

INTERNATIONAL RESEARCH JOURNAL OF MANAGEMENT SOCIOLOGY & HUMANITIES



ISSN 2277 – 9809 (online)

ISSN 2348 - 9359 (Print)

An Internationally Indexed Peer Reviewed & Refereed Journal

www.IRJMSH.com
www.isarasolutions.com

Published by iSaRa Solutions

Intertwining of women and livelihood: climate change impact in Odisha

Surbhi Bharti

Department of Social Work, University of Delhi

Abstract

Climate change in Odisha is not only an environmental problem; it is also a livelihood and social-equity problem. Women whose work is closely connected with farming, livestock, fisheries, natural resources, food processing and household water management can experience climate stress through several channels at the same time. A flood can damage crops and assets, a drought can increase water collection and reduce production, while heat can lower working capacity and intensify unpaid domestic responsibilities. These effects become particularly important where women have limited access to land, finance, technology, markets, formal insurance and decision-making power.

This article examines the relationship between women, livelihoods and climate impacts in Odisha through a secondary-evidence approach. It develops a practical Women–Climate–Livelihood Resilience Model (WCLRM) linking climate exposure, livelihood vulnerability, gendered impacts, adaptive capacity, livelihood diversification and institutional access. Evidence from Odisha's 2025–26 Economic Survey, the Department of Agriculture & Farmers' Empowerment, UNDP India and CGIAR/IRRI is used to illustrate how adaptation can change livelihood outcomes. Recent Odisha government reporting on the ECRICC coastal adaptation initiative records 304 Climate Champions, mostly women, and capacity-building reaching 32,813 community members, including 24,344 women. UNDP case studies document women farmers using SRI and solar irrigation to increase production opportunities and reduce dependence on uncertain water or diesel access. These examples demonstrate pathways of resilience, while also showing why individual success stories should not be generalized into statewide averages. The proposed model is therefore presented as a framework requiring field-level validation rather than as a trained predictive model with an invented accuracy score.

Keywords: women, climate change, livelihoods, Odisha, agriculture, adaptation, self-help groups, climate resilience, SRI, solar irrigation, WCLRM

1. Introduction

Odisha occupies a distinctive position in India's climate-risk landscape because its people and economy are closely connected with agriculture, fisheries, forests, livestock, water resources and a long coastline. Climate variability affects these livelihood systems through multiple hazards, including cyclones, floods, droughts, heat stress, irregular rainfall, salinity and coastal change. The significance of these hazards is not determined only by the physical event itself. It also depends on who has assets, information, mobility, financial resources and institutional support to respond.¹

¹ Government of Odisha, Finance Department. Odisha Economic Survey 2025–26. Evidence on ECRICC, Climate Champions and community capacity-building.

Women are central participants in Odisha's rural economy, but the value of their work is not always captured by conventional measures of income. A woman may simultaneously cultivate crops, care for livestock, collect water, process food, participate in a self-help group and perform unpaid household work. Consequently, the same climate shock can affect her in several ways. Crop damage may reduce household earnings while water scarcity increases the time required for domestic work. Heat can make outdoor agricultural labour more difficult while also increasing care responsibilities. Climate change therefore needs to be analysed not only as a hazard but as a process that can reshape the distribution of work, income, risk and decision-making.²

The central argument of this article is that women's livelihood resilience should be understood as a combination of exposure, resources, choices and institutional opportunities. Adaptation is more meaningful when women can influence productive decisions, access appropriate technologies, diversify income, obtain finance and insurance, and connect with markets. Odisha's recent programmes and documented case studies provide useful evidence for examining these pathways.

2. Literature Review

2.1 Conceptualising Climate Vulnerability and Livelihoods

The literature on climate change and livelihoods increasingly treats vulnerability as a multidimensional condition rather than as a direct consequence of exposure to a hazard. A cyclone, drought, flood or heat wave does not produce identical consequences for all households. Outcomes depend on the sensitivity of livelihood activities, the assets available to households, access to information and services, and the ability to recover after a shock.

This perspective is particularly relevant to rural livelihoods because production systems are closely connected to environmental conditions. Agriculture depends on rainfall, temperature, soil moisture, irrigation and access to agricultural inputs. Livestock depends on water, fodder and animal health. Fisheries depend on water conditions and ecological productivity. Small enterprises depend on transport, electricity, markets and consumer demand. Climate shocks can therefore affect several components of a household economy simultaneously.³

A livelihood perspective also highlights the importance of coping and recovery. A household may maintain consumption after a climate shock by borrowing money, reducing food expenditure, selling livestock or using savings. Such strategies can prevent an immediate crisis but may weaken future resilience if productive assets are depleted. Resilience therefore involves more than surviving an individual event; it involves maintaining or rebuilding the capacity to sustain livelihoods over time.

For women, this multidimensional understanding is particularly important because their economic contribution often crosses the boundary between paid and unpaid work. The effects of climate change may not appear immediately as a reduction in individual income. Instead, they may appear

² <https://assembly.odisha.gov.in/WriteReadData/News/OES%202026%20WEB%20UPLOAD.pdf>

³ Government of Odisha, Department of Agriculture & Farmers' Empowerment. Activity Reports, including 2024–25 programme reporting.
<https://agri.odisha.gov.in/en/publications/activity-report>

as increased workload, reduced time for productive activities, greater dependence on household resources, or reduced ability to participate in markets and institutions.

The present study therefore uses the livelihood perspective as a foundation for analysing climate impacts in Odisha. It treats exposure as one component of vulnerability and combines it with sensitivity, adaptive capacity, livelihood diversification and institutional access.

2.2 Gender Dimensions of Climate Vulnerability

A major theme in the literature is that climate vulnerability is gendered because social roles determine access to resources, exposure to particular tasks and control over decisions. Women may contribute extensively to agricultural production without holding formal ownership of land or equipment. They may also have less control over income generated from household production. These institutional differences can influence the choices available to women during and after climate shocks.⁴

Gendered vulnerability can emerge through several pathways. First, women may have responsibilities for collecting water and fuel, preparing food, caring for children and older household members, and maintaining household activities. When climate conditions make these tasks more difficult, the additional burden may fall disproportionately on women.

Second, women may be concentrated in forms of work that are particularly sensitive to climate conditions. Agricultural labour, livestock care, food processing, fisheries-related activities and informal enterprises can all be disrupted by extreme weather. When these activities are affected, women may lose both income opportunities and access to resources that support household wellbeing.

Third, access to productive assets matters. Land, irrigation, machinery, credit, insurance and market connections can determine whether a person can adopt an adaptation strategy. If women cannot independently access or control these resources, their adaptive capacity may remain constrained even when a technology or programme is available.⁵

The literature therefore supports moving beyond the simple question of whether women are exposed to climate hazards. The more important question is how exposure interacts with social and economic structures. Two women facing the same drought may experience very different outcomes depending on whether one has irrigation, savings, a self-help group, market access and control over productive assets while the other does not.

This perspective is reflected in the WCLRM through the inclusion of adaptive capacity and institutional access. The model assumes that exposure alone does not determine resilience and that access to resources and decision-making opportunities can alter the consequences of climate stress.

⁴ UNDP India. Women Leading Climate Resilience on India's Coasts. 2026. Case evidence on SRI adoption and Swarnalata Jena. <https://www.undp.org/india/stories/women-leading-climate-resilience-indias-coasts>

⁵ UNDP India. Powered by Possibility: How Solar Irrigation Opened New Opportunities for Women Farmers in Odisha. 2026.

2.3 Women's Unpaid Work, Time Poverty and Climate Stress

Another important strand of literature concerns unpaid work and time use. Rural economies often depend on forms of labour that are poorly captured in conventional employment statistics. Water collection, fuel collection, food processing, livestock care, household maintenance and care work may be essential to household survival without being classified as formal employment.⁶

Climate change can increase the amount of time required for these activities. Water scarcity can lengthen the distance or time needed to obtain household water. Heat can make agricultural and domestic work more physically demanding. Damage to roads or local infrastructure can increase travel time. Changes in agricultural production can also require additional labour for crop management or livestock care.

These changes are economically significant because time is a limited resource. If women spend more time collecting water or completing household tasks, less time may remain for paid employment, agricultural production, education, training, self-help-group participation or enterprise development. Climate stress can therefore produce a hidden economic cost through time allocation.

This issue is particularly relevant to Odisha's rural and coastal settings. Changes in rainfall, drought conditions or heat can affect the availability of water and the amount of labour needed to maintain production. Damage to roads, local infrastructure or water systems can also increase the time needed to reach markets, services or sources of household necessities. Where women are primarily responsible for these tasks, the additional time requirement becomes a gendered economic effect. The literature also suggests that time savings can constitute a meaningful adaptation outcome. A technology that reduces irrigation labour, shortens water collection time or reduces repetitive agricultural work may improve wellbeing and release time for income-generating activities. Its value may therefore exceed what is visible in a short-term income calculation. The current WCLRM framework incorporates this insight through the gendered-impact component, which includes workload, water access and time available for productive activity.

For future empirical research, time-use indicators could strengthen the model considerably. Researchers could record the hours women spend on agricultural work, domestic work, care activities and water-related tasks before and after an intervention. They could then examine whether climate-resilient technologies change the distribution of time within households. Such evidence would help distinguish between interventions that merely increase production and those that improve the overall conditions under which women combine paid and unpaid work.

2.4 Livelihood Diversification as a Resilience Strategy

Livelihood diversification is another recurring concept in climate and rural-development research. Dependence on one climate-sensitive activity can expose households to concentrated risk. Diversification can spread that risk across crops, livestock, processing, wage work, enterprise and other activities. It does not eliminate vulnerability, because alternative activities can also be

⁶ <https://www.undp.org/india/stories/powered-possibility-how-solar-irrigation-opened-new-opportunities-women-farmers-odisha>

affected by climate and market conditions, but it can create additional options during periods of stress.

In Odisha, diversification is particularly relevant because women may participate in multiple activities simultaneously. Self-help groups and producer organisations can support diversification by providing collective savings, training, procurement arrangements, enterprise opportunities and market connections. The agriculture-sector evidence referenced in this article describes women-oriented collective activity through Producer Groups and Producer Companies. These institutions provide an organisational channel through which production knowledge and climate-adaptive practices can be combined with economic opportunities.⁷

The literature cautions, however, that diversification should not be measured simply by counting the number of activities. An additional livelihood activity may be unstable, poorly paid or highly labour intensive. A stronger measure would examine the reliability, profitability, climate sensitivity and seasonal pattern of each income source. For example, combining crop cultivation with livestock may reduce dependence on a single harvest, but livestock itself can be affected by heat, disease, fodder shortages and water stress. Similarly, a small processing enterprise may diversify income while increasing women's workload unless labour-saving arrangements are available.

For this reason, the WCLRM treats livelihood diversification as one component of resilience rather than as a guaranteed positive outcome. Future research should measure not only the number of income sources but also their contribution to household income, their variability over time, their climate sensitivity and the degree of control women exercise over them.

2.5 Self-Help Groups, Collective Action and Institutional Access

Institutional access is increasingly recognised as a critical part of adaptation. Individual households may face constraints that cannot be solved through technology alone. Credit, insurance, extension advice, quality inputs, market information and infrastructure are often delivered through institutions. For women, collective organisations can reduce some of the transaction and information barriers associated with accessing these services individually.

Self-help groups are especially relevant because they can combine financial and social functions. Savings and credit mechanisms may improve liquidity, while meetings and training can facilitate information exchange. Collective organisation may also create opportunities for food processing, horticulture, mushroom production, livestock, handicrafts and small enterprises. In climate-vulnerable areas, such groups can become channels for communicating warnings, distributing technical information and coordinating responses after shocks.

The ECRICC evidence cited in the article adds a further institutional dimension through Climate Champions. The Odisha Economic Survey 2025–26 reports 304 Climate Champions, mostly women, and capacity-building reaching 32,813 community members, including 24,344 women.

⁷ CGIAR / International Rice Research Institute. Mitigating the risks of heat stress among women rice farmers in Odisha. 2024.<https://www.cgiar.org/news-events/news/mitigating-the-risks-of-heat-stress-among-women-rice-farmers-in-odisha>

These figures do not by themselves establish a causal effect on household resilience, but they demonstrate an institutional design in which women are positioned as local participants in climate action rather than solely as recipients of assistance.

The literature therefore supports measuring institutional access as more than programme membership. A woman may be enrolled in a group but receive little practical benefit if meetings are inaccessible, information is not relevant, credit is insufficient or market connections are weak. Effective institutional access should include participation, service utilisation, decision-making opportunities and the continuity of support. This distinction is incorporated into the WCLRM through the Institutional Access component.⁸

2.6 Climate-Smart Agriculture and Women's Productive Agency

Climate-smart and climate-resilient agricultural approaches form another important part of the literature relevant to this article. Such approaches generally seek to improve productivity while responding to climate variability and reducing exposure to resource constraints. For women farmers, however, the effectiveness of a technical practice depends on whether they can access inputs, knowledge, irrigation, labour and markets.

The documented SRI case from Balasore illustrates this interaction. UNDP India reports that Swarnalata Jena adopted the System of Rice Intensification during the 2024–25 Kharif season and harvested 28.59 quintals from one acre, compared with her reported conventional production of 16–18 quintals. The account also reports income from the sale of remaining grain. This is valuable evidence of a possible pathway from knowledge and practice change to production and economic resilience. At the same time, the case is an individual documented outcome and cannot be treated as a statewide estimate or as proof that the same yield increase will occur for every farmer.

The solar-irrigation case in Nabarangpur provides a complementary perspective. UNDP documents women farmers receiving one-horsepower solar irrigation pumps registered in their names, alongside training, exposure visits and market-linkage support. The reported expansion of cultivated area and introduction of diversified crops show how water access can influence production choices. More importantly for the literature review, the case demonstrates why productive agency matters: the intervention combined a physical technology with ownership and institutional support.

These cases suggest that technology should be analysed as part of a system rather than as an isolated input. Adoption depends on affordability, maintenance, knowledge, control over assets, water availability, labour requirements and market conditions. A gender-sensitive adaptation study should therefore ask whether women can decide when and how a technology is used and whether its benefits remain under their control.

2.7 Coastal Vulnerability, Ecosystems and Livelihood Security

The coastal literature is also central to understanding Odisha because coastal livelihoods can be simultaneously exposed to cyclones, flooding, salinity, erosion, changing rainfall and disruption

⁸ CGIAR / International Rice Research Institute. Enabling women farmers in Odisha to combat heat stress. 2025.

of fisheries and agriculture. Environmental degradation can amplify livelihood vulnerability when ecosystems that provide protective or productive functions are damaged. Mangroves, wetlands, coastal water systems and agricultural landscapes can therefore be understood as part of the livelihood-supporting environment.⁹

The ECRICC approach described in the Odisha Economic Survey is relevant because it combines ecosystem restoration, climate-adaptive livelihoods and grassroots institutions. This integrated approach reflects a broader insight from climate adaptation research: infrastructure, ecosystems and livelihoods are interconnected. Restoring an ecosystem may reduce physical exposure while livelihood support can reduce the pressure on households to adopt damaging coping strategies.

For women, coastal vulnerability may be intensified by their concentration in informal, small-scale and household-linked economic activities. Fisheries-related processing, agriculture, livestock, food preparation and petty trade can all be disrupted when roads, markets, electricity or local infrastructure are damaged. The recovery period may also increase unpaid work inside the household. A resilience framework that focuses only on post-disaster income would therefore miss important dimensions of recovery.

The literature supports an integrated approach in which ecosystem condition, livelihood security and gendered institutional participation are assessed together. For future field research in Odisha, coastal and inland samples should be compared rather than treated as interchangeable. Such comparison could reveal whether the relative importance of irrigation, ecosystem services, markets, self-help groups and climate information differs across ecological settings.

2.8 Adaptation, Agency and the Shift from Vulnerability to Capability

A further development in the literature is the shift from portraying women primarily as vulnerable recipients toward recognising their agency. Vulnerability remains important because structural inequalities can restrict choices, but agency highlights the capacity of women to use knowledge, institutions, assets and collective networks to shape adaptation outcomes.

This shift is visible in the evidence used in the present article. Climate Champions are presented as local actors in adaptation. Women farmers are documented adopting SRI and using solar irrigation. Producer groups and self-help organisations create collective platforms for economic participation. These examples support an interpretation of women as active participants in resilience-building, while also showing that agency is enabled or constrained by institutional conditions.

Agency should nevertheless be measured carefully. Participation in a training programme does not necessarily mean that a woman controls the resulting technology or income. Likewise, membership in a self-help group does not automatically indicate greater decision-making power. Empirical research should therefore include indicators of actual choices: who decides which crop to grow, who controls irrigation equipment, who manages income, who can obtain credit and who decides whether to invest in a new enterprise.

⁹ <https://www.cgiar.org/news-events/news/enabling-women-farmers-in-odisha-to-combat-heat-stress>

The capability-oriented perspective also has implications for programme evaluation. Success should not be defined only by the number of women reached or trained. A stronger evaluation would examine whether women gained durable productive capabilities and whether those capabilities improved resilience during subsequent climate shocks. This provides a conceptual bridge between gender research, livelihood analysis and the proposed WCLRM.

2.9 Evidence Gaps and Research Needs in the Odisha Context

Although the existing evidence provides useful pathways, the literature and case material also reveal several research gaps. First, documented interventions are often concentrated in particular locations and programme settings. This makes it difficult to determine whether observed outcomes are broadly representative of women across Odisha. Second, many available accounts emphasise successful adaptation examples, while less attention may be given to unsuccessful adoption, discontinuation, maintenance problems or households excluded from programmes.

Third, there is a measurement gap. Climate vulnerability is frequently represented through physical exposure or agricultural loss, while gendered dimensions such as time use, unpaid labour, asset control and decision-making receive less systematic quantitative treatment. A robust Odisha-specific study would therefore need indicators that can connect environmental exposure with household-level economic and social outcomes.

Fourth, resilience is dynamic. A household that recovers quickly from one flood may remain vulnerable to repeated shocks. Similarly, a new technology may initially improve production but create maintenance or debt burdens later. Longitudinal data would therefore be more informative than a single cross-sectional survey for assessing durable resilience.

Finally, the relationship between adaptation and markets requires greater attention. Increased production does not necessarily produce stable income if prices are volatile or if farmers lack storage, transport and reliable buyers. The literature consequently supports a combined focus on production, institutions and market systems. These gaps justify the proposed WCLRM as a framework for future field validation rather than as a completed predictive model.

2.10 Synthesis of the Literature for the Present Study

Taken together, the literature reviewed above supports five propositions that guide the analytical framework of this article. First, climate exposure is necessary but not sufficient to explain livelihood outcomes. Second, gender roles influence how climate shocks are translated into changes in productive and unpaid work. Third, livelihood diversification can create additional options, but its value depends on the stability and controllability of those options. Fourth, institutional access determines whether women can convert technologies and information into practical adaptation. Fifth, resilience should be evaluated through recovery, continuity, agency and workload as well as income.

These propositions directly inform the five dimensions of the WCLRM: Climate Exposure, Adaptive Capacity, Economic Resilience, Livelihood Diversification and Institutional Access. The literature therefore provides a conceptual justification for the model, while the Odisha case evidence provides examples of the mechanisms that the model seeks to organise.

The review also establishes an important methodological boundary. The sources used in this article include official government reporting and institutional case studies, but they do not constitute a sufficiently large labelled dataset for machine-learning validation. The model should consequently be treated as a research framework. Its value at this stage lies in specifying measurable relationships that can later be tested using household surveys, time-use data, programme records and longitudinal climate-exposure information.

In this sense, the literature review is not only a summary of previous work. It identifies the conceptual bridge between climate hazards and women's economic agency and explains why a multidimensional resilience framework is necessary for studying Odisha.

Literature Review Synthesis

Climate exposure → gendered workload and livelihood sensitivity → adaptive capacity and productive agency → livelihood diversification → institutional access → resilience and recovery.

The literature indicates that technology, finance and collective institutions are most meaningful when women can access, use and influence them. The present WCLRM translates these relationships into measurable dimensions for future field validation.

3. Climate and Livelihood Context in Odisha

Odisha's climate-related risks are closely connected with the state's geography and livelihood structure. Coastal districts face recurring cyclone and flood exposure, while other areas can experience drought, heat and rainfall variability. Agriculture remains particularly sensitive because crop production depends on the timing and availability of water, temperature conditions, soil quality and access to inputs. Fisheries and livestock are similarly exposed to changes in water conditions, storms, disease patterns and feed availability.

Recent evidence also shows that climate impacts can extend beyond farm output. CGIAR/IRRI's work with women farmers in Ganjam highlighted heat stress, water shortages and the combined pressure of agricultural and domestic responsibilities. Participants reported that extreme heat and drought could reduce crop productivity while increasing the need for water for irrigation and household use. Such findings support a broader interpretation of livelihood vulnerability in which time, health, unpaid work and access to resources are treated as economically relevant dimensions of climate impact.

The Odisha Economic Survey 2025–26 describes ECRICC as a coastal adaptation initiative covering landscapes in Balasore, Puri, Kendrapada and Ganjam. The programme combines ecosystem restoration, climate-adaptive livelihoods and grassroots institutions. The Survey reports 304 Climate Champions, mostly women, and capacity-building for 32,813 community members, including 24,344 women. This provides a state-level example of how adaptation policy can deliberately incorporate women as local actors rather than treating them only as vulnerable beneficiaries.

4. Women, Work and Livelihood Dependence

Women's livelihood contribution in rural Odisha is often distributed across several activities rather than concentrated in a single occupation. Agriculture can involve seed selection, transplanting,

weeding, harvesting, post-harvest processing and livestock care. Self-help groups can create additional opportunities through food processing, horticulture, mushroom production, handicrafts, livestock, small enterprises and market linkages. This diversification matters because climate shocks can affect one income stream more strongly than another.

The role of self-help groups is particularly important because collective organisation can lower some of the barriers that individual women face. Group structures can facilitate savings, credit, training, producer organisation, procurement and market connections. Odisha's agriculture department reports substantial women-oriented collective activity through Producer Groups and Producer Companies under the Agriculture Production Cluster approach. The existence of these institutions does not automatically guarantee resilience, but it creates an organisational platform through which climate adaptation technologies, financial services and market opportunities can be delivered.

The livelihood question is therefore broader than whether women have employment. It concerns whether the livelihood is sufficiently diverse, productive and secure to absorb shocks. A woman who has access to more than one source of income, reliable irrigation, agricultural knowledge, savings or insurance may have more options after a climate event than a woman whose household depends on a single rainfed crop. This is why livelihood diversification and institutional access are included as separate dimensions in the proposed WCLRM framework.

5. Gendered Pathways of Climate Impact

The first pathway is through production and income. Flooding, cyclone damage, drought or heat can reduce agricultural output, damage livestock and disrupt local markets. For households with limited savings, even a single poor season can create pressure to reduce consumption, borrow money or sell productive assets. Women may experience the consequences even when they are not formally recorded as the principal farmer because household resources and food security are shared.

The second pathway is through time and unpaid work. Water scarcity, damaged infrastructure and climate-related health problems can increase the amount of time required for domestic tasks. CGIAR/IRRI's work in Ganjam explicitly identifies the double burden of agricultural and domestic responsibilities as an important dimension of women's heat-related vulnerability. This means that climate adaptation should not be judged only by crop yield. A technology that reduces water collection, fuel costs or repetitive labour may have important livelihood value even if its immediate effect on farm income is modest.

The third pathway is through access to productive assets and decision-making. When women have limited control over land, irrigation equipment, finance or markets, they may have less ability to choose adaptation strategies. Conversely, interventions that place productive assets in women's names and combine technology with training can change both the physical and institutional dimensions of resilience. The UNDP solar-irrigation case in Nabarangpur illustrates this mechanism by documenting pumps registered in women's names alongside training and market-linkage support.

6. From Vulnerability to Agency

A useful shift in climate research is to move from describing women only as vulnerable to examining their agency in adaptation. Women possess local knowledge of crops, food systems, water management and household resource allocation. When that knowledge is combined with technical information, finance and institutional support, women can become active agents of climate resilience.

The Odisha Economic Survey's reporting on Climate Champions is important in this regard. By identifying mostly women as grassroots climate leaders, the programme illustrates an institutional model in which local women participate in awareness, adaptation and community-level action. Such participation can strengthen the social side of resilience because climate adaptation depends not only on infrastructure but also on collective behaviour, local coordination and knowledge sharing.

7. Methodology and Analytical Approach

This article uses a secondary-evidence and conceptual-modelling approach. Official documents from the Government of Odisha are combined with recent institutional evidence from UNDP India and CGIAR/IRRI. The purpose is not to claim a statewide causal effect from a small number of case studies. Instead, the evidence is used to identify recurring mechanisms through which climate adaptation can influence women's livelihoods.

The proposed model can subsequently be tested through primary field research. A future study could survey women farmers and women members of self-help groups across coastal and inland districts, recording climate exposure, income stability, livelihood diversity, access to institutions, adoption of technologies and recovery after shocks. Statistical or machine-learning models could then be used to examine whether the proposed dimensions predict a measurable resilience outcome.

8. Practical Model: Women–Climate–Livelihood Resilience Model (WCLRM)

The WCLRM is designed as a practical framework rather than as a completed machine-learning system. It begins with climate exposure, which represents the intensity and frequency of hazards experienced by a livelihood. Exposure is followed by livelihood sensitivity, including dependence on rainfed agriculture, fisheries, livestock or natural resources. Gendered impacts then capture changes in workload, income, food security, water access and time available for paid or productive activities.

The next stage is adaptive capacity. This includes access to self-help groups, training, irrigation, climate-resilient seeds or practices, insurance, credit, digital information and markets. These resources can support livelihood diversification, allowing households to combine agriculture with livestock, processing, enterprise or other income sources. The final outcome is livelihood resilience, represented by the ability to maintain income and essential consumption, adapt production and recover after a climate shock.

For measurement, the framework proposes five standardized components: Climate Exposure (CE), Adaptive Capacity (AC), Economic Resilience (ER), Livelihood Diversification (LD) and Institutional Access (IA). A simple composite indicator can be calculated as:

$$\text{WCLR} = (\text{CE} + \text{AC} + \text{ER} + \text{LD} + \text{IA}) / 5$$

Each component would first be converted to a 0–100 scale using transparent indicators. The formula is proposed for research purposes and is not an officially validated Odisha index.

9. Practical Evidence from Odisha

A useful example comes from rice cultivation. UNDP India reports the case of Swarnalata Jena in Balasore, who adopted the System of Rice Intensification (SRI) during the 2024–25 Kharif season. She cultivated one acre and harvested 28.59 quintals, compared with her reported conventional production of 16–18 quintals. The same account states that she sold the remaining grain after household consumption for ₹74,400 at the Minimum Support Price. UNDP also reports that more than 28,000 farmers across Balasore, Kendrapara, Ganjam and Puri were adopting SRI and other climate-resilient practices under ECRICC. These figures demonstrate the potential of improved practices, but the individual yield outcome should not be interpreted as a statewide average or as proof that SRI will produce the same increase for every farmer.

Another example is solar-powered irrigation in Nabarangpur. UNDP's 2026 case study describes Amara Bhatra and Laxmi Bhatra receiving one-horsepower solar irrigation pumps registered in their names. The reported cultivated area expanded from approximately half an acre to one acre each, while crop diversification included vegetables and, in Amara's case, strawberries. UNDP reports annual earnings of around ₹80,000 for Amara and ₹30,000 for Laxmi in the cited period. The importance of this case is not only the reported income. The intervention combined physical infrastructure with ownership, training, exposure visits and market-linkage support, illustrating how technology and institutional access can interact.

A third pathway is collective livelihood development. Odisha's agriculture department maintains annual activity reports covering programmes that support producer groups, producer companies and women-led agricultural collectives. Such structures can help transform individual household production into more coordinated economic activity. In climate-vulnerable areas, collective organisation can also facilitate access to information, finance, inputs and markets, reducing some of the constraints that make adaptation difficult for individual smallholders.

10. Results and Discussion

The evidence points to a consistent relationship between climate resilience and livelihood diversification. Where women have access to reliable irrigation, improved production practices, collective institutions or new market opportunities, they may have more choices when climatic conditions become uncertain. The documented cases also show that technology alone is insufficient. Solar irrigation became more meaningful when women controlled the pump and received training and market exposure. Similarly, SRI was associated with a reported increase in production in the documented Balasore case because the intervention involved changes in planting, water management, weeding and pest-management practices.

The second major result is that resilience should be measured beyond income. A livelihood may become more resilient when it reduces dependence on diesel, saves time, increases access to water, improves decision-making or creates a second source of income. These outcomes can be particularly important for women because unpaid work and productive work are often closely

connected. A narrow income-only model could therefore underestimate the value of interventions that change labour requirements or control over productive assets.

The third result concerns institutions. Government programmes, self-help groups, producer organisations and climate leadership structures can connect individual women to resources that are difficult to obtain independently. The ECRICC evidence demonstrates that adaptation can operate through community institutions, while agricultural programmes show the scale at which women's collective economic participation can be organised. The challenge is to ensure that institutional participation translates into durable control over assets, finance, information and markets.

11. Model Accuracy and Validation

The WCLRM presented in this article does not have a valid numerical accuracy score because it has not yet been trained and tested on a labelled field dataset. Reporting an accuracy percentage without such data would create a false impression of empirical validation. The appropriate result at this stage is therefore:

Model accuracy: not yet empirically established.

If the framework is converted into a predictive model, researchers could collect data from a sufficiently large and geographically diverse sample of women farmers and SHG members. A binary outcome such as high resilience versus low resilience could be defined using a transparent threshold based on income recovery, livelihood continuity or a composite resilience index. Logistic Regression, Random Forest or XGBoost could then be compared using Accuracy, Precision, Recall, F1-score and ROC-AUC.

Accuracy would be calculated as:

$$\text{Accuracy} = (\text{TP} + \text{TN}) / (\text{TP} + \text{TN} + \text{FP} + \text{FN}) \times 100$$

A robust validation design should use separate training and testing data and, preferably, cross-validation. District representation should include both coastal and inland settings so that the model does not simply learn the characteristics of one geography. Researchers should also test whether the model performs differently by livelihood type, household size, landholding, access to irrigation and SHG participation. This would make the proposed framework scientifically testable rather than merely descriptive.

12. Key Challenges

The first challenge is uneven access to productive assets. Technology can have limited impact if women do not control land, irrigation equipment, finance or decisions about production. The second challenge is market uncertainty. Increased production does not necessarily create stable income if farmers cannot obtain fair prices, storage, transport or reliable buyers. The third challenge is information and digital access. Climate advisories, market information and government services are increasingly delivered through digital channels, making connectivity and digital literacy relevant components of adaptation.

Another challenge is the risk of treating successful case studies as representative outcomes. A documented woman farmer may benefit from a combination of training, infrastructure, institutional support and favourable market conditions that are not available elsewhere. Research therefore needs larger samples and comparison groups before attributing changes to a specific

intervention. The purpose of the case studies in this article is to identify mechanisms, not to produce a statewide causal estimate.

13. Recommendations

Future climate-livelihood programmes should integrate women's economic agency into the design of adaptation interventions. Productive assets such as irrigation systems, equipment and enterprise infrastructure should be accompanied by training, maintenance support and appropriate ownership arrangements. Access to credit and insurance should be designed around the realities of smallholder livelihoods, while market-linkage components should be treated as a core part of livelihood resilience rather than as an optional addition.

At the community level, self-help groups and producer organisations can serve as platforms for climate information, collective procurement, financial services, processing and market coordination. Climate-resilient agriculture should also be connected with livelihood diversification so that households are not dependent on a single climate-sensitive income source. In coastal areas, ecosystem restoration and livelihood development should be planned together because mangroves, wetlands, fisheries and agricultural systems can influence local resilience.

Finally, monitoring systems should include gender-sensitive indicators. Programmes should record not only the number of women trained but also whether women control productive assets, whether household income becomes more stable, whether workload changes, whether access to markets improves and how quickly livelihoods recover after climate shocks. Such indicators would make it possible to assess whether adaptation is producing durable resilience.

14. Future Research Framework

A future empirical study can operationalise the WCLRM through a structured questionnaire covering five dimensions. Climate Exposure could include recent experience of cyclone, flood, drought, heat and salinity. Adaptive Capacity could include training, irrigation, climate information, insurance, credit and technology. Economic Resilience could measure income stability, savings, debt pressure and recovery time. Livelihood Diversification could capture the number and reliability of income sources. Institutional Access could record participation in SHGs, producer groups, extension services and market platforms.

The study could combine household surveys with focus-group discussions and selected case studies. Quantitative data would allow statistical modelling, while qualitative evidence would explain why the same intervention may work differently across communities. Such mixed-method research would be especially useful for understanding the relationship between formal programmes and women's everyday decisions.

The eventual objective should be a validated Odisha-specific resilience index or predictive model that can be used to identify households or communities requiring targeted support. The model should be periodically updated because climate risks, technologies, markets and government programmes change over time.

15. Conclusion

The relationship between women, livelihoods and climate change in Odisha is multidimensional. Climate shocks can reduce production and income, but their effects also appear through water

stress, unpaid work, time constraints, health risks, market disruption and access to productive resources. Women therefore need to be understood not only as people exposed to climate risk but also as important economic and institutional actors in adaptation.

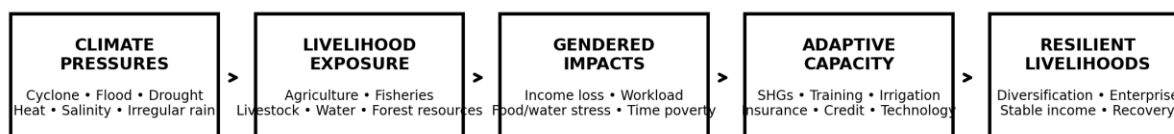
Evidence from Odisha shows several practical pathways. SRI can improve production in documented cases when combined with knowledge and appropriate farm practices. Solar irrigation can expand cultivation opportunities when women have direct control over the technology and receive complementary training. Community climate leadership and self-help groups can create institutional channels through which knowledge, finance and collective action reach households. These examples suggest that livelihood resilience is strongest when climate adaptation is connected to economic opportunity and decision-making power.

The WCLRM provides a structured way to analyse these relationships, but it should be treated as a proposed framework until tested with primary data. Most importantly, the model's accuracy should be established through transparent field validation rather than assumed. A future evidence-based approach that combines climate information, gender-sensitive livelihood indicators, institutional access and statistical validation could help policymakers and researchers understand where adaptation investments are most likely to strengthen durable livelihoods for women across Odisha.

Comparative Evidence Table

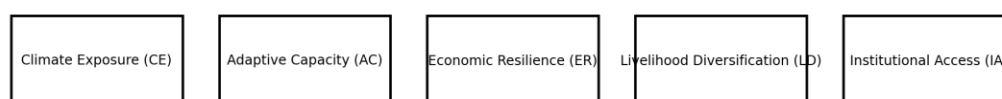
Evidence intervention	Documented outcome	Interpretation for WCLRM
SRI, Balasore	28.59 q/acre in 2024–25; prior conventional output reported as 16–18 q/acre	Climate-resilient production and knowledge can strengthen economic resilience.
Solar irrigation, Nabarangpur	Cultivation expanded from about 0.5 to 1 acre for the two documented women farmers	Reliable water access can support diversification and productive agency.
ECRICC, coastal Odisha	304 Climate Champions, mostly women; 32,813 community members trained, including 24,344 women	Institutional capacity and local leadership are part of resilience.
Heat-stress work, Ganjam	Women reported heat, drought, water and workload pressures	Resilience must include time, health and unpaid-work dimensions.

Table 1. Comparative evidence used in the article. Values are reported by the cited sources and should not be interpreted as a common-unit statewide comparison.



Women-Climate-Livelihood Resilience Model (WCLRM)

Proposed research framework: exposure is translated into livelihood outcomes through adaptive capacity and institutional access.



Proposed composite score: $WCLR = (CE + AC + ER + LD + IA) / 5$; components standardized to 0–100.

Practical pathway connecting a climate hazard to livelihood outcomes and possible adaptation responses.

References

1. Government of Odisha, Finance Department. *Odisha Economic Survey 2025–26*. Evidence on ECRICC, Climate Champions and community capacity-building. <https://assembly.odisha.gov.in/WriteReadData/News/OES%202026%20WEB%20UPLOAD.pdf>
2. Government of Odisha, Department of Agriculture & Farmers' Empowerment. *Activity Reports*, including 2024–25 programme reporting. <https://agri.odisha.gov.in/en/publications/activity-report>
3. UNDP India. *Women Leading Climate Resilience on India's Coasts*. 2026. Case evidence on SRI adoption and Swarnalata Jena. <https://www.undp.org/india/stories/women-leading-climate-resilience-indias-coasts>
4. UNDP India. *Powered by Possibility: How Solar Irrigation Opened New Opportunities for Women Farmers in Odisha*. 2026. <https://www.undp.org/india/stories/powered-possibility-how-solar-irrigation-opened-new-opportunities-women-farmers-odisha>
5. CGIAR / International Rice Research Institute. *Mitigating the risks of heat stress among women rice farmers in Odisha*. 2024. <https://www.cgiar.org/news-events/news/mitigating-the-risks-of-heat-stress-among-women-rice-farmers-in-odisha>
6. CGIAR / International Rice Research Institute. *Enabling women farmers in Odisha to combat heat stress*. 2025. <https://www.cgiar.org/news-events/news/enabling-women-farmers-in-odisha-to-combat-heat-stress>



EARN YOUR MBA

WWW.IIMPS.IN



Accreditation & Ranking



UGC / NCTE Approved.

INFO@IIMPS.IN

☎ 011-41005174

RESEARCH
GATEWAY

STOP PLAGIARISM



Arogyam Ayurveda
Holistic Healing through herbs



AROGYAM
ONLINE

PARIVARTAN PSYCHOLOGY CENTER

परिवर्तन

COLOR PSYCHOLOGY : HOW COLOR AFFECT YOUR CHILD



BLUE

Calms your Child's
Mind & Body

YELLOW

Promotes Concentration,
Stimulates the Memory

PINK

Evokes Empathy,
makes your Child Calm

RED

Excites and energizes
your Child's body

GREEN

Improves Reading speed
and Comprehension

www.parivartan4u.com



परिवर्तन

Confuse about your children's future?

भारतीय भाषा, शिक्षा, साहित्य एवं शोध

ISSN 2321 – 9726

WWW.BHARTIYASHODH.COM



**INTERNATIONAL RESEARCH JOURNAL OF
MANAGEMENT SCIENCE & TECHNOLOGY**

ISSN – 2250 – 1959 (O) 2348 – 9367 (P)

WWW.IRJMST.COM



**INTERNATIONAL RESEARCH JOURNAL OF
COMMERCE, ARTS AND SCIENCE**

ISSN 2319 – 9202

WWW.CASIRJ.COM



**INTERNATIONAL RESEARCH JOURNAL OF
MANAGEMENT SOCIOLOGY & HUMANITIES**

ISSN 2277 – 9809 (O) 2348 - 9359 (P)

WWW.IRJMSH.COM



**INTERNATIONAL RESEARCH JOURNAL OF SCIENCE
ENGINEERING AND TECHNOLOGY**

ISSN 2454-3195 (online)

WWW.RJSET.COM



**INTEGRATED RESEARCH JOURNAL OF
MANAGEMENT, SCIENCE AND INNOVATION**

ISSN 2582-5445

WWW.IRJMSI.COM



**JOURNAL OF LEGAL STUDIES, POLITICS
AND ECONOMICS RESEARCH**

WWW.JLPER.COM

JLPE