventional stakeholder maps that treat

institutions as formally equivalent, this cobweb arranges them according to *functional closeness*, *frequency of interaction*, and *practical accessibility* for women. The concentric circles, moving from green at the core to red at the periphery, represent increasing distance social, institutional, and experiential rather than physical distance alone.

At the centre of the cobweb lies "Woman – Community", signifying that women's lives, labour, and survival strategies form the core around which local systems function. This placement recognises women not as beneficiaries but as the foundational actors sustaining households, agriculture, water systems, and social cohesion. The first ring (Level 1) includes the Gram Panchayat, indicating formal governance as the closest institutional interface. However, its proximity should be interpreted critically: while the Panchayat is structurally nearest, women's influence within it is often mediated, conditional, and constrained by patriarchal norms, token representation, and procedural barriers.

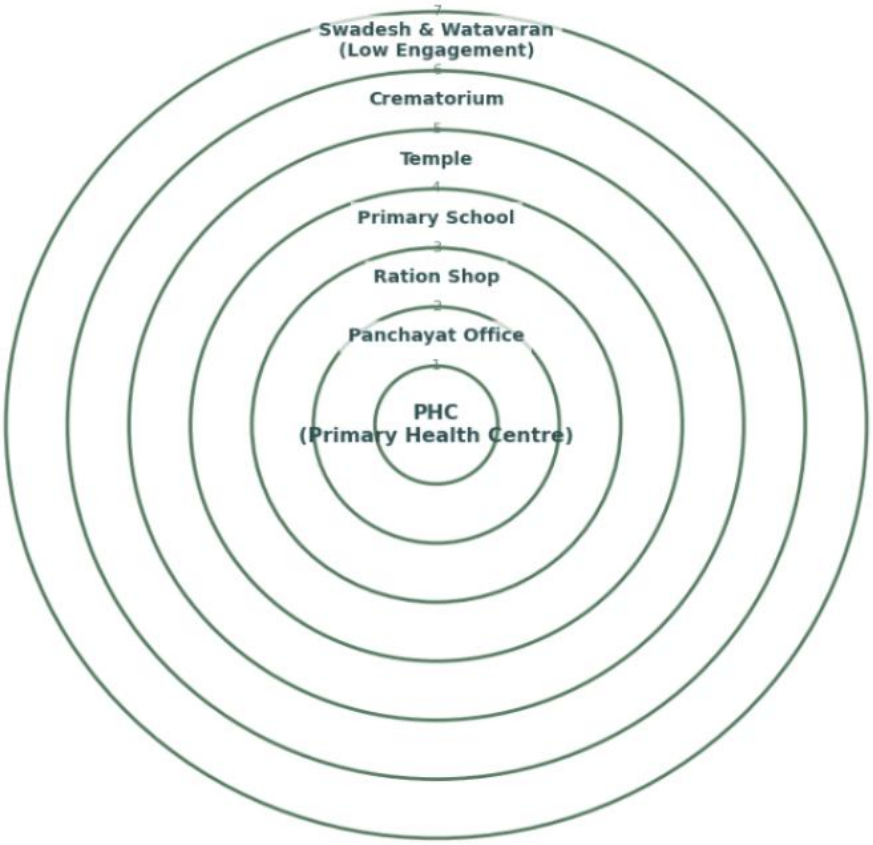
The second ring places Self-Help Groups (SHGs), reflecting their practical importance in women's daily lives. SHGs function as spaces of mutual support, informal finance, and collective coping, especially under climate stress. Their position closer to the centre than the Gram Sabha highlights how women experience SHGs as more accessible, responsive, and emotionally safe than formal political forums. Yet, their location outside the innermost circle also signals limitations: SHGs often lack decision-making power over major resource allocations or development priorities.

The third ring contains the Gram Sabha, illustrating a paradox. Although constitutionally positioned as the most democratic institution, it is experienced by women as distant due to unsuitable meeting timings, care burdens, fear of speaking, caste hierarchies, and informational asymmetries. The cobweb thus captures a critical governance gap: formal democratic spaces exist, but women's effective participation remains limited, pushing them outward in the institutional landscape.

Further outward lie the Ration Shop and Private School, institutions that women interact with regularly but over which they have minimal control. These spaces are transactional rather than participatory. Women queue, negotiate, and manage household needs here, but their voices do not shape how these services operate. This reinforces women's role as managers of scarcity rather than decision-makers.

At the outermost ring sit Farmers' Schools, representing agricultural extension and technical knowledge systems. Their distance from the centre symbolises women's systemic exclusion from climate, agriculture, and livelihood training, despite their central role in farming labour. Knowledge flows remain male-oriented, reinforcing gendered adaptive capacity gaps.

COBB WEB DIAGRAM: SUDHAGAD



At the core of the cobweb lies the Primary Health Centre (PHC), indicating that health needs form the most immediate and non-negotiable interface between the state and the community. Its centrality reflects both biological vulnerability and institutional dependency. In rural and climate-stressed contexts, health shocks waterborne diseases, maternal health issues, heat stress, injuries are frequent, making the PHC a critical survival institution. However, central placement does not necessarily imply adequacy; rather, it highlights how communities are structurally forced to rely on health systems due to failures in upstream determinants such as water, sanitation, nutrition, and livelihoods.

Surrounding the PHC is the Panchayat Office, representing formal local governance. Its proximity suggests that administrative access is relatively close in spatial or procedural terms. Yet, engagement is often mediated by power relations gender, caste, literacy, and political affiliation. While the Panchayat is a key node for schemes and grievance redressal, its effectiveness depends on inclusion, transparency, and responsiveness, which are uneven across social groups.

The next ring includes the Ration Shop, underscoring food security as a core everyday concern. The Public Distribution System (PDS) is a routine point of contact, particularly for women, who manage household food provisioning. Its placement reflects high frequency of interaction but limited agency: communities depend on it, yet have little influence over supply quality, quantity, or accountability mechanisms.

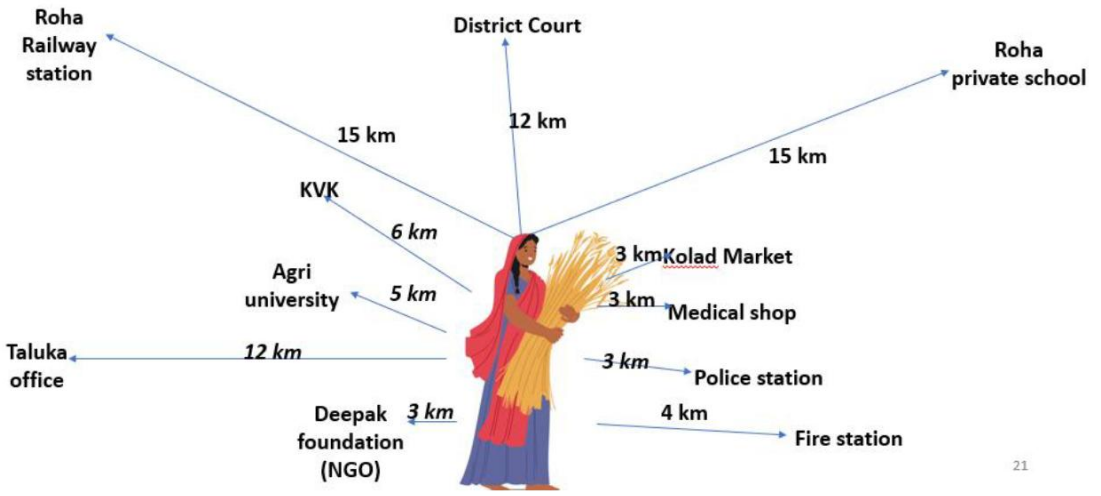
Beyond this lies the Primary School, indicating moderate engagement. Education is valued but constrained by distance, household labour needs, seasonal migration, and gender norms. The school's position suggests it is less central than food and health, especially under conditions of poverty and climate stress, where immediate survival often overrides long-term human capital investment.

Further outward is the Temple, representing social and cultural institutions. While temples play a significant role in community cohesion and moral life, their developmental relevance is indirect. They often reinforce social norms, including gender and caste hierarchies, which can both support and constrain collective action.

The Crematorium occupies an even more peripheral ring, reflecting its episodic but unavoidable importance. Its placement signifies low-frequency interaction but high emotional and cultural significance, especially during health crises or disasters.

At the outermost ring lies Swadesh & Watavaran (Low Engagement), representing non-governmental organisations. Their distance indicates limited reach, sporadic presence, or project-based engagement rather than sustained institutional integration. This highlights a key governance gap: civil society actors exist, but their impact remains peripheral due to scale, trust deficits, or weak alignment with local priorities.

MOBILITY MAPPING: ROHA



MOBILITY MAPPING: SUDHAGAD

Service/Facility	Aptavane (Main Village)	Bhavshet Thakur Wadi	Vargawne
Primary School (1-4)	< 1 km	< 500m	< 500m
Middle School (5-7)	< 1 km	2 km	5 km (Trek)
High School (>7)	1 km	6 km	9 km (5 km Walk + Bus)
Healthcare (PHC)	< 1 km	2 km	5 km (Trek)
Panchayat Office	< 1 km	2 km	5 km (Trek)
Ration Shop (PDS)	< 1 km	2 km	5 km (Trek)
Market/Grocery	4 km	6 km	9 km (5 km Walk + Bus)
Admin (BDO/Police)	4 km	6 km	9 km (5 km Walk + Bus)
Transport Mode	Walk / Direct Bus	Walk + Bus	5 km Trek + Bus

SEASONAL CALENDAR : ROHA

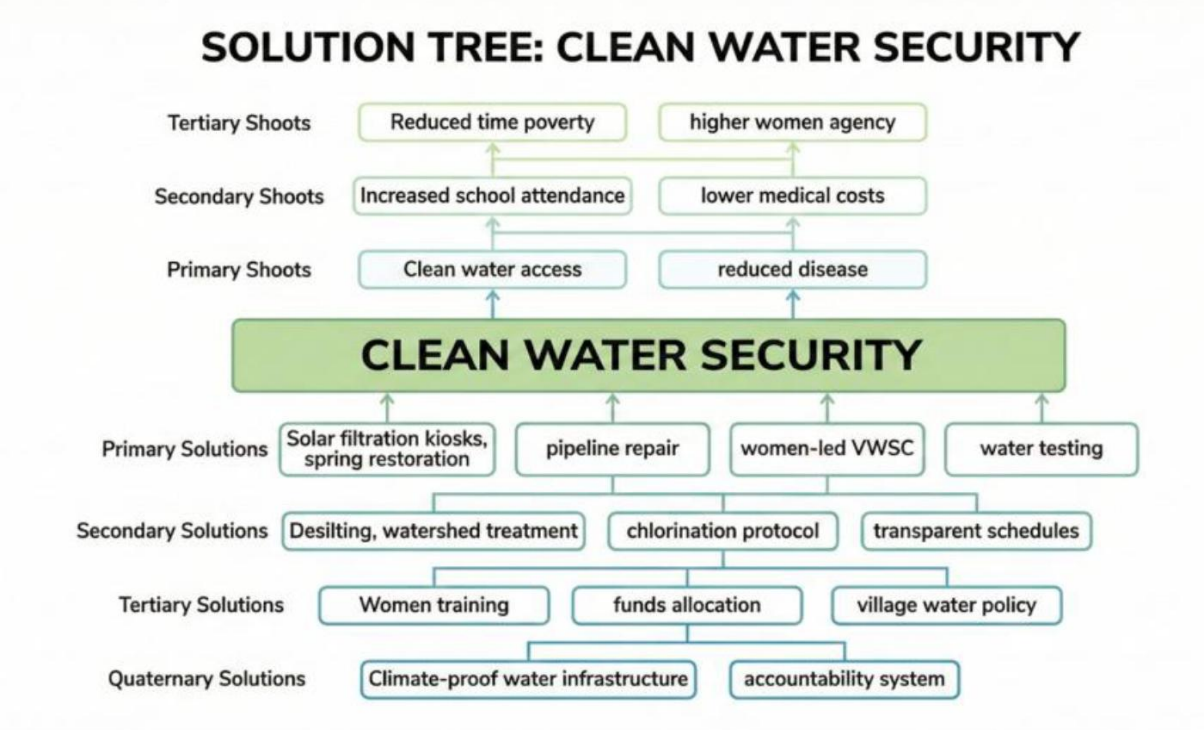
Activity	Timing	Implications for Vulnerability
Intercultural Operations	January – February	Routine agricultural labour period with moderate workload. Women's labour remains continuous but relatively stable; limited cash flow during this phase sustains baseline vulnerability.
Harvest (Rabi / Residual Crops)	March – April	Women exercise greater decision-making in post-harvest handling. However, this period coincides with rising temperatures, increasing physical strain and early signs of water stress.
Harvest, Mulching, Burning	May	Transition period marking the onset of the lean season. Heat stress intensifies, water sources begin drying, and women's workload increases despite declining productivity.
Land Preparation and Sowing (Kharif)	June	High labour demand under monsoon uncertainty. Physical exhaustion increases, especially for women, as agricultural labour overlaps with intensified domestic and water collection responsibilities.
Manuring	July	Performed during peak monsoon conditions. Exposure to waterlogging, leeches, and infections increases, while reproductive labour does not reduce, compounding health risks for women.
Weeding and Pest Control	August	One of the most labour-intensive periods, largely manual and women-dominated. Erratic rainfall and weed proliferation significantly intensify women's drudgery.
Harvest (Kharif)	September	Relatively reliable harvest period providing short-term food security. Labour demand remains high, but cash and grain inflow temporarily reduce economic stress.
Storage	October	Post-harvest management phase. Women play a key role in drying, storage, and protection of grain, critical for household food security but largely unpaid and unrecognised.

Land Preparation and Sowing (Rabi)	November	Mechanised operations dominate and are mostly controlled by men. Women's exclusion from mechanised decision-making limits control despite continued labour contribution.
Weeding (Rabi Crops)	December	Manual weeding without herbicide use increases women's physical workload. Cold-season labour combines with domestic responsibilities, sustaining chronic time poverty.

SEASONAL CALENDAR: SUDHAGAD

Activity	**Timing**	**Implications for Vulnerability**
Rice Sowing	June - July	Peak Labor Demand. High caloric expenditure during the onset of monsoon diseases.
Nachni (Millet) Intercropping	June - August	Critical for tribal food security. Millets are the nutritional safety net.
Harvest	Oct - Nov	Period of cash influx. Relatively low stress.
Vegetable Cultivation	Dec - Feb	Only possible near water sources. A differentiator between landed and landless.
Fallow Land / Lean Season	March - May	The Danger Zone. Water sources dry up; heat stress peaks; food stocks dwindle. Migration increases.

SOLUTION TREE ANALYSIS : ROHA



The Solution Tree for Clean Water Security presents a layered, systems-based pathway that explicitly links infrastructure, governance, gender justice, and long-term resilience. Unlike linear project planning, the solution tree mirrors the earlier problem tree and demonstrates that water insecurity cannot be resolved through a single intervention; instead, it requires coordinated action across technical, institutional, and social domains.

At the core, *Clean Water Security* is positioned not merely as an infrastructure outcome but as a transformational node that alters multiple dimensions of wellbeing. The framing already signals a shift from viewing water as a commodity or service to understanding it as a capability-enabling resource, particularly for women and children.

The Primary Solutions layer focuses on immediate, tangible interventions that directly address access and quality. Measures such as *solar filtration kiosks* and *spring restoration* respond to ecological realities declining groundwater, contaminated surface water, and unreliable supply while being appropriate for decentralised rural contexts. *Pipeline repair* addresses chronic governance neglect and infrastructure decay, while *women-led Village Water and Sanitation Committees (VWSCs)* represent a deliberate gender intervention. Importantly, women's leadership here is not symbolic; it aligns authority with responsibility, correcting the long-standing mismatch where women manage water daily but are excluded from decision-making. *Water testing* institutionalises quality assurance, shifting households from reactive illness management to preventive public health.

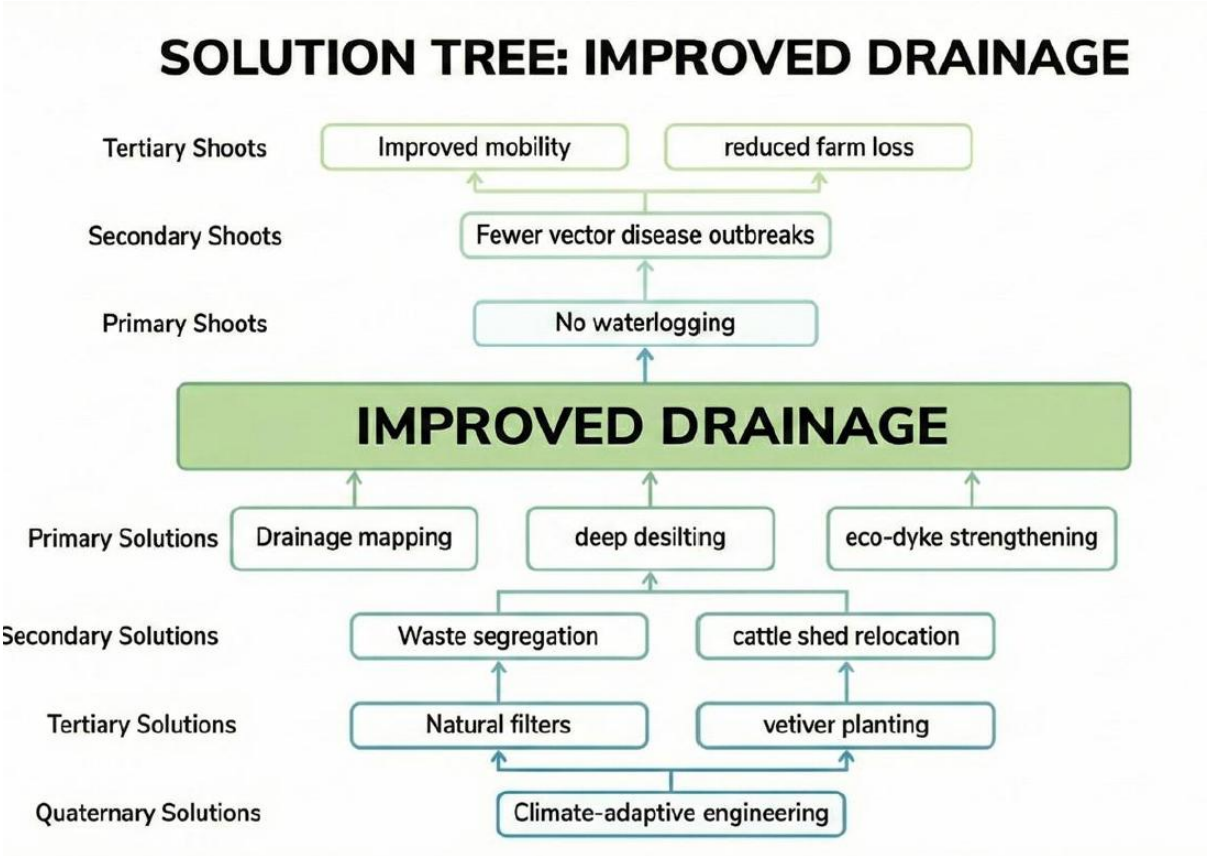
The Secondary Solutions layer addresses system functionality and sustainability. *Desilting and watershed treatment* tackle hydrological root causes, improving recharge and reducing

seasonal scarcity. *Chlorination protocols* formalise public health safeguards, while *transparent schedules* directly confront everyday power asymmetries uncertainty, favouritism, and politicisation of tanker supply that disproportionately burden women. This layer demonstrates that infrastructure without operational rules reproduces inequality.

The Tertiary Solutions move further upstream into institutional capacity and political economy. *Women's training* builds technical and governance competence, countering narratives that justify exclusion on the basis of "lack of capacity." *Funds allocation* and a *village water policy* embed water security into formal planning and budgeting, preventing dependence on ad hoc projects or NGOs. This is where SDG 5 (Gender Equality) and SDG 6 (Clean Water and Sanitation) intersect most explicitly.

Finally, the Quaternary Solutions articulate long-term structural change. *Climate-proof water infrastructure* acknowledges that climate variability is now a permanent condition, not an anomaly. *Accountability systems* social audits, grievance mechanisms, and monitoring ensure that gains are not eroded by elite capture or institutional decay. This layer links SDG 13 (Climate Action) with governance reform.

The shoots of the tree clearly illustrate why water interventions matter beyond water. Reduced disease and reliable access lead to *lower medical costs*, *higher school attendance*, and critically, *reduced time poverty* for women. At the highest level, the emergence of *higher women's agency* signals a justice-oriented outcome: water security becomes a lever for redistributing power, not just resources.



At the **core**, *Improved Drainage* is positioned as a systemic enabling condition. This central framing is critical because drainage failures are rarely visible as a standalone problem; instead, they manifest through disease outbreaks, crop losses, damaged roads, and restricted movement. By placing drainage at the centre, the solution tree correctly identifies it as an infrastructural backbone that supports multiple development outcomes simultaneously.

The **Primary Shoots** *no waterlogging* represent the most immediate and tangible outcome. Eliminating stagnant water directly interrupts mosquito breeding cycles, reduces soil anoxia in agricultural fields, and restores safe passage through village roads and pathways. This primary outcome links directly to the **Secondary Shoots**, notably *fewer vector-borne disease outbreaks*. The tree thus explicitly connects drainage with public health, countering the common tendency to silo sanitation, health, and infrastructure planning.

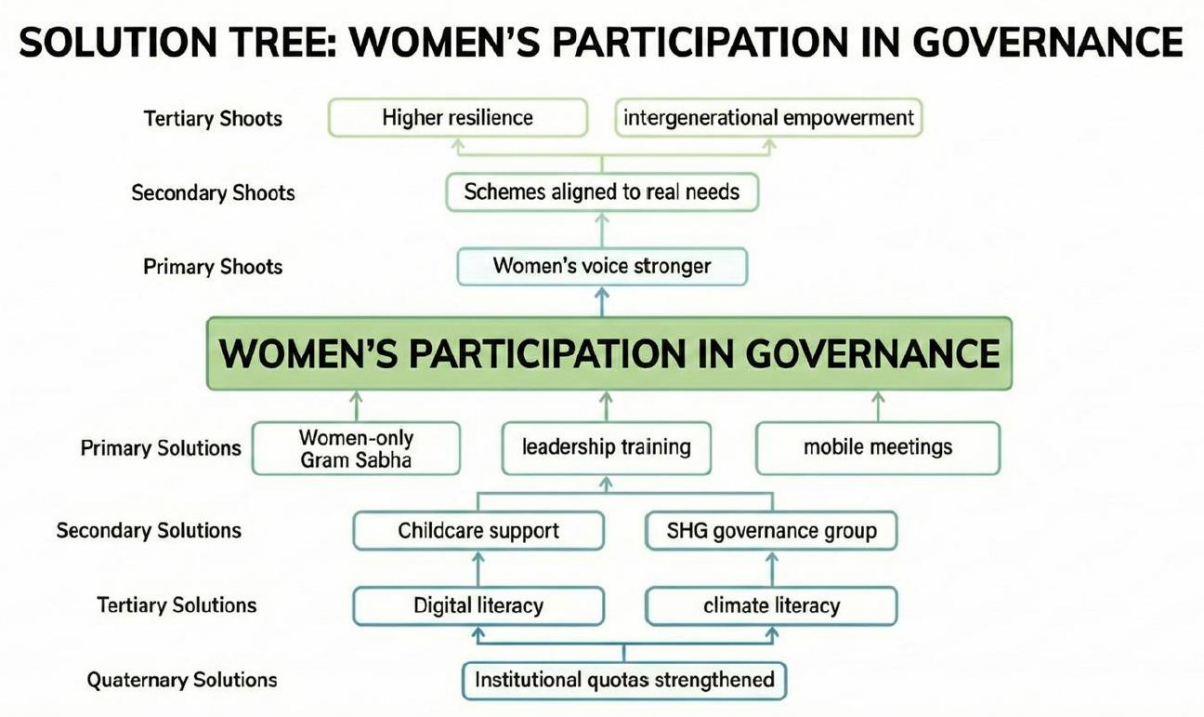
At the **Tertiary Shoots** level, the benefits expand beyond health into livelihoods and mobility. *Improved mobility* reflects safer, all-season access to schools, markets, health centres, and workplaces an outcome with particularly strong gender implications, as women's mobility is often constrained during monsoons due to flooded paths. *Reduced farm loss* highlights how drainage affects agricultural productivity, preventing crop damage, soil erosion, and delayed harvesting. Together, these outcomes demonstrate that drainage is both a **resilience-building and poverty-reduction intervention**.

The **Primary Solutions** layer focuses on technical foundations. *Drainage mapping* is especially significant, as it addresses the frequent absence of accurate, village-level drainage plans. Without mapping, desilting and construction remain ad hoc and ineffective. *Deep desilting* restores hydraulic capacity of nalas and channels, while *eco-dyke strengthening* introduces hybrid infrastructure that combines physical protection with ecological buffering, reducing failure during extreme rainfall events.

The **Secondary Solutions** introduce governance and land-use dimensions. *Waste segregation* directly tackles plastic and mixed-waste blockages, a major cause of drainage failure. *Cattle shed relocation* addresses a socially sensitive but structurally important issue, as livestock waste often enters open drains, exacerbating clogging and contamination. This layer shows that drainage cannot be fixed without negotiating everyday practices and spatial arrangements.

The **Tertiary Solutions** *natural filters* and *vetiver planting* embed ecological design into drainage systems. These nature-based solutions slow runoff, filter sediments, stabilise soil, and reduce maintenance costs, aligning drainage improvement with SDG 15 (Life on Land) and long-term sustainability.

Finally, the **Quaternary Solution** of *climate-adaptive engineering* acknowledges that historical drainage designs are inadequate under intensified rainfall regimes. This layer situates drainage within SDG 13 (Climate Action), recognising that infrastructure must be designed for future climate variability rather than past norms.



The **Solution Tree for Women's Participation in Governance** presents a structurally layered and socially grounded pathway for transforming women's political inclusion from symbolic presence to substantive power. The tree correctly recognises that low participation is not a problem of motivation, but of **institutional design, care burdens, knowledge asymmetries, and entrenched norms**, and therefore proposes solutions across multiple depths rather than a single intervention.

At the **core**, *Women's Participation in Governance* is framed as a systemic lever rather than a standalone gender objective. This positioning is analytically important because women's participation is treated not merely as a rights-based outcome (SDG 5), but as an enabling condition for better governance, resilience, and intergenerational equity. The **Primary Shoots** *women's voice stronger* represent the most immediate outcome of participation: the shift from silence or tokenism to articulation, confidence, and claim-making. This is a qualitative change in power, not just numerical attendance.

The **Secondary Shoots**, *schemes aligned to real needs*, highlight a critical governance insight: when women participate meaningfully, development priorities shift. Issues such as water reliability, sanitation, health access, childcare, and climate stress often marginal in male-dominated forums enter planning processes. This layer shows that participation directly improves policy effectiveness, not just inclusivity. The **Tertiary Shoots**, *higher resilience* and *intergenerational empowerment*, extend this logic temporally. Women's governance participation strengthens household and community adaptive capacity, while also reshaping norms for girls, signalling that leadership and public voice are legitimate female roles.

The **Primary Solutions** target immediate participation barriers. *Women-only Gram Sabha* spaces address fear, caste hierarchy, and patriarchal silencing by creating safe deliberative

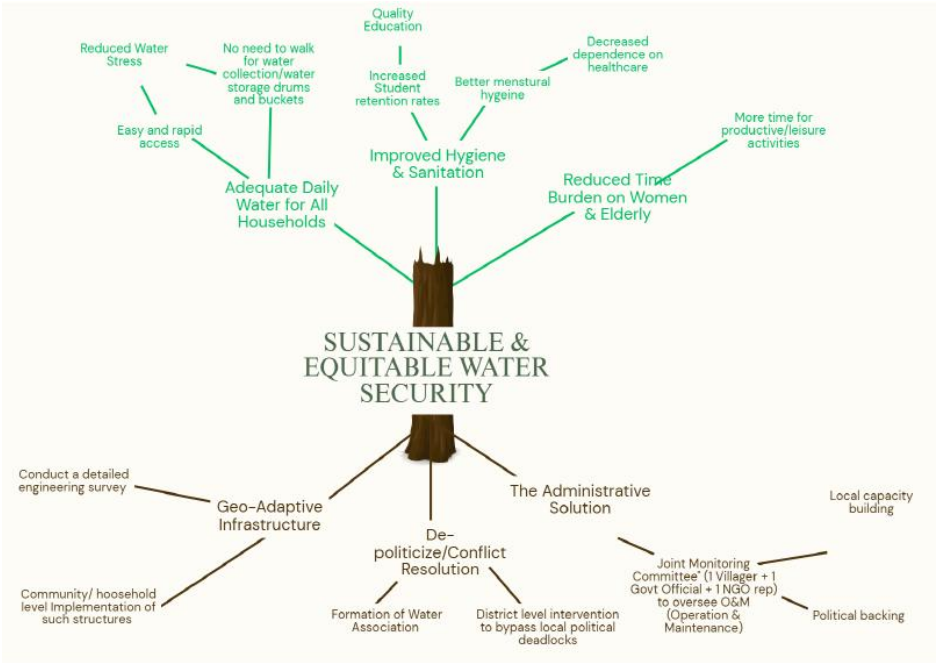
forums. *Leadership training* builds procedural confidence understanding agendas, budgets, and schemes while *mobile meetings* confront spatial and time poverty, especially relevant in remote or climatically stressed villages. Together, these solutions recognise that participation must adapt to women's lived realities rather than expecting women to adapt to rigid institutions.

The **Secondary Solutions** *childcare support* and *SHG governance groups* directly confront the care economy. By acknowledging unpaid care work as a governance constraint, the tree integrates feminist political economy into local governance reform. SHGs function as bridging institutions, translating collective economic participation into political confidence and organisational capacity.

At the **Tertiary Solutions** level, *digital literacy* and *climate literacy* expand the substance of participation. Digital skills enable women to access information, lodge grievances, and track schemes, while climate literacy equips them to engage with adaptation planning, disaster preparedness, and resource governance linking participation to SDG 13. These layers move participation beyond presence to informed decision-making.

Finally, the **Quaternary Solution** *strengthened institutional quotas* anchors change structurally. Without enforceable quotas and accountability, gains at lower levels risk reversal. This layer recognises that transformation requires institutionalisation, not just capacity-building.

SOLUTION TREE ANALYSIS: SUDHAGAD



The Solution Tree for Sustainable and Equitable Water Security presents a holistic and justice-oriented framework that explicitly connects technical water provisioning with gender equity, governance reform, and human development outcomes. Unlike conventional water-sector interventions that focus narrowly on infrastructure delivery, this tree visualises water security as a social–ecological system, where benefits, burdens, and decision-making power are unevenly distributed.

At the core, *Sustainable & Equitable Water Security* is framed not merely as availability of water, but as a condition that reshapes everyday life, especially for women, girls, and the elderly. The upper branches (positive outcomes) clearly demonstrate this multidimensionality. *Adequate daily water for all households* directly leads to *easy and rapid access* and *reduced water stress*, eliminating the need for long-distance water collection and storage through drums and buckets. This is critical because it dismantles one of the most time-intensive and physically demanding components of women's unpaid labour.

From this core, the tree links water security to human capital outcomes. *Improved hygiene and sanitation* leads to *better menstrual hygiene*, *higher student retention rates*, and ultimately *quality education*. This explicitly foregrounds adolescent girls often invisible in water planning by showing how water availability directly affects school attendance and dignity. Simultaneously, *decreased dependence on healthcare* reflects reduced waterborne disease and lower medical expenditure, a significant economic relief for low-income households.

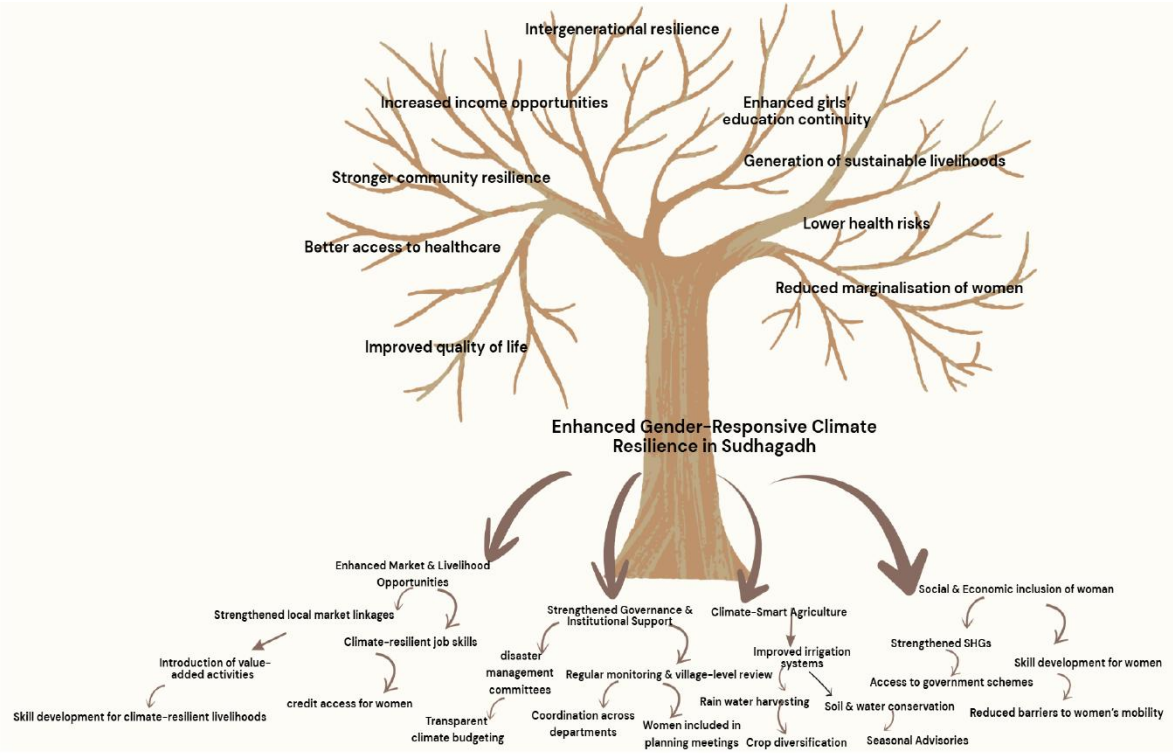
Another crucial branch is the *reduced time burden on women and the elderly*, which releases time for *productive and leisure activities*. This is a transformative insight: water security is shown not only to reduce suffering but to expand agency time that can be redirected toward livelihoods, rest, participation in governance, or education. In this sense, the solution tree embeds SDG 6 (Clean Water) within SDG 5 (Gender Equality) and SDG 4 (Quality Education), while also strengthening adaptive capacity relevant to SDG 13 (Climate Action).

The root system (solutions) is equally important. *Geo-adaptive infrastructure* acknowledges climatic and ecological realities, emphasising engineering surveys and locally appropriate designs rather than one-size-fits-all pipelines. This reflects an understanding that sustainability depends on aligning infrastructure with terrain, hydrology, and climate variability.

The branch of *de-politicisation and conflict resolution* is particularly significant. By proposing *water associations* and *district-level intervention to bypass local political deadlocks*, the tree recognises that water scarcity is often governance-driven rather than hydrological. This is a direct response to elite capture, partisan tanker politics, and exclusionary decision-making that disproportionately disadvantage women and marginalised groups.

The administrative solution *joint monitoring committees* involving villagers, government officials, and NGOs introduces shared accountability for operation and maintenance. This

shifts water systems from being reactive and breakdown-prone to institutionally sustained. The inclusion of *local capacity building* and *political backing* reinforces that technical solutions cannot survive without social legitimacy and institutional support.



The **Solution Tree for Enhanced Gender-Responsive Climate Resilience in Sudhagad** presents a comprehensive transformation pathway that links climate adaptation with gender justice, livelihoods, and institutional reform. Unlike sector-specific solutions, this tree conceptualises resilience as a **structural reorganisation of social, economic, and governance systems**, with women positioned as central agents rather than passive beneficiaries.

At the **crown of the tree**, the long-term outcomes reflect a shift from vulnerability to sustained wellbeing. *Intergenerational resilience* and *enhanced girls' education continuity* indicate that climate resilience is not confined to present shocks but reshapes future capabilities. When climate stress no longer disrupts schooling or forces girls into care and labour roles, educational trajectories stabilise, enabling long-term social mobility. Similarly, *generation of sustainable livelihoods* and *increased income opportunities* demonstrate that resilience is economic as much as ecological moving households away from crisis coping toward stability and growth.

The outcomes also highlight **gender-specific gains**. *Reduced marginalisation of women* and *lower health risks* show how climate-responsive interventions can dismantle the structural burdens women face particularly unpaid labour, health stress, and restricted mobility. *Improved quality of life* and *better access to healthcare* further reinforce that resilience is lived through everyday conditions, not abstract indicators. Importantly, *stronger community*

resilience situates women's wellbeing within collective capacity, recognising that household-level resilience aggregates into community-level stability.

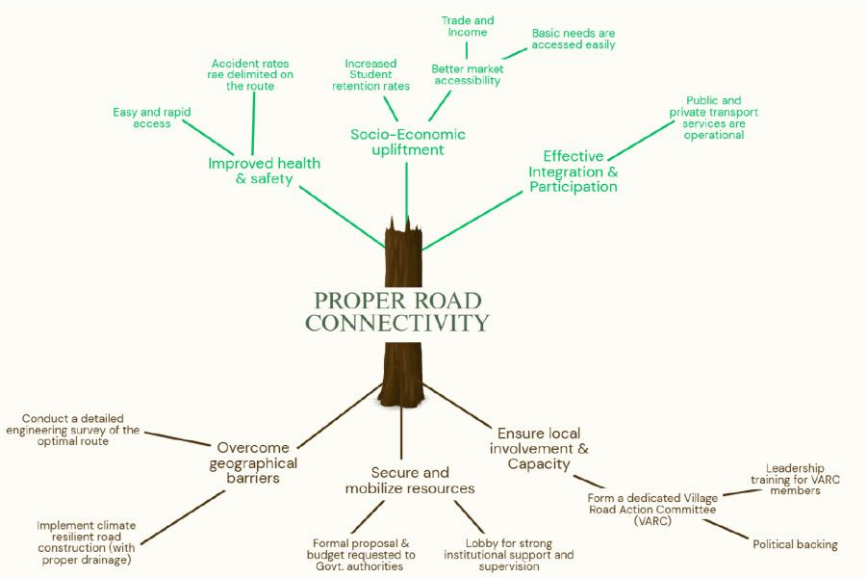
The **trunk**, labelled *Enhanced Gender-Responsive Climate Resilience in Sudhagad*, acts as the integrative core where economic, institutional, agricultural, and social pathways converge. This reflects an understanding that climate resilience cannot be achieved through isolated interventions; it requires coordinated action across sectors that shape women's lives simultaneously.

The **root system** reveals how this transformation is grounded. *Enhanced market and livelihood opportunities* focus on structural economic inclusion strengthening local market linkages, introducing value-added activities, building climate-resilient job skills, and expanding credit access for women. These roots directly challenge the feminisation of low-return labour and seasonal distress migration.

Strengthened governance and institutional support addresses the political dimensions of vulnerability. Disaster management committees, transparent climate budgeting, regular monitoring, and cross-departmental coordination are critical for preventing climate risk from being shifted onto women's unpaid labour. Crucially, the explicit inclusion of women in planning meetings marks a shift from token participation to substantive voice.

The *climate-smart agriculture* root embeds adaptation within everyday livelihoods. Improved irrigation, rainwater harvesting, soil and water conservation, crop diversification, and seasonal advisories reduce climate uncertainty while stabilising women's agricultural workloads. This connects ecological resilience directly to gendered labour outcomes.

Finally, *social and economic inclusion of women* strengthens collective agency through Self-Help Groups (SHGs), access to government schemes, skill development, and reduced mobility barriers. This root recognises that resilience requires social infrastructure networks, confidence, and institutional access not just physical assets.



The **Solution Tree for Proper Road Connectivity** presents road infrastructure not merely as a physical asset but as a **foundational enabler of social inclusion, economic mobility, and climate resilience**. The structure of the tree clearly illustrates how investments in connectivity generate cascading benefits across health, education, livelihoods, and governance, particularly for remote and marginalised settlements.

At the **crown of the tree**, the outcomes reflect multidimensional development gains. *Improved health and safety* emerges as a direct consequence of reliable roads, as emergency access improves and accident risks along unsafe informal routes are reduced. This is especially critical for women, elderly persons, and pregnant individuals who otherwise face delays in reaching health facilities. *Improved student retention rates* highlight the education–infrastructure nexus: when roads are reliable, school attendance becomes consistent, dropouts decline, and intergenerational disadvantage is interrupted.

The branch labelled *socio-economic upliftment* captures the economic transformation enabled by connectivity. Better market accessibility allows households to sell agricultural produce, forest products, and wage labour more efficiently, translating into *trade and income generation*. When *basic needs are accessed easily*, households reduce dependence on distress coping strategies such as migration, debt, or child labour. Road connectivity thus functions as an economic multiplier rather than a stand-alone development input.

Another critical outcome is *effective integration and participation*. Roads reduce physical and social isolation, enabling regular interaction with governance institutions, service providers, and civil society. The presence of *public and private transport services* further expands mobility options, particularly for women and youth, strengthening their participation in education, employment, and local decision-making. Connectivity therefore reshapes power relations by reducing spatial marginalisation.

The **trunk**, labelled *Proper Road Connectivity*, represents the integrative core linking outcomes to structural actions. It underscores that roads are not only transport corridors but **pathways of access, voice, and opportunity**, especially in geographically constrained regions.

The **roots** reveal the enabling conditions required to achieve sustainable connectivity. *Overcoming geographical barriers* recognises that hilly terrain, forest cover, and fragile slopes demand context-sensitive planning rather than standardised road designs. Conducting detailed engineering surveys and adopting climate-resilient construction with proper drainage are crucial to ensure durability under extreme rainfall and erosion.

Securing and mobilising resources addresses the political economy of infrastructure. Formal proposals, budget allocations, and sustained lobbying for institutional support are necessary to move roads from plans to implementation. This root acknowledges that infrastructure gaps often persist not due to technical impossibility, but due to low political priority assigned to remote communities.

Equally important is *ensuring local involvement and capacity*. The formation of a Village Road Action Committee (VARC) embeds accountability and ownership at the community level. Leadership training, political backing, and inclusive participation ensure that road projects reflect local needs, reduce elite capture, and remain functional over time.

5.

CLIMATE CHANGE VULNERABILITY IN ROHA, RAIGAD DISTRICT, MAHARASHTRA

5.1 Socio-Economic Profile of the Study Villages in Roha

This section presents a baseline socio-economic profile of the three study villages Pale Budruk, Pale Khurd, and Sambhe located in Roha taluka. The profile focuses on demographic structure, social composition, livelihood systems, education and health infrastructure, water and sanitation conditions, and dependence on natural resources. The objective is to document existing social and economic conditions that shape everyday life and development outcomes, which later chapters will draw upon for vulnerability and action planning analyses.

5.1.1 Demographic Characteristics

The three villages show broadly similar demographic patterns, with variation primarily in settlement size. Pale Budruk is the largest village with approximately 450 households, followed by Pale Khurd with around 350 households, and Sambhe with nearly 250 households. Household structures are predominantly joint or extended, reflecting agrarian social organization, though nuclear households are increasing as younger generations migrate for employment.

Average household size ranges from four to six members. A substantial proportion of the population lies within the working-age group of 18–45 years. However, sustained migration of youth to Mumbai, Pune, Panvel, and the Roha MIDC has altered local demographic composition. As a result, a growing share of households is managed primarily by women and elderly members, with children remaining dependent on local caregiving arrangements.

Children constitute roughly 20–25 percent of the population. Primary school enrollment is nearly universal due to government incentives, including midday meals, uniforms, and free textbooks. Attendance, however, varies across hamlets, and dropout rates increase significantly at the secondary level. Girls particularly from tribal hamlets show lower continuation rates due to household responsibilities, distance to secondary schools, and mobility and safety concerns.

5.1.2 Social Composition and Caste Dynamics

The social structure of the villages is characterised by clear caste and tribal stratification that continues to influence land ownership, residential patterns, and access to resources. Other Backward Class groups, primarily Kunbi and Agri communities, dominate agricultural land ownership and reside in centrally located, better-connected hamlets. These households typically own one to five acres of land, although fragmentation across generations has reduced average holding size.

Scheduled Caste households are largely located in peripheral hamlets. While explicit discrimination has declined, social distance persists in subtle forms, including marriage practices, festival participation, and informal social interactions. Most SC households are landless or own marginal plots, resulting in heavy dependence on agricultural wage labour.

Scheduled Tribe households, particularly the Katkari community, live in forest-adjacent hamlets located several kilometres from village centres. Historically dependent on non-timber forest products such as honey, wild fruits, medicinal plants, and fuelwood, these households have experienced livelihood transitions over time. Recognition of land rights under the Forest Rights Act (2006) has occurred unevenly. Many households report receiving land titles for plots that are difficult to cultivate due to slope, soil quality, or distance, limiting productive use.

Inter-caste interactions have increased through markets, education, and government programmes. However, caste remains a strong determinant of land access, housing location, livelihood security, and participation in local institutions.

5.1.3 Livelihood Systems and Local Economy

Agriculture remains the primary source of livelihood for all three villages. Major crops include paddy during the Kharif season, finger millet (nachni), pulses, vegetables, and groundnut. Over time, cropping patterns have shifted away from water-intensive cultivation toward crops that require lower labor and input investments. Rabi cropping has declined substantially.

Irrigation infrastructure, particularly the Kundalika canal system, has been non-functional for several years. As a result, agriculture is largely dependent on rainfall, and household incomes fluctuate seasonally. Farmers report increasing production uncertainty, rising input costs, and growing pest pressures, which have reduced profitability.

Secondary livelihood activities include agricultural wage labour, construction work, employment in nearby industrial areas, migration to urban centres, small retail businesses, forest product collection, and limited livestock rearing. Livestock numbers have declined due to fodder scarcity and labour shortages.

Women make significant contributions to agriculture, forestry, and informal employment. Despite this, wage disparities persist, with women earning significantly less than men for similar agricultural tasks. Self-Help Groups operate in all villages, providing women with access to small loans and collective spaces. However, limited market access, lack of technical support, and household financial pressures constrain the economic impact of these groups.

Access to formal credit remains limited, particularly for women, due to land-based collateral requirements, documentation barriers, and digital exclusion. Many households rely on informal moneylenders, leading to chronic indebtedness.

5.1.4 Education and Health Infrastructure

Each village has access to primary education facilities, ensuring high enrollment rates in the early grades. Secondary education requires travel to nearby towns, creating logistical and financial barriers. Literacy rates have improved over generations, but gender gaps remain pronounced among older populations. Tribal girls face additional barriers due to distance, household responsibilities, and language differences.

Health infrastructure includes a sub-center serving the village cluster, with the nearest Primary Health Center located in Roha town. ASHA workers play a crucial role in maternal and child health services, and institutional deliveries are now common. Emergency transport services are available but face seasonal access constraints.

Healthcare for the elderly and management of chronic illnesses remain inadequate. Common health concerns include seasonal fevers, anaemia among women and adolescent girls, musculoskeletal disorders linked to physical labour, malnutrition in low-income households, and occupational injuries. Women's reproductive health services exist but are mediated largely through male family members.

5.1.5 Water and Sanitation Conditions

Drinking water sources include seasonal springs, borewells, handpumps, and piped connections provided under the Jal Jeevan Mission. While household connections exist, the water supply is intermittent, and quality concerns persist. Women are primarily responsible for collecting and managing water, often relying on multiple sources to meet their household needs.

Village Water and Sanitation Committees exist but function irregularly. Participation of women in decision-making remains limited despite their central role in water use and management.

Sanitation coverage has expanded through government programmes, but functionality remains constrained by water availability. Solid waste management systems are informal, with limited segregation or disposal infrastructure.

5.1.6 Natural Resource Use

The forests surrounding the villages provide fuelwood, fodder, minor forest products, and cultural value, particularly for tribal households. Over time, forest composition has undergone changes, with a decline in native species and the spread of invasive plants. Availability of wild foods and medicinal plants has decreased.

Forest governance structures, such as Joint Forest Management Committees, exist but are weakly functional. Local ecological knowledge, particularly among tribal elders, is increasingly marginalised in formal management processes.

Soils across upland and lowland areas show varying constraints, including erosion, waterlogging, and declining organic matter. Wetlands and local waterbodies have experienced siltation and encroachment, which have affected fisheries and groundwater recharge.

5.2 Baseline Climate Vulnerability Assessment in Roha

This Baseline Climate Vulnerability Assessment examines climate risks in Roha through a **socially grounded and justice-oriented framework**, recognising that vulnerability is not solely the outcome of climatic hazards but is **produced through historical, institutional, and social inequalities**. The assessment explicitly moves beyond technocratic models that reduce

vulnerability to exposure metrics, and instead foregrounds the **lived realities of women, Scheduled Caste (SC) and Scheduled Tribe (ST) communities, the elderly, widows, and economically marginal households**.

The analytical framework draws on **Nancy Fraser's triadic justice model redistribution, recognition, and representation** to understand why existing adaptation interventions fail to reduce vulnerability for marginalized groups. This approach enables an examination of how material deprivation (land, water, assets), social devaluation (of women's labour and indigenous knowledge), and political exclusion (from governance and decision-making) interact to intensify climate risk.

Conventional climate adaptation initiatives in the region largely ignore **unpaid care work and reproductive labour**, reinforce existing power hierarchies, and operate through top-down governmentality that produces passive beneficiaries rather than autonomous actors. Climate vulnerability in Roha is therefore understood as **structurally embedded**, requiring institutional transformation rather than incremental technical fixes.

5.2.2 Ecological Context and Biophysical Stressors

Roha receives an annual rainfall of approximately **2000–2500 millimetres**, yet rainfall patterns have become increasingly erratic and unpredictable. The monsoon season has extended anomalously into late October and November, disrupting agricultural calendars that communities have historically relied upon. Rainfall intensity has increased, with extreme events delivering **100–150 mm in a single day**, causing flash floods, waterlogging, and soil erosion, particularly in low-lying areas.

Hydrological systems are under severe stress. **Seasonal springs that were once perennial are now drying up earlier each year**, with March becoming the new threshold for water scarcity, replacing the earlier April–May period. Groundwater recharge has declined due to rapid runoff, deforestation, and land degradation. The **Kundalika-fed canal system**, once central to irrigation, has been non-functional for four to five years, forcing agriculture to rely almost entirely on rainfall.

Soil characteristics vary across the landscape. Lowlands with clayey soils experience prolonged waterlogging during intense rainfall, while upland areas with shallow, rocky soils are prone to erosion and low productivity. Forest cover has declined significantly, with invasive species replacing native vegetation and reducing the availability of Non-Timber Forest Products (NTFPs). Biodiversity loss has weakened traditional ecological systems and local food security.

5.2.3 Intersectional Vulnerability

5.2.3.1 Tribal Elderly Women

Tribal elderly women experience **compounded vulnerability** arising from gender, age, caste, spatial isolation, and institutional exclusion. Many live in forest-adjacent hamlets located several kilometres from village centres, with poor road connectivity that becomes impassable

during monsoons. Low literacy and language barriers exclude them from written information systems and formal processes.

Land tenure remains insecure despite Forest Rights Act claims. Pension systems operate irregularly, and healthcare access is constrained by distance and immobility. As articulated by an elderly widow from Pale Khurd, *"I have land but cannot farm it. No water, no strength. My sons are in Panvel. I eat one meal."* This illustrates how nominal land ownership becomes meaningless without water, labour, or institutional support.

5.2.3.2 Scheduled Caste Women

Scheduled Caste women face vulnerability shaped by **spatial segregation and persistent social exclusion**. SC hamlets are typically located on village peripheries, often in flood-prone and under-served areas. Although overt discrimination has declined, informal exclusion persists in access to employment, information, and social networks.

Landlessness is widespread, forcing people to depend on irregular and often discriminatory wage labour. Women report lower literacy, limited access to schemes, and higher rates of domestic violence linked to economic stress and social marginalization. Children from SC households show higher dropout rates, reinforcing intergenerational vulnerability.

5.2.3.3 Widows and Single Women

Widows and single women experience acute vulnerability due to **gendered property regimes and social isolation**. Land and housing are typically registered in the names of male relatives, leaving widows dependent on their sons or brothers. During climate shocks, they are excluded from compensation, insurance, and credit schemes tied to male land titles.

Social norms restrict their participation in Gram Sabha meetings, while access to pensions remains irregular due to documentation barriers. These women experience climate shocks with minimal buffering capacity, relying on informal support rather than institutional entitlements.

5.2.3.4 Young Mothers

Young mothers face **extreme time poverty**, balancing childcare, agriculture, water collection, and domestic work. Anaemia and nutritional deficits are widespread, reflecting household food distribution norms in which women often eat last and least. Mobility constraints prevent participation in training programs or livelihood diversification activities.

During floods or heatwaves, young mothers cannot evacuate or access relief centers due to infant care responsibilities. The absence of childcare support excludes them from adaptation initiatives, widening knowledge and opportunity gaps.

5.4 Exposure Analysis: The Social Production of Hazards

Climate exposure in Roha is **socially produced**, not merely natural. Biophysical hazards floods, droughts, heat stress, pest outbreaks are amplified by governance failures including the prolonged breakdown of irrigation infrastructure, clogged drainage systems, inadequate road connectivity, absence of flood shelters, and unreliable water supply systems.

Spatial inequality further intensifies exposure. SC and ST hamlets are systematically located farther from roads, water infrastructure, and services, a legacy of caste-based settlement patterns. Women experience higher exposure due to their daily interaction with hazard-prone environments through farming, water collection, fuelwood gathering, and caregiving.

5.2.5 Sensitivity: Differential Impacts

5.2.5.1 Women

Women exhibit heightened sensitivity due to time poverty, poor health status, nutritional inequality, mobility restrictions, and economic dependence. Climate shocks multiply women's workloads while reducing access to income and institutional support. Sanitation failures and water scarcity exacerbate health risks, particularly during menstruation and pregnancy.

5.2.5.2 SC and ST Households

SC and ST households face higher sensitivity due to marginal landholdings, spatial remoteness, dependence on climate-sensitive livelihoods, and weaker engagement with state institutions. Informal discrimination during relief distribution further compounds vulnerability.

5.2.5.3 Elderly and Disabled Persons

Elderly and disabled individuals face immobility, health fragility, and institutional invisibility. Pension delays, inaccessible relief systems, and lack of tailored support increase dependence on family caregivers, typically women.

5.2.6 Adaptive Capacity Assessment

5.2.6.1 Redistribution Failures (Material Assets)

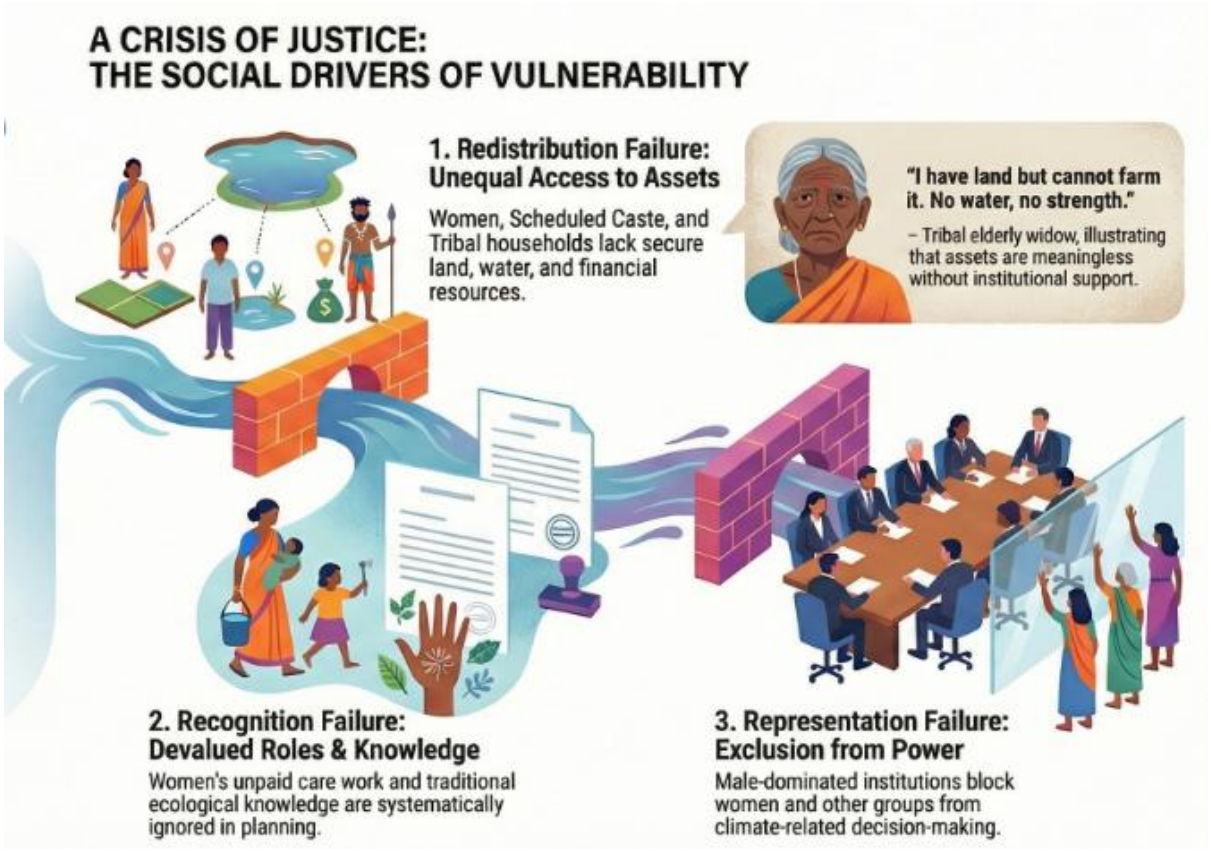
Land, water, financial, and physical assets are unequally distributed. Women lack land titles; tribal tenure remains insecure; SC households are largely landless. Water infrastructure failures and a lack of storage exacerbate scarcity. Financial exclusion forces reliance on informal lenders, while poor housing quality increases exposure to hazards.

5.6.2 Recognition Failures (Social Assets)

Women's labour, ecological knowledge, and lived experience remain undervalued. Governance institutions, such as Gram Panchayats, Water Committees, and Forest Committees, are often male-dominated, with women's participation being largely tokenistic.

5.6.3 Representation Failures (Institutional Access)

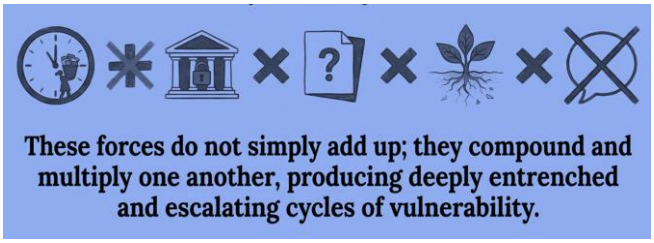
Agricultural extension, weather information, insurance, and compensation systems are tied to male land ownership. Women participate as labourers but are excluded from planning and decision-making, limiting the adoption of climate-resilient practices.



5.6.7 Priority Vulnerability Drivers

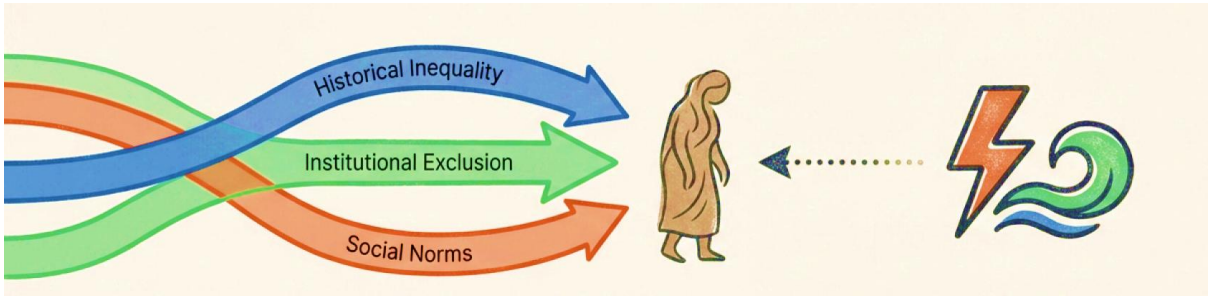
- Time poverty and the unpaid care burden
- Land and tenure insecurity
- Institutional exclusion and patriarchal governance
- Loss of traditional ecological knowledge
- Symbolic violence and cultural devaluation of women's labour

These drivers interact multiplicatively rather than additively, producing deeply entrenched vulnerability.



5.3 Gendered Vulnerability Assessment in Roha

Understanding gendered vulnerability to climate change in Roha requires an analytical approach that goes beyond treating gender as a simple demographic variable. Climate impacts in the region are not experienced uniformly; rather, they are mediated through deeply embedded social relations that structure who performs which kinds of labour, who controls resources, and who has voice in decision-making processes. To capture this complexity, the present study adopts three complementary gender analysis frameworks: the Gendered Division of Labour framework, the Harvard Framework of Access, Control, and Benefits, and the Moser Framework of Women's Triple Role. Together, these frameworks enable a multidimensional and justice-oriented assessment of how climate change produces differentiated vulnerabilities among women and men in Roha.



The **Gendered Division of Labour framework** provides the entry point for understanding exposure and sensitivity to climate stress. In Roha, women and men perform sharply differentiated roles across agriculture, household reproduction, and community life. Women dominate labour-intensive, climate-exposed tasks such as paddy transplanting, weeding, water collection, fuelwood gathering, and care work, while men control mechanized operations, market interactions, and institutional engagement. As rainfall becomes erratic and water scarcity intensifies, women's workloads expand disproportionately, leading to severe time poverty, physical exhaustion, and health decline. This framework thus captures how climate variability interacts with existing labour hierarchies to intensify women's exposure and sensitivity to climate risks.

The **Harvard Framework**, which distinguishes between access to resources and control over them, illuminates the structural roots of adaptive capacity. In Roha, women may have access to land, water, forests, and climate-related programs through their labour and daily use, but they lack decision-making authority and ownership. Land titles, irrigation infrastructure, forest governance, and climate finance remain overwhelmingly controlled by men. As a result, women are systematically excluded from crop insurance, compensation for climate losses, credit, and technology subsidies. This framework reveals how institutional arrangements convert climate shocks into long-term vulnerability by denying women the means to respond autonomously to environmental stress.

The **Moser Framework of Women's Triple Role** integrates productive, reproductive, and community management labour into a single analytical lens, making visible the cumulative

nature of gendered vulnerability. Climate change intensifies all three roles simultaneously: agricultural labour increases as yields decline, reproductive work expands due to water scarcity and health stress, and community management responsibilities escalate during disasters. Yet women's authority, income, and institutional recognition do not expand accordingly. The framework highlights time poverty as a critical but often invisible driver of vulnerability, showing how women's inability to reduce unpaid care work constrains their participation in adaptation planning and livelihood diversification.

Together, these three frameworks capture gendered climate vulnerability in Roha as a socially produced, cumulative, and relational process. They demonstrate that women's heightened vulnerability is not the result of biological difference, but of structural inequalities embedded in labour systems, resource governance, and institutional power. By integrating these frameworks, the analysis provides a robust foundation for designing climate adaptation strategies that address not only environmental risk, but also the gendered social relations through which that risk is experienced.

5.3.1 Gendered Division of Labour and Climate Vulnerability

The gendered division of labour constitutes a foundational pathway through which climate vulnerability is produced and reproduced in Roha. Women and men occupy distinct roles across productive, reproductive, and community spheres, and these divisions are not neutral or complementary but deeply hierarchical. Climate variability interacts with these entrenched labour regimes to intensify women's workload while simultaneously reducing their access to decision-making authority and institutional support. As a result, climate stress translates into disproportionate physical, temporal, and psychological burdens for women.

Women's labour is concentrated in activities that are labour-intensive, time-consuming, and directly exposed to environmental conditions. Agricultural tasks such as paddy transplanting, weeding, harvesting, and post-harvest processing require prolonged physical engagement under increasingly unpredictable rainfall, waterlogging, and heat stress. Climate-induced weed proliferation and pest outbreaks significantly increase manual labour requirements, disproportionately borne by women. In contrast, men tend to control mechanized, capital-intensive, and market-linked tasks, allowing greater mobility and flexibility under climate stress.

Beyond agriculture, women shoulder nearly the entire burden of reproductive labour, including water collection, fuelwood gathering, food preparation, childcare, eldercare, and health management. Climate shocks amplify this burden. During droughts, women spend additional hours collecting water from distant sources. During floods, they manage household displacement, food scarcity, sanitation challenges, and care for sick family members. These responsibilities expand precisely when women's physical capacity and nutritional intake are under greatest strain.

Community-level labour further reinforces vulnerability. While men dominate formal governance structures, women undertake extensive informal community management work through Self-Help Groups, mutual aid networks, and frontline service roles. These contributions are critical to community resilience but remain unpaid, unrecognized, and excluded from planning processes. Climate adaptation programs routinely overlook these labour dynamics, treating women as beneficiaries rather than as central actors sustaining everyday resilience.

Importantly, the gendered division of labour is not static. Climate variability accelerates male migration for wage employment, leaving women with expanded agricultural and household responsibilities but without corresponding increases in authority, assets, or institutional support. This "feminisation of responsibility without feminisation of power" emerges as a key driver of gendered vulnerability.

Table 5.1: Gendered Division of Labour and Climate Vulnerability Pathways

Sphere of Work	Women's Roles	Men's Roles	Climate Vulnerability Implications
Agriculture	Transplanting, weeding, harvesting, post-harvest processing	Ploughing, pesticide use, market transactions	Increased labour burden for women under erratic rainfall
Reproductive Labour	Water, fuel, food, childcare, eldercare	Minimal involvement	Time poverty intensifies during climate shocks
Community Management	SHGs, mutual aid, caregiving	Formal governance roles	Women excluded from adaptation decision-making
Wage Employment	Low-paid, informal work	Higher-paid industrial and skilled labour	Gender wage gap limits adaptive capacity

5.3.2 Access, Control, and Benefits

The distinction between access and control over resources reveals the structural mechanisms through which climate vulnerability is institutionalised. Women in Roha may access land, water, forests, and climate programs through labour and use, but they lack control over decisions, benefits, and long-term resource governance. This asymmetry fundamentally undermines women's adaptive capacity under climate stress.

Land illustrates this contradiction most clearly. Women perform substantial agricultural labour but rarely hold land titles. Without legal ownership, women cannot independently decide cropping patterns, access formal credit, enrol in crop insurance, or receive compensation after climate-induced crop losses. Widows and tribal women face compounded insecurity, as customary cultivation rights are poorly recognised and formal documentation remains incomplete. Climate shocks thus erode livelihoods without triggering institutional protection for women.

Water access follows similar patterns. Women are primary water users and managers at the household level, yet water governance institutions remain male-dominated. Decisions on supply timing, infrastructure repair, and allocation exclude women's experiential knowledge. The collapse of canal irrigation has intensified reliance on borewells, which are privately controlled by landholding men, reinforcing inequitable access during scarcity periods.

Forest resources and Non-Timber Forest Products (NTFPs) are central to tribal women's livelihoods, yet governance structures marginalise them. Traditional ecological knowledge is dismissed, and market access is controlled by male intermediaries. Climate-induced forest degradation further reduces availability, increasing labour time and reducing income, while women lack authority to influence forest management decisions.

Climate finance and technology systems reproduce gender exclusion through procedural barriers. Subsidies, insurance, and technology programs require land titles, digital literacy, and formal registration, disproportionately excluding women. Even when technologies benefit women's labour, men capture the financial and decision-making benefits, reinforcing gendered control over adaptation resources.

Table 5.2: Access versus Control over Key Resources

Resource	Women's Access	Women's Control	Climate Vulnerability Outcome
Land	Cultivation and labour	No ownership or decision power	Exclusion from insurance and compensation
Water	Collection and household use	Minimal governance authority	Increased time poverty and health risks
Forests/NTFPs	Daily collection	No market or governance control	Declining income and food security
Climate Finance	Informal participation	Male capture of benefits	Reduced adaptive investment capacity

5.3.3 Triple Role and Time Poverty

Women's vulnerability emerges most starkly when analysed through the lens of their triple role productive, reproductive, and community management work. Climate change intensifies each role simultaneously, producing cumulative stress that erodes health, agency, and long-term resilience.

In the productive role, climate variability increases labour input while reducing returns. Women's agricultural work expands due to delayed monsoons, increased weed pressure, pest outbreaks, and crop failures requiring replanting. Yet women's earnings remain stagnant, and decision-making power remains minimal. Declining NTFP availability further undermines income sources for tribal women, forcing longer collection times and reduced returns.

Reproductive labour absorbs the greatest share of climate shock impacts. Water scarcity increases collection time, fuelwood depletion extends collection distances, and disease outbreaks increase care demands. Nutritional stress intensifies as women prioritise feeding others, exacerbating anaemia and fatigue. Climate disasters transform reproductive labour into crisis management, yet institutional responses rarely support these roles.

Community management work expands during crises as women organise relief, share resources, and maintain social cohesion. However, this labour remains unpaid and invisible, while formal decision-making remains dominated by men. Women's time poverty prevents them from participating meaningfully in planning processes that shape adaptation priorities.

Time poverty thus functions as a structural mechanism of vulnerability. Women's inability to reduce reproductive labour constrains their participation in training, governance, and livelihood diversification. Climate change, therefore, deepens gender inequality by expanding unpaid labour while narrowing pathways to empowerment.

Table 5.3: Triple Role, Time Use, and Climate Stress

Role	Women's Time Use	Climate Impact	Vulnerability Outcome
Productive	5–7 hours/day	Increased labour intensity	Physical exhaustion, low returns
Reproductive	6–8 hours/day	Expanded care burden	Health decline, time poverty
Community	0.5–1 hour/day	Crisis response demands	Unrecognized labour
Leisure/Rest	2–3 hours/day	Reduced further under stress	Chronic fatigue

Across all three Gender Analysis Frameworks, gendered vulnerability in Roha emerges as **structurally produced**, not environmentally inevitable. Climate change magnifies existing inequalities embedded in labour regimes, resource control systems, and institutional governance. Women's resilience sustains households and communities, yet this resilience is extracted through unpaid labour and exclusion from power. Without addressing these foundational gendered structures, climate adaptation interventions risk reinforcing the very vulnerabilities they seek to reduce.

5.4 Integrated Gender Analysis for SDG performance tracking in Roha

Climate change in Roha does not manifest as an isolated environmental phenomenon. It unfolds within a deeply stratified rural society marked by gender inequality, caste hierarchies, land insecurity, institutional fragmentation, and ecological degradation. Conventional sectoral approaches addressing water, livelihoods, forests, or gender separately fail to capture how vulnerabilities are produced at the intersections of these systems.

The Sustainable Development Goals themselves acknowledge this interdependence. SDG 5 (Gender Equality) cannot be achieved without addressing women's unpaid labour and exclusion from resource governance. SDG 6 (Clean Water and Sanitation) intersects directly with women's time poverty, health, and dignity. SDG 13 (Climate Action) is inseparable from

differentiated exposure and adaptive capacity, which are shaped by gender, caste, and age. SDG 15 (Life on Land) is sustained largely through the everyday ecological labor of women's and tribal communities, yet governance systems systematically exclude them.

The IGVAF draws upon three well-established gender analysis frameworks: the Gendered Division of Labour framework, the Harvard Framework of access and control, and Moser's Triple Role framework. Each of these contributes a distinct analytical lens. However, rather than applying them sequentially or independently, the IGVAF synthesises them into a single architecture that is explicitly grounded in Roha's socio-ecological context.

The Gendered Division of Labour framework reveals how men and women perform different types of work and how these differences structure exposure to climate risks. The Harvard Framework distinguishes between access to resources and control over them, illuminating why women's labour does not translate into resilience. Moser's Triple Role framework highlights the simultaneity of women's productive, reproductive, and community management roles, particularly under conditions of environmental stress. These frameworks are further extended through the incorporation of spatial, temporal, and ecological dimensions, allowing the analysis to engage directly with SDGs 5, 6, 13, and 15 as interconnected goals.

What distinguishes the IGVAF from conventional gender frameworks is its explicit recognition of climate variability and ecosystem degradation as core analytical drivers rather than contextual background factors. Climate stress is treated as a force that actively reshapes social relations, intensifies existing inequalities, and exposes the limits of current institutional arrangements.

5.4.1 Spatial and temporal vulnerability

The IGVAF explicitly incorporates spatial and temporal dimensions of vulnerability, recognising that climate impacts are unevenly distributed across space and time. In Roha, caste-based

settlement patterns have historically pushed Scheduled Caste and Scheduled Tribe households to marginal, flood-prone, and remote locations. These spatial arrangements continue to shape exposure to climate hazards, access to infrastructure, and proximity to services.

Temporal vulnerability is equally significant. Climate stress follows seasonal cycles that align with peaks in women's labour burden. Pre-monsoon water scarcity, monsoon flooding, post-monsoon disease outbreaks, and summer heat stress each generate distinct but overlapping pressures. Women's workload expands cyclically, not episodically, leaving little opportunity for recovery or adaptation.

Cumulative vulnerability emerges when these spatial and temporal factors intersect with gender, caste, age, and economic status. A tribal elderly widow, for example, experiences compounded vulnerability arising from physical immobility, social isolation, insecure land tenure, and declining ecological resources. These factors multiply rather than add to one another, producing vulnerability far greater than the sum of individual disadvantages.

5.4.2 Agency, Knowledge, and Social–Ecological Feedbacks

Despite these constraints, women in Roha are not passive victims of climate change. They possess significant adaptive knowledge and agency, expressed through seed preservation, informal care networks, self-help groups, and traditional ecological practices. However, this agency is systematically constrained by institutional exclusion and symbolic devaluation.

Women's ecological labour sustains forests, water sources, and agricultural systems, yet the lack of recognition and support creates negative social–ecological feedback loops. As forests degrade, women must travel farther to collect resources, increasing labour and reducing time available for stewardship, which in turn accelerates degradation. Similar feedbacks operate in water systems, where infrastructure failures increase women's labour while excluding them from governance decisions that could improve system performance.

The IGVAF foregrounds these feedback loops to demonstrate that ecological degradation and social inequality are mutually reinforcing. Addressing one without the other is unlikely to produce sustainable outcomes.

5.4.3 Alignment with SDGs 5, 6, 13, and 15

The Integrated Gendered Vulnerability and Agency Framework demonstrates that SDG 5, SDG 6, SDG 13, and SDG 15 are not parallel objectives but interdependent dimensions of a single socio-ecological system. Gender equality cannot be achieved without redistributing control over land, water, and climate finance. Water security cannot be sustained without recognising and supporting women's labour and governance roles. Climate action cannot be effective without addressing differentiated exposure and adaptive capacity. Ecosystem protection cannot succeed without the participation and leadership of those who depend on and steward these landscapes daily.

6.

CLIMATE CHANGE VULNERABILITY IN SUDHAGAD, RAIDAD DISTRICT, MAHARASHTRA

6.1 Socio-Economic Profile of Sudhagad

The villages in Sudhagad are characterised by dispersed settlement patterns, strong dependence on agriculture and forest resources, and a predominantly tribal population. The profile documents key demographic characteristics, social composition, livelihood systems, education and health infrastructure, water and sanitation conditions, and patterns of natural resource use. The purpose of this section is to establish the existing socio-economic conditions that shape everyday life, access to services, and development trajectories in the region. Subsequent chapters draw upon this baseline to analyse climate vulnerability, gendered impacts, and community-driven action planning.

6.1.1 Demographic Characteristics

The study villages in Sudhagad exhibit low-density, dispersed settlement patterns organised into multiple wadis rather than compact village cores. Households are distributed across forest-edge and hillside locations, often separated by uneven terrain and limited road connectivity. The total number of households varies across villages, with larger wadis comprising between 80 and 120 households and smaller hamlets consisting of fewer than 30 households. This dispersed spatial arrangement has significant implications for service delivery, infrastructure access, and social interaction.

Household structures remain largely joint or extended, particularly among tribal households, where multiple generations often reside together. However, a gradual shift toward nuclear households is visible, driven by youth migration for wage employment and education. Average household size ranges between four and six members, with variations depending on migration patterns and the presence of elderly dependents.

The population structure is skewed by sustained out-migration of working-age men to nearby towns, industrial areas, and urban centres such as Panvel, Navi Mumbai, and Pune. As a result, a substantial proportion of households are effectively managed by women, elderly persons, and older adolescents. Children constitute approximately one-fifth to one-quarter of the population. While early childhood presence remains high, adolescent populations particularly boys decline sharply due to migration for work.

Primary school enrollment is relatively high due to government provisioning, but attendance fluctuates seasonally in forest-adjacent wadis. Dropout rates increase at the upper primary and secondary levels, with girls showing lower continuation rates than boys. Distance to secondary schools, household labour responsibilities, and concerns around safety and mobility contribute to reduced educational participation, especially among tribal girls.

6.1.2 Social Composition and Community Structure

The social composition of the study villages is dominated by Scheduled Tribe communities, particularly Katkari and Thakur households, alongside smaller populations of Maratha and Other Backward Class groups. Tribal households are primarily located in forest-proximate

wadis, often at higher elevations or along degraded forest margins. These locations reflect historical settlement patterns shaped by land alienation, forest governance regimes, and limited access to cultivable land.

Non-tribal households, where present, tend to occupy comparatively better-connected locations closer to roads, schools, and water infrastructure. Land ownership patterns reflect these social distinctions. Tribal households typically hold small, fragmented land parcels, many of which are rainfed, sloping, or of low soil fertility. While some households have received land titles under the Forest Rights Act (2006), productive use of these lands remains constrained by terrain, water availability, and lack of institutional support.

Social interaction across communities occurs in markets, schools, and public events, but residential segregation persists. Tribal wadis remain spatially distant from village centres and administrative institutions. This spatial separation influences access to information, participation in governance, and interaction with state agencies.

Traditional social institutions within tribal communities continue to play a role in conflict resolution and social regulation, though their influence has weakened over time. Formal governance structures such as the Gram Panchayat operate at a distance from everyday life in remote wadis, limiting effective representation of tribal concerns.

6.1.3 Livelihood Systems and Local Economy

Agriculture forms the primary livelihood base in the study villages, supplemented by forest-based activities and wage labour. Paddy cultivation during the Kharif season dominates agricultural production, alongside coarse cereals such as nachni, pulses, and limited vegetable cultivation. Farming is predominantly rainfed, and the absence of functional irrigation infrastructure restricts crop diversity and productivity.

Livelihoods are highly seasonal. Agricultural labour demand peaks during monsoon months, while the post-harvest period sees a sharp decline in local employment opportunities. As a result, many households rely on migration as a key livelihood strategy. Men migrate for construction work, industrial labour, driving, and security services, while women engage in local wage labour, forest product collection, and household-based activities.

Forest resources contribute significantly to household subsistence, particularly for tribal families. Fuelwood, fodder, minor forest produce, and wild foods supplement household consumption and income. However, declining availability of forest resources has reduced the reliability of these livelihoods.

Women play a central role in sustaining the local economy through agricultural labour, livestock care, forest collection, and informal work. Despite their extensive contribution, women's earnings remain lower and less secure than men's. Self-Help Groups operate across wadis and provide access to savings and credit, but economic activities remain small-scale and largely consumption-oriented due to limited market linkages and technical support.

Formal financial services have limited penetration. Lack of land titles, documentation barriers, and digital exclusion restrict access to institutional credit, particularly for women and tribal households. Informal borrowing remains common, contributing to long-term financial vulnerability.

6.1.4 Education and Health Infrastructure

Educational infrastructure in Sudhagad is limited by geography and dispersion. Primary schools are available within or near larger wadis, enabling basic access to early education. However, secondary schools are located at considerable distances, requiring travel across difficult terrain. Transportation costs, safety concerns, and household labour demands restrict sustained attendance, particularly for girls.

Literacy levels vary sharply across age and gender. Older women exhibit low literacy, while younger cohorts show improved enrollment and basic educational attainment. Language barriers affect tribal children, as instruction is often delivered in Marathi rather than local dialects.

Health services are provided through sub-centres and outreach by ASHA and Anganwadi workers. These workers serve as the primary interface between households and the public health system. Institutional deliveries have increased, and maternal and child health services have expanded, though access remains uneven across wadis.

Healthcare for chronic illnesses and elderly populations remains inadequate. Seasonal illnesses, anaemia among women and adolescent girls, musculoskeletal strain from physical labour, and undernutrition in poorer households are commonly reported. Distance to Primary Health Centres and irregular transport limit timely care.

6.1.5 Water and Sanitation Conditions

Water access in Sudhagad relies on a combination of springs, handpumps, wells, and piped supply schemes. While household connections have expanded under recent programmes, supply remains intermittent and uneven across wadis. Seasonal drying of springs during summer months places significant pressure on households.

Women bear primary responsibility for water collection, storage, and management. Multiple trips are often required to meet daily needs, particularly in remote hamlets. Village-level water governance structures exist but function weakly, with limited participation from women and tribal households.

Sanitation coverage has improved through toilet construction, but water scarcity undermines regular usage. Waste disposal systems remain informal, with minimal segregation or organised management.

6.1.6 Natural Resource Use

Forests form a critical component of the socio-economic system in Sudhagad. They provide fuelwood, fodder, minor forest products, and cultural significance, particularly for tribal communities. Over time, changes in forest composition, the spread of invasive species, and regulatory restrictions have altered resource availability.

Local ecological knowledge remains strong among elders, but its integration into formal management systems is limited. Joint Forest Management Committees exist in name but show low functionality.

Soils across the landscape vary from shallow, erosion-prone uplands to heavier lowland soils. Agricultural productivity is constrained by declining soil quality, limited organic matter, and inadequate conservation practices. Waterbodies and streams play a crucial role in local water security, but they face challenges such as siltation and seasonal variability.

6.2 Baseline Climate Vulnerability Assessment in Roha

This Baseline Climate Vulnerability Assessment examines climate risks in Sudhagad taluka through a socially embedded and justice-oriented analytical lens. Vulnerability in Sudhagad is not treated as a direct outcome of climatic exposure alone, but as a condition produced through long-standing socio-spatial marginalisation, ecological dependency, and institutional neglect. The assessment foregrounds the lived experiences of tribal households, women, elderly persons, widows, land-poor families, and forest-dependent communities whose vulnerabilities are shaped as much by governance structures and social relations as by rainfall variability or temperature stress.

The analytical approach is informed by a distributive justice perspective that recognises three interlinked dimensions of vulnerability: unequal access to material resources, systematic devaluation of social contributions and knowledge systems, and exclusion from decision-making spaces. Rather than framing climate risk as a technical challenge to be managed through infrastructure or advisories, this assessment conceptualises vulnerability as structurally embedded within land tenure regimes, forest governance systems, gendered labour relations, and spatial settlement patterns characteristic of Sudhagad's hilly and forested terrain.

Conventional climate and development interventions in Sudhagad have largely prioritised asset creation and service delivery without addressing the relational and institutional conditions that shape who benefits from these interventions. As a result, climate impacts are absorbed disproportionately by those already bearing the heaviest unpaid labour burdens and least institutional support. This assessment therefore positions vulnerability as a manifestation of historical dispossession, policy fragmentation, and everyday exclusion, requiring systemic transformation rather than incremental adaptation.

6.2.1 Ecological Context and Biophysical Stressors

Sudhagad receives high annual rainfall, typically ranging between 2500 and 3000 millimetres, concentrated over a relatively short monsoon period. Despite this apparent abundance, rainfall distribution has become increasingly uneven. Communities report delayed monsoon onset, prolonged dry spells within the rainy season, and short-duration high-intensity rainfall events that generate surface runoff rather than groundwater recharge. These shifts disrupt traditional agricultural calendars and undermine water security in both monsoon and summer months.

The region's hilly topography and shallow soils intensify climate stress. Intense rainfall leads to rapid runoff, soil erosion, and landslides along slopes, while valleys experience water stagnation and crop damage. Springs and streams that historically provided year-round water now exhibit seasonal behaviour, drying earlier each summer. Households increasingly depend on a shrinking number of water points, heightening competition and labour burdens.

Forest ecosystems, central to Sudhagad's ecological and economic systems, show visible signs of stress. Degradation, invasive species spread, and declining biodiversity have reduced the availability of fuelwood, fodder, and non-timber forest products. Wildlife movement patterns have altered, increasing crop damage and human–wildlife encounters. These ecological shifts directly affect food security, livelihoods, and daily survival strategies, particularly for tribal households with limited alternatives.

6.2.2 Intersectional Vulnerability in Sudhagad

6.2.2.1 Tribal Elderly Women

Tribal elderly women in Sudhagad experience vulnerability produced at the intersection of age, gender, indigeneity, and spatial isolation. Many reside in remote wadis located deep within forested or hilly areas, with limited road access. During monsoon months, these settlements become physically isolated, restricting access to health services, markets, and relief mechanisms.

Low literacy levels and linguistic barriers further marginalise elderly women from formal systems of information and entitlement. Although some hold land titles under the Forest Rights Act, the land is often fragmented, degraded, or unsuitable for cultivation. Declining physical strength, absence of younger family members due to migration, and unreliable pension payments leave elderly women dependent on irregular support networks. Climate stress amplifies these conditions by increasing water-fetching distances, reducing food availability, and intensifying health risks.

6.2.2.2 Tribal Women and Forest-Dependent Households

Adult tribal women bear the primary responsibility for sustaining household survival through agriculture, forest collection, livestock care, and unpaid domestic labour. Climate variability intensifies their workload by increasing time spent collecting water, fuelwood, and fodder as

resources become scarcer. Declining forest productivity forces women to travel farther and spend longer hours gathering essential materials.

Despite their central role, tribal women have minimal influence over forest governance or development planning. Restrictions on forest access, combined with weak recognition of traditional ecological knowledge, undermine both livelihoods and adaptive capacity. The erosion of forest-based livelihoods without viable alternatives deepens economic insecurity and increases dependence on low-paid wage labour.

6.2.2.3 Widows and Female-Headed Households

Widows and female-headed households in Sudhagad face pronounced vulnerability due to gendered property relations and social norms. Land and housing are typically registered in the names of male relatives, leaving women without formal control over productive assets. In the absence of male household members, these women struggle to access agricultural inputs, credit, or state support.

Climate shocks such as crop loss or water scarcity expose the fragility of these arrangements. Compensation mechanisms, relief assistance, and insurance schemes are tied to land ownership and documentation that women often lack. Social isolation, limited mobility, and irregular pension support further constrain their ability to cope with environmental stress.

6.2.2.4 Children and Young Mothers

Young mothers in Sudhagad experience severe time poverty as they manage childcare alongside agricultural labour, water collection, fuelwood gathering, and domestic responsibilities. Nutritional stress and anaemia are common, exacerbated by food scarcity and unequal intra-household distribution. Mobility constraints restrict access to training, health services, and income opportunities.

Children, particularly girls, are drawn into household labour during periods of water scarcity or agricultural stress, leading to irregular school attendance. Climate variability thus shapes intergenerational vulnerability by redistributing labour burdens and undermining educational continuity.

6.2.3 Exposure Analysis: The Social Production of Risk

Climate exposure in Sudhagad is shaped by the interaction between ecological conditions and governance failures. Biophysical hazards landslides, soil erosion, water scarcity, heat stress are intensified by inadequate infrastructure, poor maintenance of rural roads, absence of decentralised water storage, and weak disaster preparedness mechanisms.

Spatial marginalisation plays a critical role. Remote tribal wadis are systematically underserved by public infrastructure, leaving residents more exposed to climate hazards and slower to receive assistance during emergencies. Women's daily interaction with forests, water sources,

and agricultural fields places them in direct contact with hazard-prone environments, increasing exposure relative to men who migrate or engage in off-farm work.

6.2.4 Sensitivity: Differential Impacts Across Social Groups

6.2.4.1 Women

Women's sensitivity to climate stress arises from cumulative labour burdens, poor health, limited asset ownership, and restricted decision-making power. Climate shocks expand unpaid care work while simultaneously reducing household income and food availability. Sanitation challenges and water scarcity intensify health risks, particularly for pregnant and lactating women.

6.2.4.2 Tribal Households

Tribal households exhibit heightened sensitivity due to dependence on climate-sensitive livelihoods, marginal landholdings, and limited engagement with state institutions. Loss of forest resources directly affects subsistence and income, while weak access to information and services delays response to climatic events.

6.2.4.3 Elderly and Disabled Persons

Elderly and disabled individuals face compounded sensitivity due to immobility, chronic illness, and institutional invisibility. Climate stress increases dependence on caregivers, typically women, reinforcing gendered burdens and household vulnerability.

6.2.5 Adaptive Capacity Assessment

6.2.5.1 Redistribution Failures

Material assets in Sudhagad are unevenly distributed. Women's lack of land ownership, insecure tribal tenure, limited water infrastructure, and financial exclusion constrain adaptive capacity. Housing quality and lack of savings increase exposure to environmental shocks.

6.2.5.2 Recognition Failures

Women's labour, forest-based knowledge, and adaptive practices remain undervalued in formal planning. Governance institutions continue to privilege technical expertise over lived experience, marginalising local knowledge systems critical for resilience.

6.2.5.3 Representation Failures

Decision-making bodies related to agriculture, water, forests, and disaster management remain male-dominated. Women and tribal representatives participate nominally but lack substantive influence, limiting the effectiveness of adaptation initiatives.

6.2.6 Key Vulnerability Drivers in Sudhagad

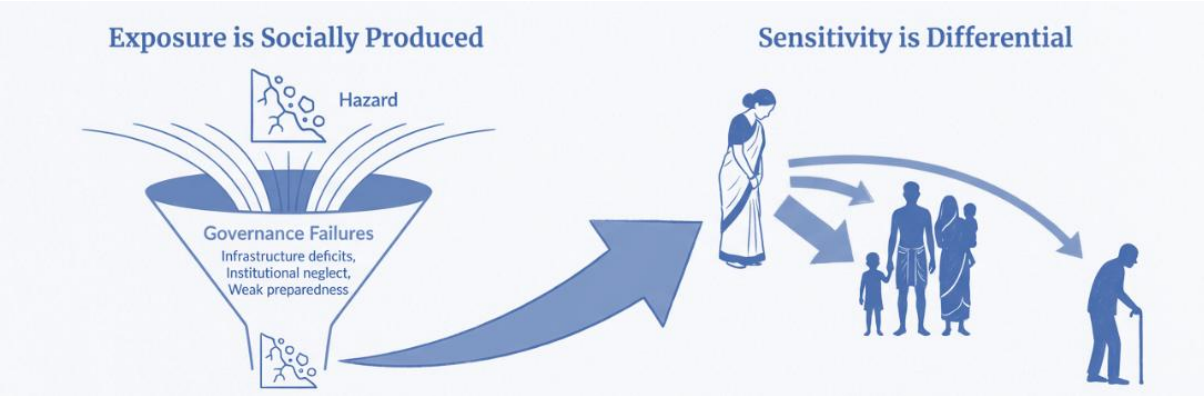
- High dependence on climate-sensitive forest and rainfed systems
- Gendered labour burdens and time poverty
- Insecure land and forest tenure
- Spatial isolation and infrastructure deficits
- Institutional exclusion and weak representation
- Erosion of traditional ecological knowledge

These drivers interact multiplicatively, producing entrenched vulnerability across social groups.

6.3 Gendered Vulnerability Assessment in Sudhagad

Understanding gendered vulnerability to climate change in Sudhagad requires an approach that recognises the region as a predominantly tribal, forest-dependent, and ecologically fragile landscape rather than an agrarian–industrial transition zone. Climate impacts in Sudhagad are not experienced as discrete environmental shocks but as gradual and cumulative stresses that interact with historical marginalisation of Scheduled Tribe communities, forest governance regimes, gendered labour relations, and chronic infrastructural neglect. Gender, in this context, cannot be treated as a demographic attribute; it is a structuring principle that shapes labour allocation, resource access, knowledge systems, and institutional voice.

To capture this complexity, the present study employs three complementary gender analysis frameworks: the Gendered Division of Labour framework, the Harvard Framework of Access, Control, and Benefits, and the Moser Framework of Women's Triple Role. Applied together, these frameworks enable a multidimensional understanding of how climate variability, ecological degradation, and institutional exclusion converge to produce differentiated vulnerabilities among women and men in Sudhagad.



6.3.1 Gendered Division of Labour

The gendered division of labour in Sudhagad is deeply embedded within a subsistence-oriented, forest-based economy shaped by hilly terrain, dispersed settlements, and limited mechanisation. Women's labour is central to the functioning of both household economies

and local ecosystems, yet this labour remains largely unpaid, unrecognised, and excluded from formal planning processes. Climate change intensifies existing labour hierarchies, increasing women's exposure to environmental stress while offering men comparatively greater opportunities to disengage through migration or seasonal wage labour.

Women's productive labour spans agriculture, forest resource collection, and livestock care. In agriculture, women are responsible for sowing, transplanting, weeding, harvesting, seed preservation, and post-harvest processing. These tasks are performed manually on sloping land under conditions of erratic rainfall, soil erosion, and declining soil fertility. Increased rainfall intensity has led to higher weed proliferation and crop damage, multiplying women's labour without corresponding increases in productivity or income. Men, by contrast, perform limited mechanised tasks where possible, negotiate with traders, and engage with external institutions.

Forest-based labour constitutes a critical component of women's daily work. Women collect fuelwood, fodder, wild vegetables, fruits, and medicinal plants, often walking long distances across steep terrain. Climate-induced forest degradation and the spread of invasive species have reduced the availability of these resources, forcing women to travel farther and spend more time collecting diminishing quantities. This expansion of labour occurs without any institutional recognition of women's role in sustaining forest-based livelihoods.

Reproductive labour in Sudhagad is particularly intensive due to ecological and infrastructural constraints. Water collection from springs and streams requires long daily journeys, especially during the dry season when sources recede. Fuelwood remains the primary cooking energy source, reinforcing dependence on forests. Childcare, eldercare, food preparation, and health management absorb substantial time and physical energy. Climate stress amplifies these burdens through increased disease incidence, food insecurity, and water scarcity.

At the community level, women perform extensive informal management work. They maintain mutual aid networks, support households during illness or crop failure, and play central roles in Self-Help Groups. During climate-related disruptions, women organise food sharing, care for displaced families, and manage household recovery. Yet formal village

institutions remain male-dominated, and women's contributions are treated as extensions of domestic responsibility rather than as governance labour.

Male migration, though less industrialised than in Roha, has increased in response to declining agricultural viability and forest productivity. As men migrate seasonally, women assume greater responsibility for farming, forest collection, and household management without gaining corresponding authority over resources or decision-making. This feminisation of responsibility without empowerment is a defining feature of gendered vulnerability in Sudhagad.

Table 6.1: Gendered Division of Labour and Climate Vulnerability in Sudhagad

Sphere of Work	Women's Roles	Men's Roles	Climate Vulnerability Implications
Agriculture	Sowing, weeding, harvesting, seed management	Limited mechanised tasks, market contact	Increased labour under erratic rainfall and erosion
Forest-based work	Fuelwood, fodder, NTFP collection	Minimal direct involvement	Longer collection time, declining returns
Reproductive labour	Water, fuel, food, care work	Marginal involvement	Severe time poverty under climate stress
Community work	SHGs, mutual aid, crisis care	Formal leadership roles	Women excluded from planning and governance

6.3.2 Access, Control, and Benefits in Sudhagad

The Harvard Framework reveals that in Sudhagad, women's vulnerability is shaped less by absolute absence of resources and more by structural exclusion from control over resources they use daily. Women have access to land, forests, and water through customary use and labour, but decision-making authority, legal recognition, and benefit capture remain overwhelmingly male-dominated or state-controlled.

Land tenure in Sudhagad is characterised by insecurity and ambiguity. While Forest Rights Act claims have been recognised in some areas, land titles are often issued in men's names, marginal in quality, or poorly supported with extension services. Women cultivate land but cannot independently decide cropping strategies, invest in soil conservation, or access formal credit. Climate-induced crop losses therefore translate directly into livelihood erosion without triggering institutional protection for women cultivators.

Water access follows a similar pattern. Women are primary collectors and managers of household water, yet they have little influence over water infrastructure planning or maintenance. Springs and streams are treated as common resources without formal governance structures that include women's voices. As climate variability alters hydrological regimes, women's experiential knowledge of seasonal water patterns remains excluded from institutional decision-making.

Forest resources are central to Sudhagad's economy, particularly for tribal women, but forest governance remains highly centralised. Joint Forest Management Committees, where present, are weak and male-dominated. Traditional ecological knowledge related to sustainable harvesting, species diversity, and forest regeneration is systematically marginalised. Market access for NTFPs is mediated by male traders and external contractors, leaving women with minimal returns despite high labour investment.

Climate finance and technology systems are largely inaccessible to women. Eligibility criteria tied to land titles, digital platforms, and bureaucratic procedures exclude women cultivators and forest-dependent households. Even where benefits reach households, men typically control financial decisions, reinforcing gendered exclusion from adaptive investments.

Table 6.2: Access versus Control in Sudhagad

Resource	Women's Access	Women's Control	Vulnerability Outcome
Land	Cultivation and subsistence use	Limited legal authority	Inability to invest or insure
Water	Daily collection and management	No governance role	Increased labour and health risks
Forests/NTFPs	Primary collectors	No market or policy control	Declining income and food security
Climate finance	Indirect household access	Male capture of benefits	Low adaptive capacity

6.3.3 Women's Triple Role and Time Poverty

The Moser Framework reveals how climate change in Sudhagad intensifies women's productive, reproductive, and community management roles simultaneously, creating cumulative stress that undermines health, agency, and resilience. Unlike monetised economies where labour intensity may be partially offset by income, Sudhagad's subsistence context offers no such buffer.

In the productive role, climate variability increases labour while reducing yields. Erratic rainfall, soil erosion, and declining forest productivity force women to work longer hours for

diminishing returns. Seed loss, crop damage, and NTFP scarcity require repeated effort without institutional support.

Reproductive labour absorbs the greatest climate burden. Water scarcity lengthens collection routes; fuelwood depletion increases forest dependence; disease outbreaks increase caregiving demands. Nutritional stress intensifies as women prioritise feeding children and elders, exacerbating anaemia and physical exhaustion. During extreme weather events, reproductive labour transforms into survival management without external assistance.

Community management responsibilities expand during crises. Women coordinate informal relief, care for vulnerable households, and maintain social cohesion. Yet this labour remains invisible to formal institutions, and women's time poverty prevents sustained engagement with governance processes.

Time poverty thus emerges as a central mechanism of vulnerability. Women's inability to reduce unpaid labour constrains participation in education, training, and decision-making. Climate change deepens this constraint, locking women into cycles of labour intensification without empowerment.

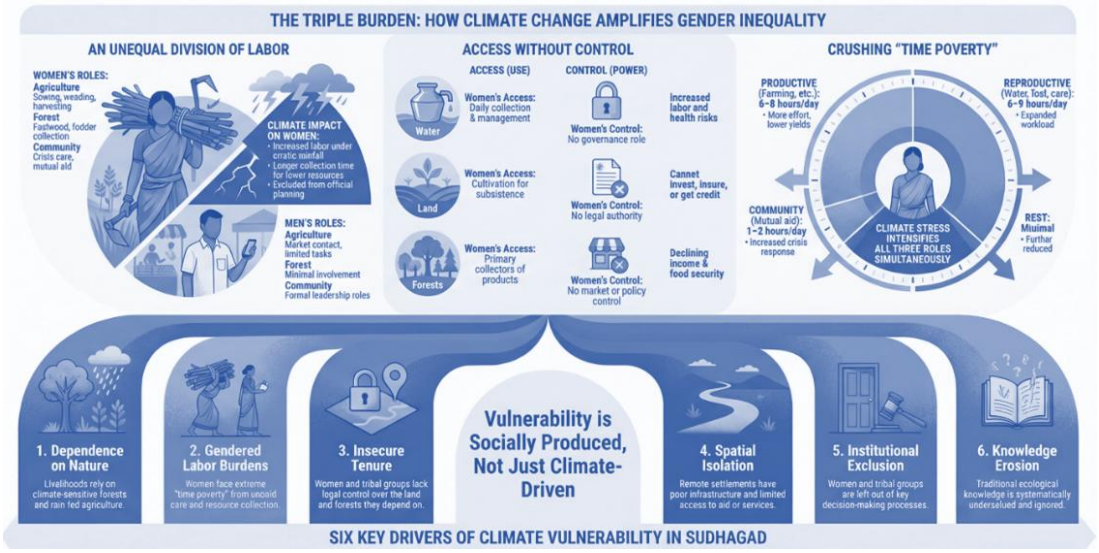
Table 6.3: Triple Role, Time Use, and Climate Stress in Sudhagad

Role	Women's Time Use	Climate Impact	Outcome
Productive	6–8 hours/day	Increased effort, lower yields	Livelihood erosion
Reproductive	6–9 hours/day	Expanded care and collection work	Health decline
Community	1–2 hours/day	Crisis response	Unrecognised labour
Rest	Minimal	Further reduced	Chronic fatigue

6.4 Integrated Gender Analysis for SDG Performance in Sudhagad

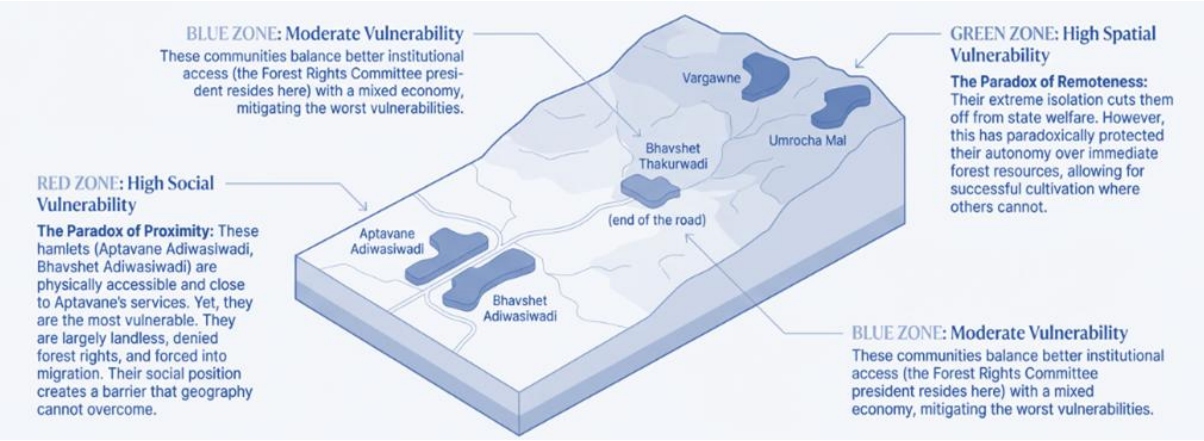
Climate vulnerability in Sudhagad unfolds at the intersection of gender inequality, ecological degradation, and institutional exclusion. SDG 5, SDG 6, SDG 13, and SDG 15 are deeply interlinked within this landscape. Gender equality cannot be achieved without addressing women's control over land and forests; water security cannot be sustained without recognising women's labour; climate action cannot succeed without enhancing adaptive capacity; and ecosystem protection depends on the knowledge and stewardship of tribal women.

The Integrated Gendered Vulnerability and Agency Framework synthesises the three gender analysis frameworks within Sudhagad's forest–hill socio-ecological system. It treats climate change as a force reshaping social relations, intensifying labour hierarchies, and exposing institutional failures. Spatial isolation, seasonal labour peaks, and ecosystem feedback loops are incorporated as core analytical dimensions.



6.4.1 Spatial and Temporal Vulnerability in Sudhagad

Settlement dispersion across steep terrain creates structural exposure to climate hazards. Remote hamlets face delayed access to services, especially during monsoons when paths become impassable. Temporal vulnerability aligns with seasonal cycles of water scarcity, agricultural labour peaks, and disease outbreaks. Women experience continuous rather than episodic stress, with little recovery time between seasons.



Cumulative vulnerability emerges when gender intersects with indigeneity, age, and poverty. Elderly tribal women, widows, and single women experience compounded constraints that multiply rather than add.

6.4.2 Agency, Knowledge, and Social–Ecological Feedbacks

Women in Sudhagad possess deep ecological knowledge related to forests, seeds, water, and seasons. However, institutional exclusion creates negative feedback loops where increased labour reduces time for stewardship, accelerating ecological decline. The IGVAF makes this feedback visible, demonstrating that social inequality and ecological degradation reinforce one another.

7. CASE STUDIES

1

Gendered Water Insecurity and the Everyday Politics of Survival in Roha

This case study examines gendered water insecurity in Pale Budruk and Pale Khurd villages of Roha taluka, focusing on how climate variability, hydrological degradation, and institutional failures intersect with gender and caste to shape everyday survival strategies. While water scarcity is often framed as a technical or infrastructural problem, this case situates it as a deeply social and political phenomenon that redistributes labour, risk, and responsibility unevenly across households and social groups.

The central research problem concerns the contradiction between formal water provisioning and lived water access. Despite near-universal household coverage under the Jal Jeevan Mission, women in both villages continue to experience chronic water insecurity manifested through irregular supply, poor quality, and seasonal breakdowns. Climate change intensifies this crisis by altering rainfall patterns, reducing spring recharge, and increasing turbidity during monsoon months. As a result, water scarcity is not confined to drought periods but persists year-round in differentiated forms.

The case is significant because water is the single most time-consuming and physically demanding component of women's unpaid labour in the study villages. Water collection structures daily routines, determines health outcomes, and mediates women's ability to participate in education, livelihoods, and governance. By examining water through a gendered lens, the case creates a direct analytical bridge between SDG 6 (Clean Water and Sanitation), SDG 5 (Gender Equality), and SDG 13 (Climate Action).

The object of analysis is the household water cycle as lived by women. Rather than focusing only on infrastructure, the case tracks how water is accessed, transported, stored, treated, and rationed across seasons, and how these practices are shaped by climate stress and institutional arrangements. Women's narratives of water collection become a diagnostic tool to understand vulnerability, power, and resilience.

The analytical framework draws on the Harvard Framework to distinguish access from control over water resources, Moser's Triple Role to capture the cumulative burden of water-related labour, Kabeer's Social Relations Framework to locate water insecurity within institutional power structures, and the Integrated Gendered Vulnerability and Agency Framework (IGVAF) to connect climate ecology, spatial inequality, and gendered labour.

This case advances existing water–climate research by centring women's lived experiences and by showing that water insecurity in Pale Budruk and Pale Khurd is not episodic but structural. Climate change does not create the crisis ex nihilo; rather, it amplifies longstanding governance failures and gendered inequalities, turning women's bodies and time into buffers against hydrological uncertainty.

Analytical Framework and Subject

The subject of this case is women's everyday water labour under conditions of climate stress. A reconstructed daily and seasonal water-use profile reveals that women's responsibilities extend far beyond collection. They include monitoring supply timings, negotiating access at shared sources, storing and rationing water, treating contaminated water, and managing sanitation in contexts of scarcity.

The analytical framework for this case study is grounded in **Feminist Political Ecology (FPE)**, which provides a critical lens to examine how gendered power relations shape access to, control over, and responsibility for natural resources under conditions of ecological stress. Feminist Political Ecology moves beyond treating water scarcity as a purely hydrological or infrastructural issue and instead conceptualises it as a socially produced condition embedded within political, cultural, and institutional arrangements. In the context of Roha, this framework is particularly appropriate because water insecurity persists despite formal provisioning under state-led schemes, indicating that vulnerability is generated through governance failures and gendered labour regimes rather than absolute scarcity alone.

FPE foregrounds three interlinked dimensions that are central to this case. First, it examines **gendered divisions of labour**, highlighting how women's unpaid reproductive and care work absorbs the consequences of water system failures. Women in Roha are not merely users of water infrastructure; they are the primary managers of household water systems monitoring supply timings, storing and rationing water, treating contaminated sources, and managing sanitation under scarcity. Feminist Political Ecology interprets this labour not as "coping" or "adaptation" in a neutral sense, but as the gendered transfer of risk from institutions to households. Climate variability intensifies this process by increasing uncertainty in rainfall, groundwater recharge, and water quality, thereby expanding women's labour while leaving governance structures unchanged.

Second, FPE interrogates **power and knowledge**, challenging whose expertise counts in water governance. In Roha, women possess detailed experiential knowledge of seasonal water availability, quality fluctuations, and household needs, yet this knowledge remains systematically excluded from formal decision-making spaces such as Village Water and Sanitation Committees. Feminist Political Ecology frames this exclusion as epistemic injustice, where technocratic and male-dominated forms of knowledge override lived ecological experience. This helps explain why infrastructure-led solutions fail to resolve water insecurity: they ignore the social relations through which water is actually accessed and managed.

Finally, FPE situates water insecurity within **broader political and institutional contexts**, linking local experiences to state policy priorities and climate governance regimes. Under SDG 6, success is measured through coverage indicators, while the gendered labour sustaining these outcomes remains invisible. Feminist Political Ecology exposes how such measurement practices obscure injustice by counting taps rather than time, connections rather than care, and infrastructure rather than dignity. By integrating climate variability (SDG 13) and gender inequality (SDG 5) into a single analytical frame, this approach reveals water insecurity in Roha as a structural and gendered outcome of political ecology, rather than an episodic environmental problem.

Discussion of the Case

Field evidence indicates that water scarcity in Pale Budruk and Pale Khurd is experienced as continuous uncertainty rather than absolute absence. Under the Jal Jeevan Mission, piped water is supplied for limited durations, often one to two hours daily, with frequent disruptions. Women must organise their entire day around these windows, waiting at taps, storing water, and rationing use across drinking, cooking, washing, sanitation, and livestock needs.

Climate variability exacerbates this burden. During monsoon months, water quantity increases but quality deteriorates, with high turbidity leading to gastrointestinal illnesses. Women must then invest additional time and fuel in boiling water or managing sickness. In summer months, declining groundwater and drying springs force women to revert to distant sources, increasing collection time to three to five hours daily.

The collapse of the Kundalika canal system has indirect but profound impacts on water security. Reduced irrigation accelerates groundwater extraction through private borewells, lowering water tables and increasing competition for domestic water. Households with private borewells, typically upper-caste and landholding, enjoy greater security, while SC and ST households rely on public sources subject to frequent failure.

Sanitation outcomes are closely linked to water availability. Although toilets have been constructed under government schemes, inadequate water supply limits use, particularly for women. This creates health risks, dignity concerns, and increased vulnerability during extreme weather events.

Women's narratives reveal that water insecurity is not merely physical but emotional and social. Anxiety about supply, conflict at shared sources, and the constant pressure to manage scarcity create chronic stress. Yet this labour remains invisible in policy discourse, treated as household coping rather than as a governance failure.

Major Inferences and Theoretical Linkages

1. Water coverage does not equate to water security.

Formal access masks deep gendered inequities in labour, control, and risk. This finding reinforces feminist critiques of infrastructure-led development that ignore social relations.

2. Climate change magnifies existing governance failures.

Erratic rainfall and declining recharge intensify women's water labour, but the roots of vulnerability lie in institutional exclusion and unequal control over resources. This aligns with Kabeer's argument that vulnerability is produced through social relations rather than individual deficits.

3. Water insecurity operates as a multiplier of gender inequality.

Time poverty, health stress, and exclusion from governance limit women's adaptive capacity, directly undermining SDG 5 while weakening progress on SDG 6 and SDG 13. The case underscores the IGVAF insight that care labour is foundational to resilience but systematically exploited.

Scope, Limitations, and Ethical Reflection

This case focuses on two villages and relies primarily on qualitative methods, including PRA tools and interviews. Quantitative measurements of water quality and flow were not conducted, and seasonal variation is based on collective recall. Despite these limitations, the convergence of accounts across caste and age groups suggests strong internal validity.

Ethically, the case exposes a profound injustice: women bear the costs of hydrological and institutional failure through unpaid labour and compromised health. Climate adaptation policies that celebrate household tap connections without addressing governance, quality, and gendered labour risk reproducing this injustice. Water security, as this case demonstrates, is not only a technical goal but a question of dignity, equity, and climate justice.

2

Forest Degradation, Gendered Ecological Labour, and Tribal Livelihood Insecurity in Roha

This case study examines the gendered dimensions of forest degradation and livelihood insecurity among Scheduled Tribe households in Pale Khurd and adjoining forest-adjacent hamlets in Roha taluka. The focus is on how ecological change, climate variability, and forest governance regimes intersect to reshape women's everyday labour, income security, and autonomy. While forests are officially framed as protected ecological assets under state control, for tribal women they constitute lived spaces of survival, care, and cultural continuity.

The central research problem concerns the growing disjuncture between formal forest governance and everyday forest dependence. Tribal women continue to rely on forests for fuelwood, fodder, wild foods, and small quantities of Non-Timber Forest Products (NTFPs), yet declining forest quality, invasive species, and regulatory restrictions have significantly reduced availability and increased labour burdens. Climate change exacerbates this crisis by altering rainfall patterns, increasing forest fire risk in summer, and reducing regeneration of key species.

This case is significant because SDG 15 (Life on Land) is often operationalised through conservation targets, afforestation drives, and biodiversity metrics, with limited attention to the gendered labour that sustains forest–human systems. In Pale Khurd, women's ecological labour functions as an informal safety net that absorbs both ecological decline and institutional neglect. The case therefore creates a critical linkage between SDG 15 and SDG 5 (Gender Equality), while also intersecting with SDG 13 (Climate Action) through climate-induced forest stress.

The object of analysis is women's forest-based livelihood cycle. By tracing daily and seasonal patterns of fuelwood collection, fodder gathering, NTFP harvesting, and forest care, the case documents how ecological degradation translates into time poverty, income loss, and heightened vulnerability for tribal women. Forest use becomes a diagnostic lens for examining power, recognition, and exclusion.

The analytical framework integrates the Harvard Framework to distinguish access from control over forest resources, Moser's Triple Role framework to capture the cumulative labour burden, Kabeer's Social Relations Framework to locate forest dependence within institutional power structures, and the Integrated Gendered Vulnerability and Agency Framework (IGVAF) to connect climate ecology, spatial marginality, and intersectional vulnerability.

This case contributes to climate and forest studies by foregrounding women's lived experiences and by demonstrating that forest degradation is not gender-neutral. Climate-induced ecological stress is mediated through governance systems that systematically undervalue tribal women's knowledge and labour, producing vulnerability that is structural rather than accidental.

Analytical Framework and Subject

The subject of this case is gendered ecological labour under conditions of forest degradation. A reconstructed forest-use profile reveals that women's engagement with forests is daily, embodied, and multifaceted. Tasks include collecting fuelwood and fodder, gathering wild vegetables and fruits, managing household energy needs, and transmitting ecological knowledge across generations.

The analytical framework for this case study is grounded in the **Political Ecology of Conservation and Livelihoods**, a perspective that critically examines how environmental protection, resource governance, and livelihood systems interact under conditions of inequality and climate stress. This framework is particularly suited to analysing forest degradation and tribal livelihood insecurity in Roha because it foregrounds the tensions between state-led conservation regimes and everyday survival practices of forest-dependent communities. Rather than treating forests as neutral ecological spaces, political ecology conceptualises them as contested terrains shaped by power, history, and unequal access to resources.

At the core of this framework is the idea that **environmental degradation and conservation are both political processes**. In Pale Khurd and adjacent forest hamlets, declining forest quality cannot be explained solely by climate variability or overuse. Instead, political ecology highlights how restrictive forest governance, weak recognition of customary rights, and exclusionary institutional practices interact with climate stress to intensify vulnerability. Women's dependence on forests for fuelwood, fodder, and Non-Timber Forest Products (NTFPs) places them at the frontline of ecological change, yet they remain marginal to decision-making processes that define access rules, harvesting norms, and restoration priorities. The framework thus reveals how conservation policies externalise ecological and governance costs onto women's labour while presenting forest protection as a technocratic achievement aligned with SDG 15.

The Political Ecology of Conservation also foregrounds **livelihood displacement and labour intensification** as key mechanisms through which vulnerability is produced. As forest resources decline due to invasive species, reduced regeneration, and climate-induced stress, women compensate by travelling longer distances, spending more time collecting resources, and accepting declining returns from NTFPs. Rather than interpreting this as adaptive behaviour alone, the framework situates it within a structural context where women's labour masks ecological decline and governance failure. Climate change (SDG 13) accelerates this

process by altering rainfall patterns, increasing fire risk, and reducing biomass availability, thereby tightening the dependence–degradation cycle.

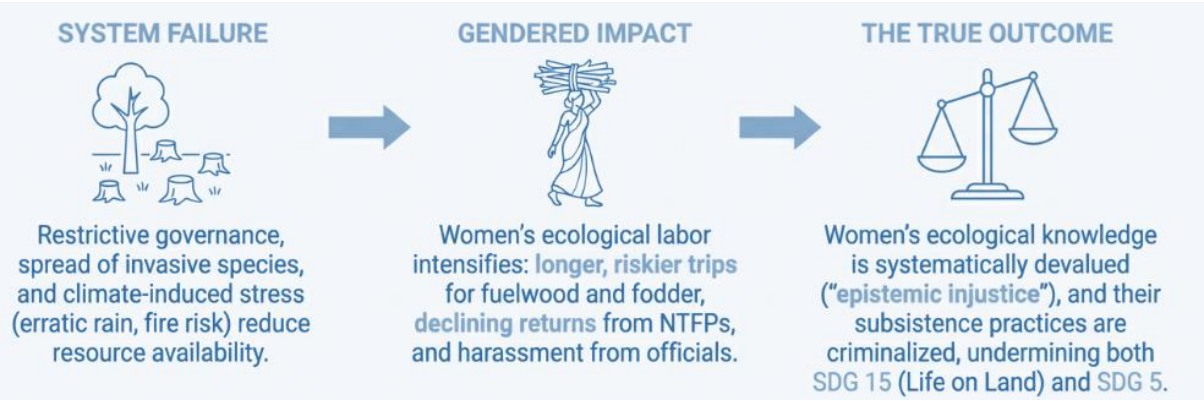
Finally, this framework connects ecological outcomes to **justice and legitimacy**, aligning closely with SDG 5 (Gender Equality). Political ecology interrogates whose livelihoods are rendered expendable in the pursuit of conservation targets and whose knowledge is recognised as legitimate. In Roha, tribal women's ecological knowledge species selection, seasonal indicators, and sustainable harvesting practices is systematically devalued in favour of bureaucratic forestry models. This exclusion weakens both social equity and ecological resilience. By applying the Political Ecology of Conservation and Livelihoods framework, this case study demonstrates that forest degradation is not merely an environmental issue but a gendered and political one, where climate action and ecosystem protection succeed or fail based on how power, labour, and rights are distributed.

Discussion of the Case

Field narratives indicate a marked decline in forest quality over the past decade. Women report reduced availability of fuelwood, fodder, wild fruits, and medicinal plants. Native species have been replaced by invasive plants that offer little subsistence value. Climate variability, particularly erratic rainfall and prolonged dry spells, has disrupted regeneration cycles.

As forest resources decline, women's labour increases disproportionately. Collection trips that once took one to two hours now require three to four hours, often involving longer distances and steeper terrain. This intensifies physical strain, safety risks, and time poverty, particularly for elderly women and widows.

Forest governance structures exacerbate vulnerability. Joint Forest Management Committees exist largely on paper, with minimal participation from women NTFP collectors. Women report harassment for fuelwood collection despite their dependence on forests for daily cooking. Market access for NTFPs is controlled by male intermediaries, leaving women with low returns and little bargaining power.



Climate stress compounds these challenges. Summer heat increases fire risk and reduces fodder availability, affecting livestock health. Monsoon variability affects fruiting patterns,

reducing seasonal food security. These ecological shocks translate directly into household stress, nutritional deficits, and income loss.

Despite these constraints, women display significant adaptive agency. They adjust collection schedules, substitute species, share resources through informal networks, and transmit ecological knowledge. However, this agency remains unsupported and extracted rather than empowered.

Major Inferences and Theoretical Linkages

A key inference is that forest degradation operates as a gendered process. Women's labour compensates for ecological decline, masking the severity of degradation while intensifying exploitation. This aligns with feminist political ecology critiques that conservation often externalises costs onto marginalised women.

A second inference is that access without control produces vulnerability. Tribal women's daily interaction with forests does not confer rights or security, confirming the Harvard Framework's relevance in analysing adaptive capacity failures.

A third inference is that climate action and ecosystem protection cannot succeed without gender justice. SDG 15 initiatives that ignore women's labour and knowledge risk undermining both ecological sustainability and social equity. IGVAF highlights how ecological and social feedback loops reinforce vulnerability when governance excludes primary stewards.

Scope, Limitations, and Ethical Reflection

This case is based on qualitative fieldwork and collective recall. Quantitative data on biomass availability or income from NTFPs were not systematically collected. Nevertheless, consistent narratives across households suggest robust patterns.

Ethically, the case raises concerns about conservation models that criminalise survival while extracting unpaid ecological labour from tribal women. Climate and forest policies that ignore these injustices risk reproducing vulnerability under the guise of sustainability. True progress on SDG 15 requires recognising, redistributing, and representing the women whose labour sustains forest landscapes.

3

Water Insecurity, Care Burden, and Gendered Everyday Survival in Roha

This case study examines gendered water insecurity in Pale Budruk and its peripheral hamlets in Roha taluka, with a specific focus on how climate variability, infrastructural failure, and governance arrangements translate into disproportionate burdens for women and girls. While access to drinking water is formally recognised as a basic service and a core component of SDG 6 (Clean Water and Sanitation), the lived experience of water access in Roha reveals deep inequalities shaped by gender, caste, spatial location, and institutional neglect.

The central research problem addressed in this case is the gap between nominal water access and effective water security. Although households have been provided with piped water connections under the Jal Jeevan Mission, water supply remains intermittent, unreliable, and unevenly distributed. Climate-induced variability in rainfall, declining groundwater recharge, and inadequate maintenance of infrastructure have transformed water access into a daily negotiation rather than a guaranteed service. This burden is borne almost entirely by women, whose reproductive and care responsibilities position them as the primary managers of household water.

The case is significant because water insecurity is often treated as a technical or engineering problem, addressed through infrastructure provisioning alone. In Pale Budruk, however, water scarcity is deeply social. It reshapes time use, health outcomes, dignity, and women's ability to participate in education, livelihoods, and governance. Water thus becomes a critical intersection point between SDG 6 and SDG 5 (Gender Equality), while climate variability directly links the issue to SDG 13 (Climate Action).

The object of analysis is the everyday water cycle: sourcing, storing, allocating, and using water across seasons. By tracing how women navigate multiple water sources taps, handpumps, borewells, springs, and rivers the case documents how climate stress and institutional failure are absorbed through unpaid female labour. Water access becomes a lens to examine power, recognition, and representation in local governance systems.

The analytical framework integrates the Harvard Framework to distinguish women's access to water from their lack of control over water governance; Moser's Triple Role framework to capture the expansion of reproductive and community management labour under scarcity; Kabeer's Social Relations Framework to situate water insecurity within institutional exclusion;

and the Integrated Gendered Vulnerability and Agency Framework (IGVAF) to connect climate ecology, spatial inequality, and cumulative vulnerability.

This case advances understanding by showing that water insecurity is not merely about scarcity but about whose time, bodies, and dignity are used to compensate for failing systems. It foregrounds the ethical dimension of SDG 6 by revealing how women's unpaid labour subsidises both climate variability and governance failure.

Analytical Framework and Subject

The subject of this case is gendered water labour under conditions of climate stress and infrastructural fragility. A reconstructed daily and seasonal water-use profile reveals that women's engagement with water is continuous and multi-layered. Tasks include early morning and late evening water collection, storage management, allocation for drinking, cooking, washing, sanitation, and livestock, and crisis management during shortages or contamination.

The analytical framework guiding this case study is the **Feminist Political Economy of Care and Infrastructure**, which examines how economic systems, public services, and climate stress redistribute costs onto unpaid and underpaid care labour, predominantly performed by women. This framework is particularly suited to analysing water insecurity in Roha because it shifts attention away from infrastructure as a neutral technical asset and instead interrogates **who absorbs failure when systems break down**. Water scarcity in Pale Budruk is not simply a problem of supply; it is a problem of how care, responsibility, and risk are socially allocated under climate stress.

At the centre of this framework is the concept of **care as invisible infrastructure**. Feminist political economists argue that households especially women function as shock absorbers for both market and state failures. In this case, women's daily water labour compensates for intermittent piped supply, declining groundwater recharge, and weak maintenance regimes. When Jal Jeevan Mission infrastructure fails to deliver reliable water, women reorganise their time, bodies, and routines to maintain household survival. Climate variability (SDG 13) intensifies this process by increasing uncertainty in rainfall, accelerating spring depletion, and degrading water quality during monsoons. The framework thus makes visible how climate stress is translated into expanded unpaid labour rather than triggering institutional accountability.

This perspective also foregrounds **time poverty and bodily costs** as central dimensions of vulnerability. Unlike technocratic water assessments that measure litres per capita or number of connections (SDG 6), the feminist political economy framework asks how many hours of labour are required to make water usable. In Roha, women spend three to five hours daily collecting, storing, boiling, and rationing water during scarcity periods. This labour directly undermines women's health, rest, income opportunities, and participation in public life, reinforcing gender inequality (SDG 5). The framework therefore reframes water insecurity as a gendered labour crisis rather than a temporary service gap.

Crucially, the Feminist Political Economy of Care also interrogates **governance and accountability**. Water institutions implicitly assume infinite female time and flexibility, treating women's coping strategies as normal household behaviour rather than as evidence of systemic failure. Women's experiential knowledge of water quality, seasonal variation, and household needs remains excluded from planning and monitoring processes. This exclusion is not accidental; it reflects deeper political–economic priorities that privilege visible infrastructure creation over the less visible work of maintenance, care, and social reproduction.

By applying this framework, the case study demonstrates that progress on SDG 6 cannot be meaningfully assessed without examining who pays the hidden costs of water insecurity. Water access achieved through women's unpaid labour is neither sustainable nor just. The Feminist Political Economy of Care and Infrastructure thus provides a powerful lens to connect climate action, gender equality, and water security, revealing that resilience built on exploitation is not resilience at all.

Discussion of the Case

Field narratives reveal that water insecurity in Pale Budruk is cyclical but increasingly chronic. During monsoon months, water availability improves but quality deteriorates due to runoff, contamination, and flooding. During summer, scarcity becomes acute as springs dry earlier and groundwater levels fall. Women manage these fluctuations by diversifying sources, rationing use, and prioritising drinking and cooking over hygiene.

The labour implications are severe. Women wake before dawn to collect water before queues form and repeat trips in the evening. Carrying heavy vessels over uneven terrain leads to musculoskeletal pain, fatigue, and injury. Girls often assist, affecting school attendance and study time. Elderly women and widows face particular hardship due to limited mobility.

Sanitation outcomes are directly affected. Toilets constructed under government schemes become unusable when water is unavailable, forcing open defecation and increasing health risks and loss of dignity, especially during menstruation. Women report urinary infections, stress, and fear associated with inadequate sanitation.

Water governance failures amplify these burdens. Maintenance delays, unequal distribution, and lack of transparency erode trust. Women rarely lodge complaints due to fear of retaliation, lack of confidence, or previous inaction. Climate stress thus interacts with institutional silence to normalise hardship.

Despite this, women demonstrate adaptive strategies: storing water, sharing sources, coordinating collection schedules, and supporting each other during crises. However, this resilience is extracted rather than supported, masking systemic failure.

Major Inferences and Theoretical Linkages

A key inference is that water insecurity is a gendered form of climate vulnerability. Women's unpaid labour absorbs both environmental variability and governance breakdown, aligning with feminist critiques of infrastructure-led development.

A second inference is that access without voice perpetuates vulnerability. The Harvard Framework reveals that women's central role in water management does not translate into authority, undermining adaptive capacity.

A third inference is that SDG 6 outcomes are inseparable from SDG 5 and SDG 13. Clean water cannot be achieved without redistributing governance power, recognising care labour, and addressing climate stress. IGVAF demonstrates how water systems function as social–ecological feedback loops, where exclusion accelerates degradation and vulnerability.

Scope, Limitations, and Ethical Reflection

This case relies on qualitative accounts and participatory observation rather than quantitative water flow measurements. Seasonal recall bias is possible, but convergence across narratives suggests robust patterns.

Ethically, the case raises questions about dignity and justice. Women in Pale Budruk are not merely lacking water; they are bearing the human cost of system failure. Climate-resilient water policy that ignores gendered labour risks deepening inequality under the banner of sustainability. Achieving SDG 6 requires recognising women not as carriers of water, but as rights-bearing citizens and decision-makers.

4

Forest Dependence, Gendered Labour, and the Erosion of Social–Ecological Resilience in Katkari Hamlets of Roha

This case study examines the gendered dimensions of forest dependence and ecological degradation in Katkari tribal hamlets located in and around Roha taluka, with a specific focus on how climate variability, forest governance regimes, and livelihood precarity intersect to shape vulnerability. Anchored in SDG 15 (Life on Land), the case highlights how forests function not merely as ecological spaces but as socio-economic systems deeply embedded in everyday survival, cultural identity, and gendered labour relations.

The research problem addressed here concerns the disjuncture between formal forest conservation policies and the lived realities of tribal women who depend on forests for fuelwood, fodder, food, and income. While forest degradation and biodiversity loss are widely acknowledged in policy discourse, the gendered labour that compensates for declining ecosystem services remains largely invisible. Climate change has intensified this dynamic by altering rainfall regimes, extending dry periods, and accelerating the spread of invasive species, thereby increasing the time, effort, and risk involved in forest-based activities.

The case is significant because SDG 15 is often framed in terms of ecological indicators tree cover, biodiversity indices, carbon sequestration without sufficient attention to the social relations through which ecosystems are sustained or degraded. In Roha, tribal women are the primary interface between forest ecosystems and household economies. Their daily labour buffers households against ecological stress, yet they are systematically excluded from forest governance and benefit-sharing mechanisms.

The object of analysis is the everyday forest–household interface. By tracing activities such as fuelwood collection, fodder gathering, Non-Timber Forest Product (NTFP) harvesting, and informal forest management practices, the case documents how climate stress and governance structures reshape women's labour, mobility, health, and economic security. Forests emerge not as static resources but as contested spaces where conservation, livelihood needs, and gendered power relations collide.

Analytically, the case draws on the Harvard Framework to distinguish women's access to forests from their lack of control over forest governance and markets; Moser's Triple Role framework to capture the intensification of productive, reproductive, and community

management labour as forests degrade; Kabeer's Social Relations Framework to situate forest dependence within institutional exclusion and epistemic marginalisation; and the Integrated Gendered Vulnerability and Agency Framework (IGVAF) to connect ecological degradation, spatial isolation, and cumulative vulnerability.

This case advances understanding by demonstrating that forest degradation under climate change is not only an ecological crisis but also a gendered labour crisis. It shows that without recognising and redistributing the costs borne by tribal women, SDG 15 interventions risk externalising conservation burdens onto those least responsible for ecological decline.

Analytical Framework and Subject

The subject of this case is gendered forest labour under conditions of ecological stress and restrictive governance. A reconstructed forest-use profile reveals that women's engagement with forests is daily, repetitive, and physically demanding. Tasks include walking long distances to collect fuelwood, gathering fodder for livestock, harvesting wild foods and medicinal plants, and processing NTFPs for household use or sale.

The analytical framework guiding Case Study 4 is **Feminist Political Ecology (FPE)**, combined with a **Social–Ecological Resilience** perspective. This framework is particularly appropriate for examining forest dependence and degradation in Katkari hamlets of Roha because it explicitly links **ecological change with power, gender, caste, and labour relations**. Rather than treating forests as neutral ecological spaces or women as passive victims of degradation, Feminist Political Ecology interrogates **who controls nature, whose knowledge counts, and whose labour sustains ecosystems under stress**.

At its core, Feminist Political Ecology argues that environmental change is never socially neutral. Ecological degradation is mediated through gendered divisions of labour, caste hierarchies, and institutional power. In Roha's Katkari hamlets, women are the primary interface between forest ecosystems and household survival. They collect fuelwood, fodder, wild foods, medicinal plants, and manage everyday ecological care. Yet they are excluded from forest governance structures, criminalised for subsistence practices, and erased from conservation narratives. Climate variability (SDG 13) intensifies forest stress through prolonged dry spells, erratic rainfall, and invasive species proliferation, but the costs of this degradation are disproportionately transferred onto women's bodies and time.

The feminist political ecology lens foregrounds **labour intensification as a key mechanism of vulnerability**. As forests degrade, women do not exit forest dependence; instead, they walk farther, spend more time, and carry heavier loads to secure diminishing resources. This expanded ecological labour masks the severity of degradation in official indicators such as forest cover or plantation counts (SDG 15). In effect, women's unpaid labour becomes a buffer that allows ecological decline to continue without immediate crisis visibility. This directly links environmental sustainability to gender inequality (SDG 5), showing that conservation outcomes are often achieved through the silent extraction of women's labour.

The Social–Ecological Resilience component of the framework deepens this analysis by examining feedback loops between ecosystems and social systems. In Katkari hamlets, declining forest quality increases women's labour burden, which in turn reduces the time and energy available for sustainable stewardship, participation in governance, or intergenerational knowledge transmission. This creates a **negative resilience loop**, where ecological degradation and social vulnerability reinforce one another. Traditional ecological knowledge particularly held by older women is eroded as institutional forestry dismisses it as informal or illegal, weakening adaptive capacity at both household and landscape scales.

This framework also centres **justice and legitimacy**. Feminist Political Ecology questions conservation models that protect forests by excluding those most dependent on them. In Roha, forest governance prioritises regulatory control over negotiated legitimacy, treating tribal women as encroachers rather than as ecological actors. As a result, SDG 15 interventions risk reproducing vulnerability rather than building resilience.

By applying Feminist Political Ecology and Social–Ecological Resilience, this case study reframes forest degradation as a gendered political process rather than a purely environmental problem. It demonstrates that sustainable forest governance under climate change requires recognising women's ecological labour, restoring indigenous knowledge systems, and redistributing decision-making power without which neither ecological resilience nor gender justice can be achieved.

Discussion of the Case

Field narratives indicate that forest degradation in Roha has been gradual but cumulative. Women report that fuelwood sources that were once available near hamlets now require walks of two to three kilometres. Invasive species such as Lantana camara have reduced access to native fodder and increased the risk of injury during collection. Declining availability of wild fruits and medicinal plants has reduced dietary diversity and household resilience.

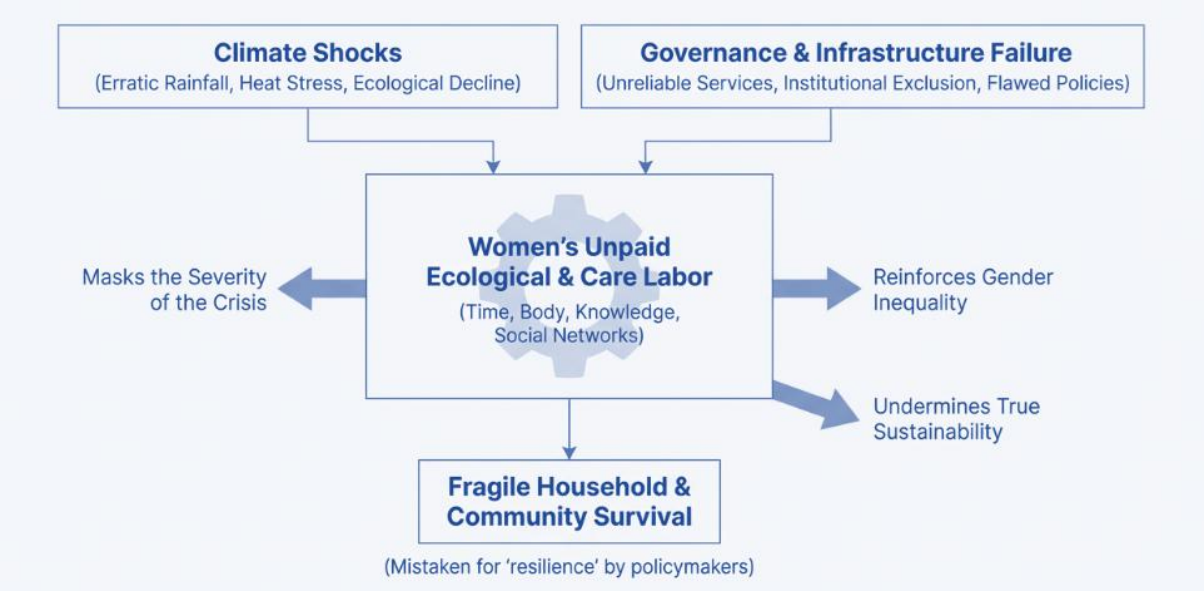
Climate variability has intensified these pressures. Extended dry spells reduce biomass regeneration, while erratic rainfall affects flowering and fruiting cycles critical for NTFPs. Women compensate by spending more time in forests, often entering unfamiliar or unsafe areas. This increases exposure to wildlife, harassment, and physical injury, particularly for elderly women and widows.

Livelihood implications are significant. Income from tendu leaves, honey, and other NTFPs has declined, while market access remains controlled by male intermediaries. Women receive a small fraction of the final market value and lack storage, processing, or bargaining power. When forest access is restricted during certain periods, women have few alternative livelihood options, intensifying dependence on low-paid wage labour.

Governance arrangements exacerbate vulnerability. Forest Department regulations are experienced as punitive rather than supportive, with women reporting harassment for

fuelwood collection despite subsistence needs. JFMC meetings are irregular, poorly communicated, and inaccessible to women due to timing, language, and social norms. Climate adaptation initiatives related to afforestation or watershed management rarely involve women meaningfully, despite their central role in ecosystem use.

Despite these constraints, women demonstrate adaptive strategies rooted in traditional knowledge rotational collection, species substitution, informal sharing arrangements, and seasonal adjustment of use. However, without institutional recognition or support, these strategies are fragile and insufficient to counter accelerating ecological stress.



Major Inferences and Theoretical Linkages

A central inference is that forest degradation produces gendered vulnerability through labour intensification rather than outright loss of access. Women's unpaid labour expands to compensate for declining ecosystem services, masking ecological collapse in official indicators.

A second inference is that exclusion from governance undermines conservation outcomes. The Harvard Framework illustrates that access without control leads to unsustainable extraction driven by necessity rather than choice. Kabeer's framework highlights how institutional power relations devalue indigenous knowledge, weakening adaptive capacity.

A third inference is that SDG 15 cannot be achieved independently of SDG 5 and SDG 13. Forest conservation that ignores gendered labour and climate stress risks transferring ecological costs onto marginalised women. IGVAF demonstrates that social–ecological feedback loops where degradation increases labour, reducing time for stewardship accelerate both ecological and social vulnerability.

Scope, Limitations, and Ethical Reflection

This case relies on qualitative evidence from participatory discussions and observation. Quantitative biodiversity assessments were not conducted, and findings reflect perceived

change rather than measured ecological indicators. However, consistency across narratives suggests strong validity.

Ethically, the case raises questions of justice and legitimacy. Tribal women in Roha are framed as threats to forests rather than as stewards sustaining everyday ecological functions. Climate and conservation policies that criminalise subsistence practices while ignoring structural drivers of degradation fail both SDG 15 and SDG 5. A just ecological transition must redistribute not only benefits but also decision-making power, recognising women's labour and knowledge as central to forest resilience.

5

Water Insecurity, Gendered Care Work, and Everyday Climate Stress in Roha Villages

This case study examines household water insecurity in Roha through a gendered lens, positioning access to water not only as an infrastructure issue but as a daily labour, care, and governance challenge that disproportionately affects women. Anchored in SDG 6 (Clean Water and Sanitation), the case explores how climate variability, declining local water sources, and weak institutional arrangements reshape women's time use, health, dignity, and adaptive capacity.

The central research problem addressed here is the invisibility of women's water labour in climate and development planning. While Roha receives high annual rainfall, households experience chronic water scarcity during summer months and acute water quality problems during the monsoon. These contradictions reveal that water insecurity is not the result of absolute scarcity but of governance failure, infrastructural fragility, and social inequality. Climate change intensifies these failures by increasing rainfall variability, shortening groundwater recharge periods, and accelerating the drying of springs.

This case is significant because SDG 6 indicators often focus on coverage number of household connections or toilets constructed without examining reliability, quality, or labour implications. In Roha, piped water connections under the Jal Jeevan Mission coexist with long hours of water collection, unsafe sources, and sanitation facilities rendered unusable due to water shortages. Women absorb the gap between policy intent and lived reality through unpaid labour.

The object of analysis is women's everyday water work: collecting, storing, rationing, treating, and managing water for drinking, cooking, sanitation, livestock, and care of children and the elderly. By tracing these practices across seasons and linking them to climatic and institutional conditions, the case reveals how water insecurity becomes a pathway for gendered vulnerability.

The analytical framework integrates the Harvard Framework to distinguish access from control over water resources, Moser's Triple Role framework to capture the stacking of productive, reproductive, and community management labour, Kabeer's Social Relations Framework to situate water insecurity within institutional exclusion, and the IGVAF to connect climate stress, spatial inequality, and cumulative vulnerability.

Analytical Framework and Subject

The subject of this case is the gendered production of water security at the household and community level. Women are the primary managers of domestic water systems, yet their role is largely invisible in formal governance.

The analytical framework guiding Case Study 5 is the **Care Economy Framework**, grounded in **Feminist Economics of Infrastructure**. This framework is particularly suited to analysing water insecurity and gendered care work in Roha because it treats water systems not merely as technical infrastructure, but as **care-supporting socio-economic systems** whose failure is absorbed through unpaid female labour. Unlike governance- or ecology-focused frameworks used in earlier cases, this approach centres **care work, time use, and social reproduction** as the primary analytical entry points.

The Care Economy framework starts from the premise that economies function only because of vast amounts of unpaid reproductive and care labour such as water collection, food preparation, sanitation, childcare, and eldercare performed predominantly by women. In Roha villages, water insecurity directly expands this invisible economy. When piped water supply is intermittent or unsafe, women compensate by fetching water from multiple sources, boiling contaminated water, managing hygiene under scarcity, and caring for family members affected by waterborne diseases. Climate variability (SDG 13) intensifies this dynamic by increasing rainfall unpredictability, turbidity during monsoons, and summer scarcity, thereby **lengthening women's care workday without recognition or remuneration**.

Feminist Economics of Infrastructure extends this logic by arguing that infrastructure failures are not gender-neutral. In Roha, Jal Jeevan Mission connections exist on paper, yet the system's unreliability shifts responsibility for functionality onto households specifically women. The framework reveals how infrastructure design and evaluation focus on outputs (connections, toilets built) rather than outcomes (time saved, health improved, dignity ensured). This disconnect produces a hidden subsidy: women's unpaid labour absorbs the costs of malfunctioning water systems, allowing institutions to claim success while gendered burdens intensify. This directly undermines SDG 5, even as SDG 6 targets appear formally achieved.

The framework also foregrounds **time poverty as a structural constraint**. Women's care responsibilities expand precisely when climate stress is highest during heatwaves, droughts, floods, and disease outbreaks. This leaves little time for income-generating work, participation in governance, or rest. Care Economy analysis shows that water insecurity is not just a resource issue but a **time crisis**, with long-term implications for women's health, autonomy, and intergenerational equity. Girls' education is affected as daughters assist with water collection, reproducing vulnerability across generations.

Finally, this framework introduces a justice lens by questioning whose labour sustains public goods. Water security in Roha is maintained not through robust institutions, but through the

endurance of women's bodies. This creates a moral hazard in policy design, where systemic failures are normalised because households cope. By linking unpaid care work to infrastructure and climate stress, the Care Economy framework demonstrates that achieving SDG 6 without transforming gender relations is both inefficient and unjust.

In sum, this analytical framework reframes water insecurity as a **crisis of care and social reproduction**, not merely of supply. It shows that climate-resilient water systems must be evaluated by how much unpaid labour they eliminate not how much they invisibly extract making gender equality central rather than incidental to climate and water policy.

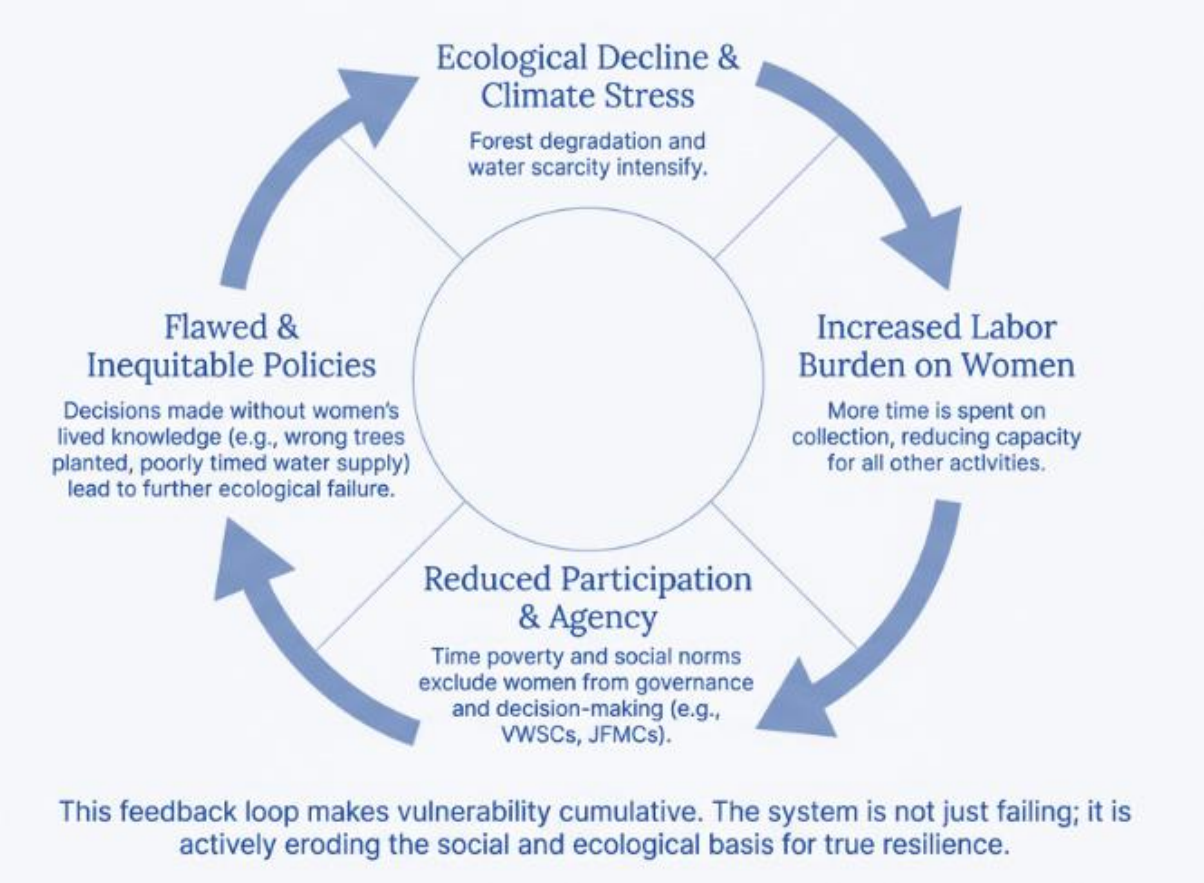
Discussion of the Case

Field findings reveal that water insecurity in Roha is cyclical, predictable, and gendered. During summer months, women rise before dawn to secure water during short supply windows. When piped supply fails, they revert to springs, borewells, or river sources, often walking long distances and carrying heavy loads. Elderly women and young girls are frequently involved, increasing health risks and educational disruption.

Water quality deteriorates sharply during the monsoon. Flooding and runoff increase turbidity and contamination, leading to diarrhoea, skin infections, and fevers, particularly among children and the elderly. Women absorb the resulting care burden nursing the sick, boiling water, and managing hygiene under constrained conditions. Fuel costs for boiling water further strain household finances.

Sanitation infrastructure illustrates the limits of coverage-focused approaches. Toilets constructed under government schemes are often unusable due to lack of water, forcing continued open defecation. Women report avoiding toilet use to conserve water or due to safety concerns at night, compromising dignity and health. Menstrual hygiene management is particularly affected, with inadequate water and disposal facilities intensifying discomfort and stigma.

Governance failures are central. VWSCs lack transparency and accountability. Women's participation is often symbolic, with decisions pre-determined by male leaders or external contractors. Complaint mechanisms are weak, and repairs are delayed, especially in peripheral hamlets. Climate stress exacerbates these failures, as infrastructure designed for predictable rainfall struggles under new variability.



Despite these constraints, women develop coping strategies storing water, prioritising uses, informal sharing, and adjusting daily routines. However, these strategies rely on unpaid labour and personal sacrifice, masking systemic failure rather than resolving it.

Major Inferences and Theoretical Linkages

A key inference is that water insecurity under climate change is produced through governance gaps rather than natural scarcity. The Harvard Framework shows that access without control forces women to compensate through labour rather than decision-making.

A second inference is that water insecurity is a multiplier of gendered vulnerability. Moser's framework reveals how water stress simultaneously increases reproductive labour, constrains productive activities, and demands community mediation, producing acute time poverty.

A third inference is that SDG 6 cannot be achieved independently of SDG 5 and SDG 13. Climate variability reshapes hydrological systems, while gender norms determine who absorbs the resulting stress. Kabeer's framework highlights how institutional norms exclude women's knowledge, weakening adaptive capacity. IGVAF demonstrates how spatial and temporal inequalities compound vulnerability across caste, age, and gender.

Scope, Limitations, and Ethical Reflection

This case is based on qualitative accounts and participatory tools rather than quantitative water quality testing or hydrological measurement. While this limits technical precision, the

convergence of narratives across villages and stakeholder groups suggests strong validity regarding lived experience.

Ethically, the case raises concerns about the invisibilisation of women's labour in achieving water security. Women in Roha are effectively treated as informal infrastructure absorbing risk, labour, and care costs generated by climate change and institutional failure. Any SDG 6 intervention that measures success by connections rather than lived reliability risks reinforcing gender injustice. A just approach must recognise women not only as users but as decision-makers in water governance, linking SDG 6 outcomes directly to SDG 5, SDG 13, and SDG 15.

6

Forest Degradation, Gendered Ecological Labour, and Institutional Exclusion in Sudhagad

This case study examines the relationship between forest ecosystems, gendered labour, and climate vulnerability in Sudhagad taluka, with a specific focus on women from Scheduled Tribe and forest-dependent households. Anchored in SDG 15 (Life on Land), the case analyses how ecological degradation, climate variability, and exclusionary forest governance interact to produce cumulative and gendered vulnerability. Rather than treating forests solely as biophysical assets, the study conceptualises them as lived socio-ecological systems sustained through everyday labour, care, and knowledge much of which is performed by women.

The core research problem addressed here is the disconnect between forest conservation frameworks and the realities of forest-dependent livelihoods under climate stress. In Sudhagad, forests are simultaneously sites of survival, labour, and regulation. Women depend on forest landscapes for fuelwood, fodder, minor forest produce, and cultural practices, yet they remain marginal to decision-making processes that govern access, conservation, and restoration. Climate change intensifies this contradiction by accelerating forest degradation while increasing household dependence on forest resources.

This case is significant because SDG 15 indicators tend to emphasise forest cover, plantation targets, or biodiversity metrics, while neglecting questions of access, labour, and justice. In Sudhagad, official narratives of forest protection coexist with declining availability of native species, increased distances for resource collection, and rising conflict between forest-dependent communities and regulatory institutions. Women absorb the consequences of this mismatch through expanded labour, reduced nutrition, and heightened exposure to risk.

The object of analysis is women's ecological labour daily fuelwood and fodder collection, Non-Timber Forest Product (NTFP) harvesting, and informal forest stewardship and how this labour is reshaped by climate variability, forest degradation, and governance regimes. The case links SDG 15 directly with SDG 5 (Gender Equality) and SDG 13 (Climate Action), demonstrating that ecosystem sustainability cannot be separated from gender justice.

The analytical framework integrates the Harvard Framework to distinguish access from control over forest resources, Moser's Triple Role framework to capture how ecological degradation intensifies women's productive and reproductive labour, Kabeer's Social Relations Framework

to locate forest exclusion within institutional power, and the Integrated Gendered Vulnerability and Agency Framework (IGVAF) to trace cumulative vulnerability across ecological, social, and spatial dimensions.

Analytical Framework and Subject

The subject of this case is the **gendered political ecology of forests in Sudhagad**. Women are the primary interface between households and forest ecosystems, yet their role is systematically undervalued and regulated.

The analytical framework guiding Case Study 6 is **Feminist Political Ecology (FPE)**. This framework is especially appropriate for analysing forest degradation, gendered ecological labour, and institutional exclusion in Sudhagad because it explicitly connects **ecological change, political power, and gendered labour relations**. Unlike care- or infrastructure-focused frameworks, FPE situates environmental degradation within histories of resource control, state authority, and social differentiation, making it well suited to forest-dependent tribal contexts.

Feminist Political Ecology begins from the premise that environmental change is never socially neutral. Access to, control over, and responsibility for natural resources are structured by gender, caste, class, and ethnicity. In Sudhagad, forests are governed through state-centric conservation regimes that prioritise protection, regulation, and plantation targets, while everyday dependence on forests for fuelwood, fodder, food, and cultural practices remains feminised and informal. FPE allows this case to interrogate how **women become the primary managers of ecological decline** without gaining corresponding rights, authority, or recognition. Forest degradation under climate stress thus appears not only as ecological loss, but as a redistribution of labour and risk onto tribal women.

A core strength of FPE is its attention to **knowledge politics**. In Sudhagad, tribal women possess detailed ecological knowledge of species regeneration, seasonal harvesting norms, soil moisture, and forest health indicators. However, this knowledge is systematically marginalised in favour of "scientific forestry" administered by the Forest Department. Plantation programmes often prioritise fast-growing or commercially favoured species that do not meet subsistence needs, increasing women's labour while degrading ecological resilience. FPE exposes this as **epistemic injustice**, where certain knowledges are delegitimised, producing both ecological failure and social exclusion. This insight directly links SDG 15 (Life on Land) with SDG 5 (Gender Equality), showing that biodiversity loss is accelerated when women's knowledge is excluded.

The framework also foregrounds **power and regulation**. Forest governance in Sudhagad operates through surveillance, fines, and restriction rather than negotiated legitimacy. Women's subsistence practices fuelwood collection, fodder gathering, minor forest produce harvesting are often criminalised, forcing women into longer, riskier collection routes. Under climate variability (SDG 13), when agricultural yields decline and forest dependence increases,

these regulatory pressures intensify vulnerability. FPE reveals how conservation policies, when disconnected from social realities, externalise environmental costs onto marginalised women while protecting institutional authority.

Feminist Political Ecology further captures **social–ecological feedback loops**. As forests degrade due to climate stress and inappropriate management, women must invest more labour to meet household needs. This time poverty reduces their capacity for collective action, stewardship, or resistance, which in turn weakens ecological governance and accelerates degradation. Vulnerability thus becomes cumulative and self-reinforcing.

Discussion of the Case

Field narratives from Sudhagad reveal that forest degradation is experienced first and most intensely through women's bodies and time. Women report walking significantly longer distances to collect fuelwood and fodder compared to a decade ago. Native species used for fuel and medicine have declined, replaced by invasive plants with limited utility. These changes are attributed to altered rainfall patterns, soil erosion, and plantation practices that prioritise fast-growing species over ecological suitability.

Climate variability intensifies pressure on forests. During drought years, households rely more heavily on forest resources as agricultural yields decline. Women's collection trips increase in frequency and duration, often under conditions of heat stress and physical exhaustion. Encounters with wildlife and fear of penalties add psychological stress to physical labour.

Forest governance structures exacerbate vulnerability. Women describe being stopped, questioned, or fined for collecting fuelwood, even for household use. Such encounters discourage sustainable practices and push collection into more remote and unsafe areas. Appeals mechanisms are weak, and women lack legal literacy or collective platforms to negotiate access.

The erosion of traditional ecological knowledge is a critical concern. Elderly tribal women possess detailed knowledge of species regeneration, seasonal indicators, and sustainable harvesting, yet this knowledge is not transmitted effectively due to youth migration and institutional devaluation. As forests degrade, women's capacity to act as stewards diminishes, creating a negative feedback loop between ecological decline and social vulnerability.

Despite these constraints, women demonstrate adaptive strategies shifting collection timings, substituting fuels, sharing resources, and participating in informal collectives. However, these strategies are coping mechanisms rather than pathways to resilience, as they rely on unpaid labour and do not address structural exclusion.

Major Inferences and Theoretical Linkages

A first major inference is that forest sustainability under climate change depends on recognising and supporting women's ecological labour. The Harvard Framework shows that

access without control forces women to compensate for governance failure through labour rather than influence.

A second inference is that forest degradation multiplies gendered vulnerability. Moser's framework demonstrates how declining ecosystems increase women's productive, reproductive, and community management burdens simultaneously, producing chronic time poverty and health stress.

A third inference is that SDG 15 cannot be achieved without integrating SDG 5 and SDG 13. Climate variability accelerates forest degradation, while gendered institutions determine who bears the costs. Kabeer's framework highlights how institutional exclusion undermines both justice and ecological outcomes. IGVAF illustrates how social and ecological feedback loops reinforce vulnerability, making isolated technical interventions insufficient.

Scope, Limitations, and Ethical Reflection

This case is based on qualitative evidence from participatory tools, interviews, and collective discussions. Quantitative forest cover data and biodiversity assessments were not conducted, limiting ecological precision. However, the consistency of lived experiences across villages suggests robust patterns of gendered ecological vulnerability.

Ethically, the case raises fundamental questions about conservation without consent. Women in Sudhagad are expected to protect forests while being excluded from governance and criminalised for subsistence use. Climate adaptation and biodiversity policies that ignore these injustices risk undermining both social equity and ecological sustainability. A just SDG 15 pathway must therefore recognise women as ecological agents, redistribute governance authority, and integrate climate adaptation with gender justice.

7

Water Scarcity, Gendered Labour, and Institutional Fragility in Sudhagad

This case study examines water insecurity in Sudhagad through a gendered and justice-oriented lens, focusing on how climate variability, fragile infrastructure, and institutional exclusion reorganise everyday life and labour for women. Anchored in SDG 6 (Clean Water and Sanitation), the case analyses water not merely as a physical resource but as a social relation shaped by power, caste, gender, and governance. In Sudhagad, water scarcity is not episodic but seasonal and structural, deeply embedded in daily routines and survival strategies.

The central research problem addressed here is the feminisation of water stress under climate change. While rainfall levels in Sudhagad remain relatively high, water availability for domestic use, sanitation, and livelihoods has become increasingly unreliable due to drying springs, declining groundwater recharge, damaged pipelines, and lack of storage systems. Women bear the primary responsibility for securing water for households, yet they remain largely excluded from water governance institutions and decision-making processes.

This case is significant because SDG 6 indicators often focus on coverage number of taps, toilets constructed, or schemes implemented without interrogating reliability, labour burden, or equity. In Sudhagad, Jal Jeevan Mission connections exist in several villages, but supply is intermittent and inadequate, compelling households to depend on seasonal springs, handpumps, rivers, and private borewells. Climate change exacerbates these failures by increasing rainfall variability and shortening the period during which natural sources remain viable.

The object of analysis is women's water labour: collection, storage, rationing, and quality management across seasons. This labour intensifies under climate stress and interacts with sanitation challenges, health risks, and time poverty. The case explicitly links SDG 6 with **SDG 5 (Gender Equality)** and **SDG 13 (Climate Action)**, showing that water security cannot be achieved without addressing gendered labour relations and climate-induced hydrological stress.

The analytical framework integrates the Harvard Framework to examine access versus control over water, Moser's Triple Role framework to capture the expansion of women's unpaid labour, Kabeer's Social Relations Framework to locate water insecurity within institutional power, and the Integrated Gendered Vulnerability and Agency Framework (IGVAF) to trace cumulative vulnerability across spatial, temporal, and ecological dimensions.

Analytical Framework and Subject

The subject of this case is the gendered political economy of water in Sudhagad. Women are the primary managers of household water systems, yet water governance remains technocratic and male-dominated.

The analytical framework applied to Case Study 7 is the **Political Ecology of Infrastructure and Everyday Governance**. This framework is particularly suited to analysing water scarcity in Sudhagad because it shifts attention away from water as a purely natural or technical resource and instead examines water systems as **political, institutional, and socially mediated infrastructures**. It enables an understanding of how climate variability, state provisioning, and local power relations interact to shape differentiated access, labour burdens, and vulnerability especially for women.

At its core, the political ecology of infrastructure argues that infrastructures such as water pipelines, tanks, handpumps, and sanitation systems are not neutral delivery mechanisms. They embody political priorities, institutional capacities, and social hierarchies. In Sudhagad, the presence of Jal Jeevan Mission connections creates the appearance of universal access, yet everyday water security depends on reliability, repair, storage, and governance. This framework allows the case to interrogate the gap between **formal provisioning and lived functionality**, showing how women's unpaid labour compensates for infrastructural fragility intensified by climate change (SDG 13).

This framework foregrounds **everyday governance**, meaning how systems actually function in practice rather than how they are designed on paper. In Sudhagad, Village Water and Sanitation Committees exist, but they operate irregularly, are male-dominated, and lack accountability. Decisions about repair, tanker supply, or borewell use are mediated through informal networks rather than transparent processes. Women, despite being primary water managers, remain excluded from these governance circuits. The political ecology lens exposes how governance failures are not accidental but structurally embedded, transferring risk downward onto households and specifically onto women (SDG 5).

A key contribution of this framework is its attention to **labour substitution**. When infrastructure fails due to pipeline damage, drying springs, or delayed repairs labour substitutes for technology. In Sudhagad, this substitution is gendered. Women walk longer distances, queue for hours, store and ration water, and manage sanitation under scarcity. Climate variability accelerates this process by shortening the functional period of springs and increasing rainfall unpredictability. The framework thus connects SDG 6 (Clean Water and Sanitation) directly to women's time poverty, health stress, and diminished participation in public life.

The framework also highlights **spatial and caste-mediated inequalities** embedded in infrastructure layouts. Peripheral hamlets, often inhabited by Scheduled Caste and Scheduled Tribe households, are located farther from main pipelines and storage tanks, experience lower

pressure, and face longer repair delays. These spatial inequities amplify climate exposure and deepen social vulnerability. Political ecology makes visible how infrastructure reproduces historical patterns of exclusion rather than correcting them.

Finally, this framework situates water insecurity within broader **climate–governance feedback loops**. As climate change destabilises hydrological systems, infrastructure designed for predictable conditions becomes increasingly fragile. Instead of triggering institutional reform, this fragility is absorbed through women's unpaid labour, masking system failure and delaying accountability. The result is a normalisation of crisis.

Discussion of the Case

Field evidence from Sudhagad indicates that water scarcity is experienced primarily through women's time and bodies. During summer months, women report spending three to five hours daily collecting water, often making multiple trips. These journeys involve steep terrain, slippery paths during early monsoon, and exposure to heat stress. The physical strain is compounded by the need to carry water while managing childcare.

Climate variability has altered hydrological rhythms. Springs that were once perennial now dry by late winter, forcing households to switch sources multiple times a year. This instability requires constant adjustment and increases uncertainty. Women must plan water use carefully, rationing consumption and prioritising drinking and cooking over bathing or sanitation.

Sanitation infrastructure remains functionally constrained by water availability. Toilets constructed under government programmes are often unused during scarcity periods, forcing a return to open defecation. This creates dignity, safety, and health risks for women, particularly during menstruation and pregnancy. Waterborne diseases increase during monsoon flooding and during scarcity when water quality deteriorates.

Institutional fragility exacerbates vulnerability. Water committees lack regular meetings, technical capacity, and accountability. Maintenance delays are common, and repair responsibilities are unclear. Women report that complaints raised informally are rarely addressed unless mediated by male household members or local leaders.

Despite these challenges, women demonstrate adaptive strategies: storing water in improvised containers, coordinating collection schedules, sharing water during crises, and modifying household practices. However, these adaptations rely on unpaid labour and social obligation rather than institutional support, limiting their sustainability.

Major Inferences and Theoretical Linkages

A key inference is that water insecurity under climate change is fundamentally gendered. The Harvard Framework shows that access without control transfers the costs of system failure onto women's labour rather than triggering institutional accountability.

A second inference is that water scarcity amplifies women's triple burden. Moser's framework illustrates how reproductive labour expands dramatically, while productive and community roles are undermined by time poverty and health stress.

A third inference is that SDG 6 cannot be achieved in isolation. Climate variability (SDG 13) reshapes water availability, while gendered institutions (SDG 5) determine who absorbs risk. Kabeer's framework highlights how institutional exclusion erodes autonomy and dignity, while IGVAF demonstrates how social and ecological feedback loops perpetuate vulnerability.

Scope, Limitations, and Ethical Reflection

This case relies on qualitative data from participatory tools and interviews. Quantitative measurements of water quantity and quality were not conducted, limiting technical specificity. However, the consistency of women's narratives across villages suggests deeply embedded structural patterns.

Ethically, the case raises concerns about water policies that count connections rather than burdens. Women in Sudhagad compensate for climate and governance failures through unpaid labour, compromising health, education, and participation. A just SDG 6 pathway must therefore move beyond infrastructure to redistribute decision-making power, recognise women's water labour, and integrate climate resilience with gender justice.

8

Forest Degradation, Gendered Ecological Labour, and Tribal Vulnerability in Sudhagad

This case study examines forest-dependent livelihoods in Sudhagad through the lens of SDG 15 (Life on Land), with a particular focus on how ecological degradation, climate variability, and governance failures generate gendered and caste-differentiated vulnerability. In Sudhagad, forests are not peripheral landscapes but central socio-ecological systems that sustain household energy needs, food security, health practices, and cultural identity especially for Scheduled Tribe communities. The degradation of these forests therefore represents not only an environmental crisis but a livelihood and justice crisis.

The core problem addressed in this case is the intensification of women's ecological labour under conditions of forest decline. Women, particularly tribal women, are the primary collectors of fuelwood, fodder, wild foods, and medicinal plants. As forest quality deteriorates due to climate stress, invasive species, extraction pressures, and weak governance, women must travel longer distances, spend more time, and exert greater physical effort to secure diminishing resources. This labour intensification remains invisible within forest management frameworks that prioritise protection targets and plantation metrics over lived dependency and care work.

The case is significant because SDG 15 implementation often assumes that conservation outcomes are socially neutral or universally beneficial. In Sudhagad, however, forest protection regimes intersect with historical marginalisation of tribal communities, insecure land tenure, and exclusion from decision-making institutions. Climate change further complicates this landscape by altering forest composition, increasing fire risk, and reducing the availability of Non-Timber Forest Products (NTFPs). Women experience these changes first and most acutely, yet their knowledge and labour remain undervalued.

The object of analysis is women's everyday interaction with forest ecosystems: fuelwood collection, fodder gathering, NTFP harvesting, and informal forest stewardship. By tracing how these activities change over time and space, the case links SDG 15 with **SDG 5 (Gender Equality)** and **SDG 13 (Climate Action)**, demonstrating that ecosystem degradation and gender inequality are mutually reinforcing.

The analytical framework integrates the Harvard Framework to examine access versus control over forest resources, Moser's Triple Role framework to capture expanding labour burdens, Kabeer's Social Relations Framework to locate exclusion within institutional power, and the

Integrated Gendered Vulnerability and Agency Framework (IGVAF) to analyse cumulative socio-ecological vulnerability in Sudhagad's tribal landscapes.

Analytical Framework and Subject

The subject of this case is the gendered political ecology of forests in Sudhagad. While forests are formally managed by state institutions, their daily maintenance and utilisation depend heavily on women's labour labour that remains unpaid, unrecognised, and criminalised in some instances.

The analytical framework applied to Case Study 8 is **Feminist Political Ecology (FPE) with a focus on degradation and care**. This framework is particularly appropriate for analysing forest degradation and tribal vulnerability in Sudhagad because it explicitly links **ecological change, gendered labour, power relations, and knowledge systems**. Unlike conventional environmental frameworks that treat degradation as a biophysical outcome, Feminist Political Ecology understands environmental change as socially produced and unevenly experienced, with women especially tribal women bearing disproportionate costs through unpaid ecological labour.

At its core, Feminist Political Ecology argues that access to, control over, and responsibility for natural resources are shaped by gender, caste, class, and institutional power. In Sudhagad, forests are governed through state-centric conservation regimes, yet their everyday functioning depends on women's labour in fuelwood collection, fodder gathering, NTFP harvesting, and informal stewardship. This framework allows the case to examine how **women's care for ecosystems sustains both households and landscapes**, even as institutional arrangements exclude them from decision-making and benefit-sharing (SDG 5 and SDG 15).

A defining feature of this framework is its emphasis on **care as ecological labour**. Tribal women's work in Sudhagad walking long distances for fuelwood, selecting species, avoiding overharvesting, and adjusting collection to seasonal cycles constitutes a form of environmental care that maintains forest–human systems. However, as climate variability accelerates forest degradation through invasive species spread, altered rainfall, and prolonged dry spells, this care becomes more labour-intensive and physically costly. Feminist Political Ecology makes visible how climate change (SDG 13) transforms women's everyday practices into sites of vulnerability rather than resilience.

The framework also foregrounds **knowledge politics**. Women in Sudhagad possess detailed ecological knowledge regarding species regeneration, seasonal indicators, soil moisture, and sustainable extraction practices. Yet this knowledge is systematically devalued in favour of technocratic forestry models that prioritise plantation targets and enforcement. Feminist Political Ecology conceptualises this as epistemic injustice where certain forms of knowledge are excluded from legitimacy. This exclusion weakens adaptive capacity and undermines conservation outcomes under SDG 15.

Another critical dimension of the framework is its attention to **institutional power and criminalisation**. Forest Department regulations frame subsistence collection as illegal extraction, exposing women to harassment, fines, and fear. Feminist Political Ecology situates this not as a behavioural issue but as a governance failure that shifts the costs of conservation onto marginalised women. Climate stress intensifies this injustice, as declining agricultural viability increases dependence on forests precisely when access is most restricted.

The framework also captures **intersectional vulnerability**. Gendered ecological labour in Sudhagad is shaped by tribal identity, poverty, remoteness, and weak tenure security. Elderly women and widows face the highest burdens as declining forest quality increases labour demands while reducing nutritional and income returns. These layered vulnerabilities cannot be understood through environmental indicators alone.

Discussion of the Case

Field narratives from Sudhagad indicate that forest degradation is experienced most directly as increased labour for women. Fuelwood collection, once possible within nearby forest patches, now requires longer walks into steeper terrain. Women report spending one to two additional hours daily during dry seasons, carrying heavier loads and facing increased health risks, including musculoskeletal strain and fatigue.

Climate variability has altered forest ecology. Reduced soil moisture, changing flowering cycles, and invasive species such as *Lantana camara* have displaced native vegetation. This has reduced the availability of wild fruits, leafy greens, and medicinal plants traditionally used for nutrition and healthcare. Women compensate by increasing collection frequency or purchasing substitutes, increasing both labour and cash expenditure.

Forest governance exacerbates vulnerability. Restrictions on access are enforced unevenly, and women report fear of harassment or fines during collection. Despite Forest Rights Act provisions, many households lack secure or usable titles, limiting their ability to manage forest land sustainably. Women's exclusion from decision-making means that forest management plans rarely reflect local dependency patterns.

Adaptive strategies exist. Women adjust collection timing, diversify fuel sources, and rely on mutual aid networks. However, these strategies operate within shrinking ecological margins and increasing institutional constraints, making them fragile and unsustainable without structural change.

Major Inferences and Theoretical Linkages

A central inference is that forest degradation under climate change disproportionately burdens women through labour intensification rather than income loss alone. The Harvard Framework shows how access without control externalises ecological costs onto women's bodies.

A second inference is that conservation without gender justice reproduces vulnerability. Moser's framework highlights how women's reproductive and community labour absorbs ecological decline, while Kabeer's framework reveals how institutional exclusion undermines autonomy and dignity.

A third inference is that SDG 15 outcomes are inseparable from SDG 5 and SDG 13. Climate stress reshapes forest ecosystems, while gendered institutions determine who adapts and at what cost. IGVAF demonstrates how social and ecological feedback loops accelerate degradation when women's stewardship is unsupported.

Scope, Limitations, and Ethical Reflection

This case is based on qualitative data and participatory methods. Quantitative ecological assessments were beyond scope, but triangulation across interviews and PRA tools supports the robustness of findings.

Ethically, the case raises critical questions about conservation models that depend on women's unpaid labour while excluding them from authority. Tribal women in Sudhagad sustain forest ecosystems under increasingly hostile conditions, yet bear the costs of climate change and governance failure. Achieving SDG 15 requires not only protecting forests, but redistributing power, recognising women's ecological labour, and embedding climate justice within conservation practice.

9

Water Insecurity, Gendered Care Burdens, and Institutional Exclusion in Sudhagad

This case study examines water insecurity in Sudhagad through a gendered and justice-oriented lens, situating everyday struggles around drinking water and sanitation within the broader mandates of SDG 6 (Clean Water and Sanitation) and its interlinkages with SDG 5 (Gender Equality) and SDG 13 (Climate Action). In Sudhagad's hilly and forested terrain, water scarcity is not merely a seasonal inconvenience but a structural condition shaped by geography, climate variability, infrastructure failure, and unequal governance.

The central problem addressed in this case is the **gendered reallocation of risk and labour** under conditions of declining water reliability. As springs dry earlier, piped water supply remains intermittent, and rainfall becomes erratic, the burden of securing water shifts disproportionately onto women and adolescent girls. This shift is not accidental; it is embedded in gender norms that naturalise women's responsibility for household water, sanitation, and care work, while excluding them from water governance institutions.

The case is significant because SDG 6 interventions in rural India often focus on infrastructure delivery pipes, taps, toilets without adequately accounting for **who manages failure** when systems do not function as designed. In Sudhagad, household tap connections under the Jal Jeevan Mission coexist with long queues, unreliable supply timings, and poor water quality. Climate change has intensified these challenges by reducing base flows in springs, increasing turbidity during monsoon months, and creating longer dry spells during summer.

The object of analysis is women's daily water work: fetching, storing, rationing, treating, and managing water for drinking, cooking, sanitation, livestock, and care of the sick. By tracing how this work expands under climate stress and institutional gaps, the case connects water insecurity to time poverty, health vulnerability, and exclusion from public decision-making.

The analytical framework integrates the **Harvard Framework** to analyse access versus control over water resources, **Moser's Triple Role** to capture the expansion of reproductive labour, **Kabeer's Social Relations Framework** to locate exclusion within governance structures, and the **Integrated Gendered Vulnerability and Agency Framework (IGVAF)** to link climate variability, spatial marginalisation, and cumulative vulnerability in Sudhagad.

Analytical Framework and Subject

The subject of this case is the gendered political economy of water in Sudhagad. Water systems here include seasonal springs, handpumps, borewells, streams, and piped supply

schemes. While these systems are formally managed by state agencies and village committees, their day-to-day functioning depends on women's unpaid labour and adaptive strategies.

The analytical framework applied to Case Study 9 is the **Care Economy and Time Poverty Framework**, adapted to analyse water insecurity and institutional exclusion in Sudhagad under conditions of climate variability. This framework is particularly suited to the case because the central mechanism of vulnerability is not the physical absence of water alone, but the **systematic transfer of water system failure onto women's unpaid care labour and time**. It foregrounds care work as an economic, social, and political domain that is critical to both survival and climate adaptation, yet remains institutionally invisible.

The Care Economy framework conceptualises activities such as water collection, storage, sanitation management, childcare, eldercare, and health maintenance as productive labour that sustains households, communities, and economies. In Sudhagad, women's water work forms the backbone of everyday survival. Climate variability manifested through drying springs, erratic rainfall, and declining groundwater recharge expands this labour dramatically. The framework allows the analysis to shift from infrastructure-centric assessments of SDG 6 to a labour-centric understanding of water security, explicitly linking water access to SDG 5 (gender equality) and SDG 13 (climate action).

A key strength of this framework is its focus on **time poverty as a structural form of vulnerability**. Time poverty occurs when individuals primarily women lack discretionary time due to excessive unpaid labour burdens. In Sudhagad, women's daily schedules are reorganised around water collection windows, often requiring multiple trips across steep terrain. As climate change shortens the availability of reliable sources, women's time spent on water work increases from a few hours to most of the day during peak summer months. This leaves little time for rest, income generation, education, participation in governance, or health care, creating a cycle of cumulative deprivation.

The framework also enables an analysis of **institutional offloading of responsibility**. Water governance systems in Sudhagad operate on the implicit assumption that women will compensate for infrastructural failure through flexibility, endurance, and care. Village Water and Sanitation Committees, complaint mechanisms, and maintenance systems are weak, male-dominated, and slow to respond. The Care Economy framework interprets this not as accidental neglect but as a political economy of care, where women's unpaid labour subsidises state failure and climate stress without recognition or redistribution.

Another critical dimension is the interaction between **care work and health vulnerability**. Water scarcity and poor water quality increase disease burden, particularly during monsoon contamination and summer scarcity. Women absorb the expanded care workload nursing sick children and elders, managing hygiene under constrained conditions, and adjusting household

practices. Climate change thus multiplies care responsibilities precisely when physical exhaustion and nutritional stress are highest, reinforcing gendered vulnerability pathways.

The framework also captures **intergenerational and caste-based dimensions of care labour**. Girls are often pulled into water collection, affecting schooling, while elderly women continue heavy physical work despite declining health. Peripheral SC and ST hamlets face longer distances and poorer service reliability, intensifying both care burdens and time poverty.

Discussion of the Case

Field findings from Sudhagad show that **water insecurity is cyclical but cumulative**. During summer months, women report spending three to five hours daily collecting water, often making multiple trips to springs or handpumps. As springs dry earlier each year, distances increase, and queues lengthen. Women adjust by waking before dawn or collecting water late at night, increasing fatigue and safety risks.

Climate variability exacerbates water quality issues. Heavy monsoon rainfall increases turbidity and contamination in surface sources, leading to seasonal spikes in waterborne diseases. Women manage these health risks by boiling water or rationing usage, increasing fuelwood demand and care work. Sanitation infrastructure, though expanded under national programmes, remains constrained by water availability, forcing continued open defecation in some hamlets.

Governance gaps deepen vulnerability. Breakdowns in piped supply often take weeks to resolve, and women lack formal channels to demand timely repair. Decisions about borewell installation or tanker supply are mediated through male-dominated networks, leaving women dependent on informal negotiations.

Adaptive strategies include water storage, source diversification, and mutual aid. However, these strategies shift responsibility onto households rather than addressing systemic failures. Women's labour thus functions as a buffer absorbing institutional and climatic shocks.

Major Inferences and Theoretical Linkages

A key inference is that **water insecurity operates as a gendered amplifier of climate risk**. The Harvard Framework shows how access without control externalises system failure onto women's time and bodies.

A second inference is that SDG 6 outcomes cannot be evaluated solely by infrastructure coverage. Moser's framework demonstrates that when water systems fail, reproductive labour expands dramatically, undermining health, dignity, and participation in public life.

A third inference is that institutional exclusion sustains vulnerability. Kabeer's framework highlights how governance structures privilege technical authority over lived experience, while IGVAF reveals how climate variability, spatial marginalisation, and gender norms interact to produce cumulative vulnerability.

Scope, Limitations, and Ethical Reflection

This case relies on qualitative methods and participatory tools. Quantitative hydrological measurements were beyond scope, but convergence across narratives supports the findings.

Ethically, the case raises fundamental questions about justice in water governance. Women in Sudhagad manage scarcity created by climate change and infrastructural neglect, yet remain excluded from decision-making. Achieving SDG 6 requires moving beyond pipes and taps to address power, labour, and voice. Without recognising and redistributing responsibility for water management, water security initiatives risk reproducing gendered vulnerability rather than alleviating it.

10

Forest Degradation, Women's Ecological Labour, and Institutional Exclusion in Sudhagad

This case study examines forest–livelihood relations in Sudhagad through the lens of SDG 15 (Life on Land), with a specific focus on how forest degradation, governance regimes, and climate variability reshape women's labour, knowledge systems, and vulnerability. In Sudhagad, forests are not peripheral ecological spaces but central to everyday survival, particularly for Scheduled Tribe households and marginalised agrarian families. Fuelwood, fodder, leaf litter, minor forest produce, and ecosystem services such as water regulation and soil stability form the backbone of household economies.

The research problem addressed here is the **systematic mismatch between women's ecological dependence and labour on the one hand, and their exclusion from forest governance and benefit-sharing on the other**. While women are the primary interface between households and forests, institutional arrangements governing forest management marginalise their knowledge, criminalise traditional practices, and prioritise bureaucratic control over lived sustainability.

This case is significant because SDG 15 interventions often emphasise afforestation targets, biodiversity metrics, and forest cover statistics, while overlooking the **gendered social relations** that sustain or undermine ecological systems. In Sudhagad, forest degradation cannot be understood only as an environmental issue; it is entangled with climate variability, land tenure insecurity, labour migration, and the erosion of indigenous ecological knowledge.

The object of analysis is women's everyday forest labour and stewardship practices: fuelwood and fodder collection, Non-Timber Forest Product (NTFP) harvesting, grazing management, soil and leaf litter use, and informal fire control. By documenting how these practices are transformed under ecological decline and institutional exclusion, the case links SDG 15 directly to **SDG 5 (Gender Equality)** and **SDG 13 (Climate Action)**.

The analytical framework integrates the **Harvard Framework** to examine access versus control over forest resources, **Moser's Triple Role** to analyse the expansion of unpaid ecological labour, **Kabeer's Social Relations Framework** to locate exclusion within state–community relations, and the **Integrated Gendered Vulnerability and Agency Framework (IGVAF)** to trace feedback loops between forest degradation, climate stress, and social inequality.

Analytical Framework and Subject

The subject of this case is the **gendered political ecology of forests in Sudhagad**. Forests here are governed through formal state institutions, primarily the Forest Department, with limited community participation through Joint Forest Management Committees (JFMCs). However, the lived management of forests occurs through daily extraction, observation, and care work performed largely by women.

The analytical framework guiding this case study is **Feminist Political Ecology (FPE)** combined with an **Institutional Legitimacy and Environmental Justice lens**. This framework is particularly suited to examining forest degradation and women's ecological labour in Sudhagad because the core issue is not only environmental decline, but **who bears the costs of conservation, who is recognised as a legitimate ecological actor, and whose knowledge governs forest futures**. Unlike resource-access or livelihood-only frameworks, Feminist Political Ecology explicitly connects gender, power, ecology, and institutions within a single analytical field.

Feminist Political Ecology starts from the premise that environmental change is always socially mediated and politically structured. Forests are not neutral ecological spaces; they are governed landscapes shaped by state power, historical marginalisation, and gendered labour relations. In Sudhagad, women particularly from Scheduled Tribe communities are the primary everyday managers of forest ecosystems through fuelwood collection, fodder gathering, soil and leaf litter use, and informal fire management. Yet forest governance institutions frame them as extractors or rule-breakers rather than as stewards. FPE allows the analysis to foreground this contradiction and to show how **women's unpaid ecological labour subsidises forest protection while women remain excluded from authority and benefits**.

A central contribution of this framework is its emphasis on **knowledge, legitimacy, and epistemic power**. Women in Sudhagad possess detailed ecological knowledge regarding species regeneration, seasonal indicators, sustainable harvesting, and fire risk. However, institutional forestry privileges technical, bureaucratic knowledge over indigenous and experiential knowledge. Plantation-driven conservation models favour fast-growing species that meet administrative targets but undermine subsistence needs and biodiversity. Feminist Political Ecology exposes this as epistemic injustice, where women's knowledge is devalued despite being essential for ecological resilience. This directly links SDG 15 (Life on Land) with SDG 5 (Gender Equality) by showing that ecological sustainability cannot be achieved without recognising women as legitimate knowledge holders.

The Institutional Legitimacy component of the framework focuses on the **gap between authority and consent**. Forest governance in Sudhagad operates largely through regulatory power rules, fines, patrols, and restrictions rather than negotiated legitimacy. Women's subsistence practices are criminalised even as climate change increases dependence on forest resources. This produces fear, concealment, and unsustainable extraction patterns driven by

necessity rather than stewardship. The framework thus explains why conservation outcomes deteriorate despite increased regulation: institutions lack legitimacy among those whose labour sustains the forest.

Climate change (SDG 13) intensifies these dynamics by accelerating forest degradation through prolonged dry spells, invasive species spread, and increased fire risk. As ecosystems decline, women's labour increases, yet institutional exclusion prevents adaptive co-management. Feminist Political Ecology captures this **negative social–ecological feedback loop**, where degradation increases labour burden, reducing women's capacity for stewardship, which further accelerates ecological decline.

Importantly, the framework reframes forest degradation as a **justice issue rather than a compliance problem**. Women are not failing conservation; conservation is failing women. SDG 15 interventions that ignore gendered labour regimes externalise ecological costs onto marginalised women, undermining both equity and sustainability. By integrating gender, ecology, power, and legitimacy, this framework demonstrates that resilient forest landscapes in Sudhagad require not stricter control, but redistribution of authority, recognition of women's ecological labour, and inclusive climate-adaptive governance.

Major Inferences and Theoretical Linkages

A first major inference is that **forest degradation externalises ecological costs onto women's labour**. The Harvard Framework shows how lack of control converts environmental decline into time poverty and health stress for women.

A second inference is that SDG 15 cannot be achieved without addressing gendered labour regimes. Moser's framework demonstrates that women's ecological labour expands as forests degrade, yet remains invisible and unsupported.

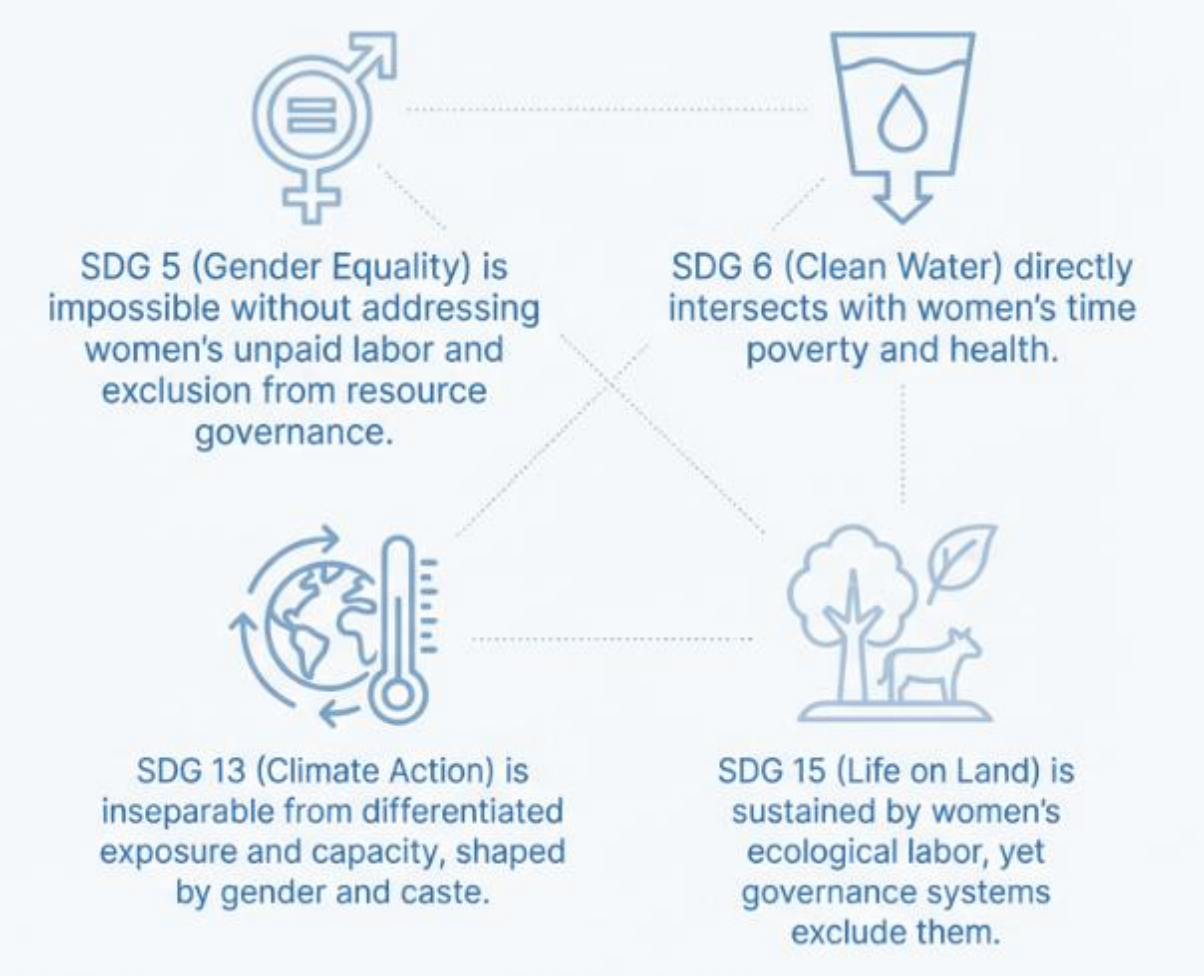
A third inference concerns institutional legitimacy. Kabeer's framework reveals how exclusionary governance undermines both social justice and ecological outcomes. IGVAF highlights feedback loops: degradation increases labour burden, which reduces women's capacity for stewardship, further accelerating ecological decline.

Scope, Limitations, and Ethical Reflection

This case is qualitative and based on participatory methods. While it does not provide quantitative biodiversity metrics, it captures lived ecological change and governance dynamics with high validity.

Ethically, the case exposes a central contradiction of SDG 15 implementation: forests are protected in name, while the women who sustain them are marginalised. Climate change magnifies this injustice by increasing dependence on declining ecosystems. Achieving SDG 15 in Sudhagad requires recognising women not as extractors to be regulated, but as ecological actors whose knowledge, labour, and leadership are essential for resilient landscapes.

8.
CONCLUSION AND RECOMMENDATIONS



8.1 Overview and Synthesis of Findings

This chapter synthesizes the key insights emerging from the integration of global climate governance frameworks, national climate trends, and localized participatory scoping studies conducted in the Roha and Sudhagad talukas of Raigad District, Maharashtra. The analysis leads to a clear conclusion: **climate change is not a socially neutral phenomenon**, but a structural stress multiplier that exacerbates pre-existing inequalities related to gender, caste, land ownership, and institutional access.

India's observed rise in mean surface air temperature—approximately 0.7°C since 1901—has contributed to erratic monsoon patterns, intensified heatwaves, and growing water insecurity. These climatic stressors interact with long-standing socio-economic disparities, resulting in differentiated vulnerability outcomes. Findings from the study sites demonstrate that women, particularly those from Scheduled Caste (SC) and Scheduled Tribe (ST) communities, disproportionately absorb climate-related shocks through increased unpaid labour, informal caregiving, and resource management responsibilities.

Across both Roha and Sudhagad, women function as informal shock absorbers for ecological degradation and infrastructural inadequacies. Their labour compensates for unreliable water systems, declining forest productivity, and limited institutional responsiveness. This reliance on unpaid female labour masks systemic failures and creates an illusion of resilience while deepening structural vulnerability.

8.2 Climate Vulnerability as a Structurally Produced Outcome

The study confirms that vulnerability is not inherent to specific groups but is produced through persistent failures in redistribution, recognition, and representation. Applying Nancy Fraser's triadic justice framework reveals that women face redistribution failures through lack of land titles and control over productive assets; recognition failures through the invisibilization of their labour and ecological knowledge; and representation failures through exclusion from formal governance spaces such as Gram Sabhas and Village Water and Sanitation Committees.

8.3 Women's Labour as Invisible Infrastructure

Women's unpaid labour emerges as a form of "invisible infrastructure" that sustains household and community resilience. During periods of water scarcity, women spend several hours daily collecting, storing, and managing water, alongside caring for family members affected by waterborne illness. In forest-dependent regions like Sudhagad, ecosystem degradation has increased the time and effort required for fuelwood and fodder collection, intensifying women's time poverty without corresponding decision-making authority.

8.4 Intergenerational Implications

Participatory tools such as intergenerational mapping reveal that climate vulnerability accumulates across generations. While male livelihood trajectories increasingly shift toward migration-based wage labour, female trajectories show escalating care and subsistence

responsibilities. Younger women and girls face heightened risks of educational disruption, producing long-term capability erosion if structural interventions are not implemented.

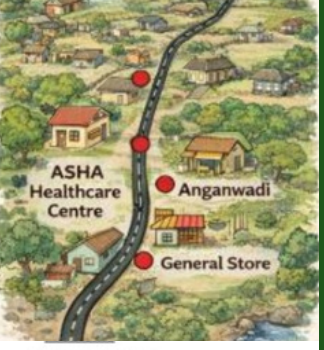
8.5 Policy and SDG Implications

The findings underscore the interdependence of **SDGs 5 (Gender Equality), 6 (Clean Water and Sanitation), 13 (Climate Action), and 15 (Life on Land)**. Sectorally siloed interventions risk maladaptation by transferring costs to women's unpaid labour. Effective climate action therefore requires a transition from gender-aware approaches to **gender-transformative strategies** that address structural inequities.

8.6 Recommendations for Gender-Transformative Climate Action

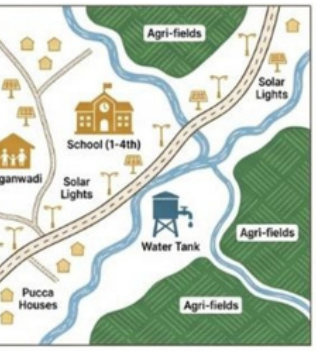
Key recommendations include:

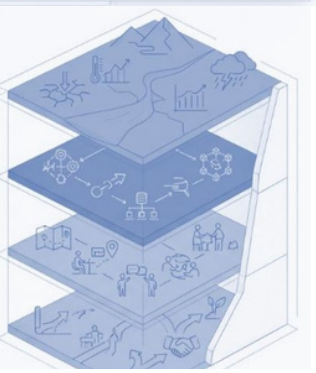
- Institutionalizing substantive women's participation in local governance through time-sensitive meeting design, childcare support, and leadership capacity-building.
- Securing women's land, forest, and resource rights, including strengthened implementation of joint land titling and the Forest Rights Act.
- Investing in geo-adaptive, climate-resilient infrastructure that reduces women's labour burdens rather than externalizing technical failures.
- Recognizing and reducing unpaid care work as a central component of climate resilience.
- Integrating women's traditional ecological knowledge into formal climate planning and ecosystem restoration efforts.
- Adopting intersectional, SDG-integrated planning frameworks within State Action Plans on Climate Change.



1 Improper drainage
2 Open Defaecation
3 No Agriculture during rainfall
4 Poor Participation in Gram Sabha
5 Lack of clean drinking water
6 Burning of Sanitary pads

Problem	Score
1	0
2	6
3	2
4	8
5	10
6	12





ABOUT THE REPORT

This report presents a gendered analysis of climate vulnerability by integrating global climate policy frameworks with participatory research conducted in the Roha and Sudhagad talukas of Raigad District, Maharashtra. Moving beyond technocratic and infrastructure-led climate approaches, the study applies a composite Gender Analysis Framework (GAF) drawing on Naila Kabeer's Social Relations Approach, the Harvard Analytical Framework, and Caroline Moser's Gender Planning Framework to demonstrate that climate vulnerability is socially produced through unequal access to resources, decision-making power, and institutional recognition.

Using Kabeer's resources–agency–achievements framework, the study examines how women's limited access to land titles, climate finance, extension services, and governance platforms constrains adaptive capacity and weakens bargaining power within households and communities. The Harvard Framework informs systematic mapping of the gendered division of labor, access and control over productive assets, and benefit flows from climate interventions, revealing a persistent disconnect between women's rising responsibilities and their exclusion from formal resource governance.

Moser's framework further deepens the analysis by distinguishing women's productive, reproductive, and community management roles, highlighting how climate stress intensifies unpaid care work, subsistence provisioning, and collective resource labor while adaptation policies remain narrowly focused on income generation. Across both sites, women prioritized water insecurity over income loss, demonstrating how climate change restructures time use, mobility, and wellbeing through gendered labor burdens.

In Roha, male outmigration linked to industrial employment has feminized agriculture without corresponding shifts in institutional authority. In Sudhagad, forest degradation, water scarcity, and remoteness amplify the vulnerabilities of tribal women through compounded gender and ecological marginalization.

Overall, the report finds that climate change functions as a stress multiplier of entrenched gender inequalities. Achieving SDGs 5, 6, 13, and 15, therefore, requires a shift from gender-aware to gender-transformative climate action, redistributing resource rights, strengthening tenure security, institutionalizing women's leadership, and recognizing women's ecological knowledge as central to climate governance.

RE-IMAGINING FUTURES
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