

Gendered Participation in Pre-Harvest and Post-Harvest Agriculture: A Comparative Study of Punjab, Kerala, and Uttarakhand

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ABSTRACT

This paper assesses the role and position of women in pre-harvest and post-harvest agricultural activities in India through a comparative study of three states: Punjab, Kerala, and Uttarakhand. Across all three, women carry the majority of the burden of manual farm operations, yet exercise little economic agency or choice over the income their labour generates. In Punjab, mechanisation displaced women out of crop farming without giving them the agency to move into higher value sectors, while in Uttarakhand women's entrepreneurial capacity remains constrained by their weaker socioeconomic position. Kerala's Kudumbashree collectives show that group organisation can partially bridge this gap, though these groups continue to cultivate informally leased land with no legal claim to it. The underlying constraint across all three states is the lack of asset ownership and resulting absence of economic agency, since land records are almost entirely in men's names and formal credit requires documented ownership, leaving women without the paperwork that would formalise their work and open access to finance. Policy must therefore go further, granting women the ability to own assets in their own names and recognising their contribution to agriculture.

1. Introduction

Women form the backbone of India's agricultural workforce, yet their contribution remains largely unrecognised. Around 74% of India's female workforce is engaged in agriculture (Jayasheela, 2015), and women are responsible for roughly 70% of actual farm work, yet receive less than 1% of total agricultural credit (Kumari et al., 2016). Women also earn significantly less than men for the same agricultural work, with the average daily wage for women in tasks such as sowing and weeding standing at approximately Rs 384, and women's wages falling below half of men's wages in some regions (Vajiram & Ravi, 2026). Studying women's role in agriculture is therefore essential, as the gap between their contribution and their recognition reveals deep structural inequalities in how agricultural systems are designed.

This research examines the role of women in pre-harvest and post-harvest agricultural activities in India, using a comparative case study approach across three states: Punjab, Kerala, and Uttarakhand. Each of these states is also associated with a distinct set of agricultural commodities, which allows patterns to be observed across different types of crop farming rather than being limited to a single crop system. Punjab is a highly mechanised green revolution state with a commercialised wheat and paddy economy, Kerala combines paddy and plantation crops with a strong tradition of collective organisation, and Uttarakhand is a hilly state where subsistence farming of cereals and pulses continues alongside widespread male outmigration. By comparing these three states, this research seeks to understand the nature of women's involvement in agriculture and the specific activities they perform, their social and economic position relative to the labour they contribute, and the challenges and lessons that emerge for strengthening their role in the sector.

2. Literature Review

Title	Author/ Year	Summary
Gender differences in rice value chain participation and career preferences of rural youth in India	Veettil et al. (2020)	This study assesses rural youth's willingness to stay in agriculture in eastern India. The female youth showed surprisingly high readiness to engage in farming, and the paper explains this is partly because female youth have fewer alternative employment options outside agriculture, unlike male youth who are more likely to migrate for non-farm jobs. Lower-caste youth showed more interest than upper-caste youth, because upper-caste youth associate non-agricultural work with higher social status and have more pathways out, while lower-caste families are more dependent on farming with fewer alternatives. Involvement in value chain activities is because exposure to the commercial and technical side of agriculture (like machinery

		and processing) makes it feel like a viable career rather than just subsistence labour (like rice processing and custom machinery) increased the likelihood of choosing agriculture as a career. The policy takeaway is that male and female youth need different support (men prioritize credit access, women prioritize irrigation and training) so a one-size-fits-all youth agriculture policy won't work.
Building an Inclusive Agriculture: Strengthening Gender Equality in Agricultural Value Chains	Rubin et al.	This paper reviews women's roles across various agricultural value chains including horticulture, staple crops, livestock, and coffee/cocoa. The core finding is that women make up a large share of workers and smallholders in these chains but consistently face unequal outcomes: they do more labor but receive less income, hold fewer permanent or management-level positions, and face structural barriers like land tenure gaps and male-dominated extension services. The paper recommends that policies need to be intentional about gender goals rather than assuming women will automatically benefit. It also argues against assuming certain crops or tasks are strictly "for men" or "for women" since this varies by region and context. Additionally, it calls for better data on women's specific needs and which parts of the value chain actually improve their lives, since without this, policies end up being designed

		around assumptions rather than reality.
Gender and Global Value Chains: Challenges of Economic and Social Upgrading in Agri-Food	Barrientos (2014)	This paper looks at how global value chains (GVCs) in agri-food affect women workers and smallholders. The core finding is that economic upgrading (moving up the value chain) doesn't automatically translate to better conditions for women. The paper explains that economic upgrading doesn't automatically help women because women tend to be concentrated in the lower-skilled, lower-paid nodes of the value chain, so even when the chain becomes more profitable overall, women stay stuck in the same positions. Additionally, gender norms determine who gets access to better opportunities, meaning improvements tend to flow to men first. The paper also shows through its case studies that the specific sector matters, since in floriculture women gained some benefits because the industry was more female-integrated from the start, whereas in cocoa, women ended up doing more work while losing ground economically due to the industry structure and local gender norms. By using African case studies in floriculture, horticulture, and cocoa, it shows that outcomes range from partial social improvement to outright downgrading, depending on the context and how gender is embedded in the production system.

Women's empowerment and gender equality in agricultural value chains: evidence from four countries in Asia and Africa	Quisumbing et al (2021)	This paper examines women's empowerment across agricultural value chains in Bangladesh, Philippines, Benin, and Malawi. The central finding is that neither market participation, entrepreneurship, nor household wealth automatically leads to women's empowerment and what actually determines outcomes is the social and cultural context, the specific commodity, and which node of the value chain women are engaged in. Training and education generally help but can paradoxically widen the gender gap within households if men benefit more from training and education because extension services and agricultural training programmes are mostly designed for and delivered to male farmers, so when training is provided to a household, it's usually the man who attends and gains the skills and knowledge, leaving women behind. So the key policy takeaway is that food system interventions must account for local gender dynamics to avoid making existing inequalities worse.
Constraints and opportunities for women in agriculture in India	Patra et al. (2018)	This paper reports the actual farm activities carried out by rural women in India in rural India, who contribute around 70% of the actual farm work, including livestock management, poultry, harvesting etc, but still are not recognized as farmers. They are still ineligible for land, credit and extension services. The key thesis is an

		undervaluing of women's role in agriculture and the need to unravel this issue by recognising women's various inputs, widening their access to resources and making technology more women-friendly, in order for agriculture to sustainably and equitably develop.
Gender equity and reduction of post-harvest losses in agricultural value chains	Nordhagen (2021)	This GAIN working paper links three issues that are rarely studied together: food loss, gender equity, and nutrition. Women dominate the post-harvest handling stage of agri-food value chains, where most food loss occurs, but their lower access to resources, information, and loss-reduction technologies means they likely face higher loss rates than men. The key argument is that post-harvest loss reduction interventions will only work well if they are designed with women's roles and constraints explicitly in mind, and that doing so could simultaneously improve nutrition outcomes and women's empowerment.
Analysis of Role Performance of Women Farmers in Pre and Post Harvest Agricultural operations	Kumari and Sandhavi (2016)	This study from Samastipur district, Bihar surveyed 100 farm women to map their participation across agricultural activities. The finding is a clear gendered division of labor: women dominate post-harvest work like grain preservation, seed storage, winnowing, and harvesting, but are largely excluded from pre-harvest operations like ploughing and pesticide

		application, which are treated as men's work. Landless and marginal women farmers had the highest physical involvement but the least supervisory control, while women with medium-sized holdings supervised more, pointing to land ownership as a key factor shaping women's agency within farm work.
Gender roles in post harvest activities: a case study in assam	Deka and Saikia (2020)	This study from Assam surveyed 900 farm families across six agro-climatic zones to map gender roles in post-harvest activities. Women were found to be heavily involved in drying, storage, and cleaning of grains, and work alongside men across most post-harvest tasks, but are largely excluded from commercial-level marketing and management. The key recommendation is that targeted technical training in storage methods and post-harvest handling needs to be provided to rural women, since they bear most of the labour but currently lack the knowledge infrastructure to reduce losses and improve their income from it.
Gender and agricultural value chains: A review of current knowledge and practice and their policy implications	Coles and Mitchell (2011)	This paper uses value chain analysis as a framework for understanding gender inequity in agricultural markets. The central argument is that women's participation in a value chain does not automatically translate to empowerment or poverty reduction, what actually determines

		outcomes is women's control over productive resources and decision-making at the household level, shaped by socio-cultural norms. Generic, one-size-fits-all interventions risk being ineffective or actively harmful, so the paper calls for context-specific, rigorous gender analysis before designing any upgrading strategy.
A Review on Women Agri-Entrepreneurship: Roles and opportunities in Agriculture for Sustainable Growth in India	Rana et al. (2022)	This paper looks at the scope and barriers for women agripreneurs in India, using case studies of successful women farmers alongside a structural analysis of what holds most women back. While individual success stories show real potential, in polyhouse farming, dairy, zero-budget natural farming, and value-added processing, the systemic challenges remain severe: lack of land ownership rights blocking credit access, low literacy, poor market linkages, middlemen dependency, inadequate cold storage and infrastructure, and the double burden of domestic responsibilities. The conclusion is that government schemes exist but are insufficient, and that dedicated policy support combining skill development, technology access, and market linkages is necessary to scale women's agripreneurship for sustainable rural growth.

3. Methodology and Findings

This study examines the role of women in pre-harvest and post-harvest agricultural activities in India, using a comparative case study approach across three states: Punjab, Kerala, and

Uttarakhand. This research is based on secondary data and review of existing reports and academic research. This includes sources such as Agricultural Statistics at a Glance 2024-2025, the Kudumbashree Mission, the Initiative for What Works to Advance Women and Girls in the Economy (IWWAGE), among others .

These three states were specifically selected because they are geographically diverse and represent starkly contrasting agricultural and social contexts. Punjab is a highly mechanised, green revolution state in northern India with a commercialised farming economy. Kerala is a southern state with a strong tradition of social reform and collective organisation. Uttarakhand is a hilly northern state characterised by subsistence farming and widespread male outmigration. By comparing these three states, this research aims to draw out both the common patterns and the key differences in how women engage with agriculture, what barriers they face, and what conditions allow for more equitable outcomes. Each of the three states has been assessed against six parameters: key agricultural crops grown in the state, agriculture's contribution to the state's gross value added 2023-2024, nature and extent of women's participation in agriculture, the pre-harvest and post-harvest activities they perform, and the challenges they face. These are detailed in the table below:

Parameters	Punjab	Kerala	Uttarakhand
Key agriculture crops grown in the state	wheat, paddy, maize, potato, mustard	paddy, banana, vegetables, coconut	paddy, pulses, coarse grains, vegetables, medicinal herbs
Agriculture's contribution to the state's gross value added (GSVA) 2023-24	Punjab, one of the highly mechanised green revolution state, contributes ~15% of India's total wheat and rice output; Agriculture's share in state GSVA was approximately 20.9%	Agriculture contributes around 10% of Kerala's GDP, with the focus increasingly shifting to high value crops. Agriculture's share in state GSVA was approximately 9.26%	Agriculture is mostly subsistence level, where hilly terrain limits large scale commercial farming. Agriculture's share in state GSVA was approximately 11.74%
Nature and extent of	Before mechanisation,	Kerala shows high	In Uttarakhand, 64% of

women's participation in agriculture	women in Punjab were heavily involved in crop farming, performing the most physically demanding manual tasks such as weeding, transplanting, and harvesting. The introduction of agricultural machinery fundamentally altered their role. Machines like the reaper and tractor-operated combine replaced precisely the operations women had carried, displacing them from crop farming with no alternative employment to absorb them (Rani et al., 2021). Post-mechanisation data reflects this, with female labour now contributing only about 9.8% of total labour time on wheat farms in Punjab, most of it concentrated in the few	female participation through Kudumbashree collectives, where women enter as cultivators rather than labourers. Kudumbashree organises women into Joint Liability Groups (JLGs) of 4 to 5 members under NABARD guidelines. The reason a JLG can access credit where an individual woman cannot is that NABARD's framework replaces physical collateral, normally a land title that most rural women lack, with mutual guarantee between group members, backed by NABARD refinancing up to 95% of the bank loan. The group also opens a bank account in its own name and builds a documented credit	the female population is engaged as cultivators and 84.4% as agricultural labourers (Census 2011). On average, a woman farmer works 3,485 hours per year compared to 1,200 hours for men. Because of massive male outmigration, women have become the de facto heads of farm households, managing all farming operations alone while receiving minimal government or institutional support. Despite managing every stage of production, women rarely control the income, since men sell the produce, pocket the earnings, and hold financial agency. Women supplement family income by selling grass, pulses, and organic produce,
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	remaining manual tasks like harvesting. While 70.7% of working women in rural Punjab are still counted within agriculture and fishing combined (IWWAGE, 2023), their presence within crop farming specifically has shrunk to manual, low-value operations. Mechanisation, while reducing physical drudgery, erased women's primary source of agricultural participation, replacing their labour without replacing their livelihoods. As a result, many women shifted to the livestock and dairy sector, where they now make up approximately 90% of the workforce in Punjab and Haryana (NDDB, cited in Vajiramandravi, 2023). Livestock work is	history, which an individual landless woman has no way of establishing. A state subsidy brings the 7% bank interest down to an effective 2%. On land, Kerala's Land Reforms Act of 1970 makes leasing illegal, so Kudumbashree works around this by having the Community Development Society, registered at panchayat level, and panchayat leaders themselves negotiate informal leases with landowners. A landowner is unlikely to hand over land to an individual woman on an arrangement with no legal backing, but the involvement of the panchayat and a registered community body gives the agreement enough local legitimacy for that trust	earning around Rs 1,000 a month, but have limited financial decision-making power. Women in nuclear households, where men have migrated, gain more autonomy over farming decisions, yet land ownership remains a key barrier, with only 13% of women in India owning land, which restricts their access to credit and formal markets.
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	almost entirely manual and physically intensive, with women responsible for milking, fodder collection, cleaning animal sheds, milk processing, and feeding animals, spending two to eight hours daily on these tasks alone (Foundation for Agrarian Studies, cited in Vajiramandravi, 2023). Yet this labour remains largely invisible in official statistics, as it is classified as household work rather than agricultural labour. Despite their dominant role, women still lack access to credit and land ownership, preventing them from investing in or formalising their role in livestock activities.	to be extended to the group. Over 2.8 lakh women in 61,836 JLGs now farm 38,706 hectares across Kerala, growing paddy, banana, tubers, and vegetables. The underlying mechanism is that collectivisation substitutes for the two assets women individually lack, collateral and negotiating power, by turning group membership itself into a form of security that both banks and landowners accept. This structure allows women to lease land, access credit, control production decisions, and share farming responsibilities, making Kerala one of the few cases where women are recognised as farmers rather than labourers.	
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Pre-harvest and post-harvest activities performed by women	Pre-harvest activities in Punjab that women historically performed include sowing and transplanting, both of which are physically demanding tasks requiring prolonged bending and standing in waterlogged fields for hours. However, these operations have been increasingly mechanised through seed drills and rotavators, displacing women from these manual roles (Rani et al., 2021). In post-harvest operations, women remain heavily involved in threshing and winnowing, which are physically intensive tasks done outdoors in heat and dust, causing respiratory issues and musculoskeletal strain. Women are also centrally responsible for	At the pre-harvest stage, women in Kudumbashree collectives carry out land preparation and sowing as a group, dividing the physical labour among JLG members rather than each woman working her own plot alone. At the post-harvest stage, they handle processing of the harvested produce and then market it collectively through the JLG, pooling their output so that they can negotiate better prices than any individual woman would be able to secure on her own.	At the pre-harvest stage, women in Uttarakhand carry out all field operations themselves, including ploughing, sowing, and weeding, and because men have migrated out and machinery is largely unavailable in the hilly terrain, this work is done alone and entirely by hand. These tasks are physically grueling, involving prolonged bending, crouching, and carrying loads across steep slopes, which is reflected in the fact that a woman farmer here works an average of 3,485 hours a year (Pulitzer Center, 2017). At the post-harvest stage, women handle threshing and storage, both of which are similarly manual and labour-intensive, and
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	dairy processing activities including milking, milk boiling, and ghee production, which are time-consuming daily tasks performed multiple times throughout the day regardless of season.		they also sell grass, pulses, and cow dung to generate supplementary income for the household.
Key challenges faced by women in agriculture in the state	Displaced women have been pushed into subsistence-level livestock work which, while labour-intensive, generates minimal and irregular earnings. Their income has consequently reduced, with the study reporting the sharpest decline for farm labourers (Rani et al., 2021). Compounding this, there are no specific credit schemes designed for women engaged in livestock activities, meaning they cannot	Kerala's land reform legislation technically makes leasing of agricultural land illegal, so Kudumbashree collectives work around the ban by leasing land informally through agreements negotiated by local panchayat leaders and community development societies. Collectives therefore operate without legal protection over the land they farm. Women also still face drudgery without improved equipment, and there is	Women's access to machinery is almost nonexistent in the hilly terrain, meaning all operations are done manually and the physical burden falls entirely on women. Man-animal conflict, including attacks by leopards, monkeys, and wild boar, poses a constant threat to crops and farmers. Flash floods and droughts have made subsistence farming increasingly precarious. Government agricultural investment

	access formal financing to scale up or invest in their work, trapping them in low-productivity, unrecognised labour with no institutional pathway out. Their income has consequently reduced, with the study reporting the sharpest decline for farm labourers.	limited focus on post-harvest processing support for higher value production.	is largely concentrated in the terai plains region, leaving hill districts with minimal institutional support. Most critically, women lack land titles, which prevents them from accessing formal credit or entering contract farming arrangements that could improve their incomes.
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The following are some of the key observations that emerge across all three states, organised using the STEEP framework covering social, technological, economic, environmental, and political dimensions:

Social

- Women perform the majority of key physical agricultural activities across all three states but are socially classified as labourers or unpaid family workers rather than farmers, making their contributions invisible in official records.
- Men control financial and market facing decisions even when women do the bulk of the work, reflecting deeply embedded gender norms around mobility and public economic participation.
- The one structural exception is Kerala, where Kudumbashree has actively restructured women's role from labourer to cultivator through collective organisation.

Technological

- Extension functionaries in India are predominantly men, which means technical guidance and new agricultural knowledge disproportionately reach male farmers while women, who perform the bulk of the labour, are left out (Veetil et al., 2021). Another study/report

finds that women's lower access to information and loss-reduction technologies leaves them at a disadvantage at the post-harvest stage, where they are most active (Nordhagen, 2021).

- Mechanisation has had a paradoxical effect in that while it reduces physical drudgery, it has simultaneously displaced women from the manual tasks they previously dominated, particularly in Punjab, without creating alternative meaningful high value employment.
- Most machinery is not designed for female body types or operational contexts, further marginalising women from mechanised agriculture.

Economic

- Access to formal credit and land ownership remains a structural barrier for women in all three states, as without land titles women cannot access institutional loans or government schemes tied to land ownership.
- In Punjab, there are no specific credit schemes for women in livestock despite their 90% workforce share, while in Uttarakhand women do the farming but men sell the produce and control the income.
- Kerala's Kudumbashree JLG helps in large to overcome this lack of economic agency through group lending at subsidised interest rates, though women's broader economic agency remains limited even there, because they lack ownership.

Environmental

- Women's agricultural work is disproportionately exposed to harsh environmental conditions, as pre-harvest tasks like transplanting and weeding are performed outdoors in extreme heat for long hours while post-harvest tasks like winnowing expose women to dust and poor ventilation.
- In Uttarakhand specifically, women face additional environmental challenges including flash floods, droughts, and man-animal conflict that threaten both their crops and physical safety, without adequate government support or climate adaptation resources.

Political

- Kerala's Land Reforms Act of 1970 makes leasing of agricultural land illegal, forcing Kudumbashree collectives to operate through informal agreements negotiated by panchayat leaders and community development societies, which means women farm without any legal claim to the land they cultivate (Choudhury et al., 2021).
- Across all three states, agricultural policy has historically been built around male farmers, from procurement systems to extension services to credit schemes, leaving women's

needs structurally invisible in policymaking (Veettil et al., 2021). The clearest consequence of this is land ownership. Only about 13% of women in India hold land titles (The Citizen, 2023), and because most government schemes, credit facilities, and contract farming arrangements are tied to land records, women remain locked out of the formal agricultural economy regardless of how much labour they contribute.

Across all three states, some key common patterns emerge. Women perform the majority of physical agricultural labour, yet consistently lack access to machinery, technology, and economic agency, rarely controlling the income their labour generates.

What stands out is that in both Punjab and Uttarakhand, agricultural responsibility shifted onto women as a consequence of circumstances outside their control, and this shift came with no accompanying gain in authority or resources. In Punjab, mechanisation displaced women from crop farming, pushing them into livestock work by default. In Uttarakhand, male outmigration left women managing farms alone, yet men still control the income when they return. In both cases, women participation is marked by lack of economic agency or choice. However, women's entrepreneurial abilities and spirit are particularly evident through the cases of Uttarakhand and Kerala. In Uttarakhand, women show resourcefulness by selling grass, pulses, organic produce, and handmade goods for supplementary income of roughly Rs 1,000 a month, pointing to an entrepreneurial instinct constrained by lack of credit, land titles, and institutional recognition. Kerala offers a contrasting lesson. Through Kudumbashree, women organised into Joint Liability Groups of four to five members gain access to formal credit, the ability to lease fallow and cultivable land, control over production decisions at the pre-harvest stage, and collective bargaining power to market their produce at the post-harvest stage. The traditional pattern across all three states has remained the same, with the burden of manual labour falling on women while they have lacked decision-making authority and economic power. The case of Kerala, however, demonstrates that when women are organised into collectives, they are able to overcome some of the socio-economic barriers that are faced by them individually .

4. Conclusion

This paper examined the role of women in pre-harvest and post-harvest agricultural activities, by undertaking a comparative assessment of three states of India, and the structural factors that shape their participation and outcomes. A key observation holds across all three case studies, that women bear the burden of heavy manual labour at both the pre-harvest and post-harvest stages, irrespective of state, crop, or farming system.

Running underneath all three cases is the question of asset ownership. Formal credit in India is extended against collateral, which in agriculture almost always means a land title, and lending

decisions rest on documentation that proves ownership. Since land records are overwhelmingly registered in men's names, women cannot furnish the paperwork or the assets that banks require. The result is that women who perform the majority of agricultural work are structurally excluded from the financing that would let them invest in it and exercise greater economic agency. Assets, therefore, are not simply a marker of wealth but the precondition for entering the formal agricultural economy, and their absence explains why deep involvement in farming has not translated into economic standing for women.

The case of Punjab demonstrates that mechanisation, though introduced to raise productivity and reduce manual drudgery, also produced suboptimal outcomes for women's participation in agriculture. Machinery displaced them from the very operations they had previously dominated, and no alternative high value employment emerged to absorb the displaced workforce. Uttarakhand presents a contrasting picture. Women there assume responsibility for entire farm operations when men migrate out, and supplement household income through the sale of produce and handmade goods. The entrepreneurial capability is evident, but economic agency and institutional support remain absent, without which this potential fails to translate into meaningful improvements in their social and economic position. The case of Kerala illustrates how collective organisation can overcome these structural barriers. Through JLGs, Kudumbashree enable women to access formal credit, lease land, exercise control over production decisions, and market their produce collectively, thereby shifting their identity from agricultural labourer to cultivator.

Several policy directions follow from these findings. The collective group model warrants adaptation and scaling across states, as it directly addresses the credit and land ownership constraints that individual women often fail to overcome. Even in Kerala, however, these collectives operate through informal leases with no legal claim to the land they cultivate, which means policy must go further and create legitimate pathways for women to hold land in their own names. Agricultural extension services also require substantially greater female representation, so that training and technical knowledge reach the hands that actually carry out most farm operations rather than terminating at male household heads. Training and skill development programmes should be designed around women's actual roles, covering post-harvest handling, storage technology, and market linkages, while creating pathways for occupational and geographical mobility. Finally, machinery design must account for women's operational realities, so that future mechanisation strengthens their position rather than displacing them from it.

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