

Women-led sustainable agriculture in Bihar

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Women-led sustainable agriculture in Bihar is an exemplary model that shows the possibilities for advancing gender equity, environmental resilience, and sustainable agriculture at the same time. The article discusses the role of women in the adoption of diversified cropping systems, agroecology, and community based management of resources in the climate-vulnerable districts of Bihar, in the face of rising climate stress and ecological degradation in the state. The article showcases how women are becoming the leading agents in the adaptation of sustainable agriculture through the conservation of seeds, soil management, and water harvesting techniques, as per the sociological research, policies, and practices in the state. The overall message of the article is that women-led agriculture is not only the key to climate resilient, sustainable agriculture but it is also a pathway to raise gender equity, aligning with Sustainable Development Goals 5, 13, and 15.

Keywords: Cropping systems, Gender equity, Sustainable development goals, Women

WOMEN play a pivotal role in Bihar's agricultural sector, contributing significantly to crop production, livestock management, and allied activities. Despite their substantial involvement often accounting for over one third of total farm labour, women face persistent challenges such as limited land ownership, wage disparities, and restricted access to resources and decision making power. In recent years, there are examples of women-led sustainable agriculture initiatives like horticulture based initiatives, collective dairy farming, self-help groups (SHGs), and climate smart agriculture (CSA) practices. These initiatives not only contributed to the improvement of livelihoods, food security, and environmental sustainability in rural areas, but also contributed to women's empowerment at the social and economic levels.

The concept of women-led sustainable agriculture does not view women as mere recipients of development programmes; rather, it sees women as active agents in sustainability transitions whose daily agrarian practices directly contribute to environmental sustainability and climate change adaptation. This view is particularly relevant in Bihar because it is a smallholder dominated region, highly vulnerable to climate change, and frequently hit by floods and droughts. It is also a region where there are gender inequalities in land, credit,

and institutional support. Women-led sustainable agriculture in Bihar is highly consistent with the Sustainable Development Goals (SDGs) set by the United Nations, aligning with SDG 5: Gender Equality, SDG 13: Climate Action, and SDG 15: Life on Land. This article showcases various aspects of women led sustainable agriculture in Bihar, highlighting participation patterns, entrepreneurship, collective action models, climate adaptation strategies, policy frameworks, and ongoing challenges.

Women as agents of sustainability

Women contribute substantially to agricultural labour in Bihar that is up to 36% of total farm work with especially high involvement in harvesting and seeding. Their roles extend beyond crops to livestock rearing (dairy/goat/poultry), mushroom cultivation, horticulture, post-harvest processing, and home gardens. However, only about 13% of land is owned by women while the wage gaps persist at 7–16% compared with men. Significant research has also proven that the role of women in agriculture goes beyond the provision of labour to encompass aspects such as resource conservation, management of seed diversity, maintenance of soil fertility, and risk management. Research conducted on women in agriculture has



Cow dung cakes for household use and additional income

proven that decisions made by women on agricultural activities are inclined towards diversification strategies, minimal external input use, and ecosystem approaches. Bina Agarwal's research on gender and land rights in South Asia has also proven that women's management of resources has a positive impact on the ecosystem. Some studies have also shown that women farmers in districts such as Muzaffarpur and Darbhanga in the state of Bihar who use approaches such as mixed cropping systems, seed management, composting, and water harvesting have exhibited high adaptive capacity to environmental shocks such as erratic monsoon seasons and flood-induced salinisation of soils.

Gender blindness in climate and agricultural planning

Self-help groups (SHGs) and Farmer Producer Companies (FPCs) are critical platforms for economic empowerment and sustainability. Women-led FPCs like Samarpan Jeevika Mahila Kisan Producer Company Limited based in Muzaffarpur, Bihar, have improved productivity through training in sustainable practices while enhancing bargaining power for better prices. Dairy cooperatives under the National Dairy Plan have increased intra-household bargaining power and social inclusion for women. SHG membership is associated with greater access to information and some improvement in agricultural decision-making but less impact on actual practice without broader support. Despite the demonstrated contributions of women to agriculture in Bihar, there exists a substantial gender transformative deficit in the state's policies. This can be observed in instruments such as the Bihar State Action Plan on Climate Change (2015; revised in 2023) and schemes under the Mukhyamantri Krishi Yojana, which assume gender neutral roles in land ownership and decision-making for male farmers. Less than a sixteenth of women in Bihar have secure land tenure, which is a question of concern as the women farmers are unable to access institutional credit, crop insurance schemes, etc., due to this limitation. Additionally, the burden of unpaid work as caregiver in household also reduces women's participation in formal agriculture

institutions. Although initiatives such as JEEViKA and the Bihar Rural Livelihoods Promotion Society (BRLPS) have improved women's participation in the economy, only 12% of women-led producer groups linked to BRLPS have verified environmental co-benefits.

Rethinking agricultural development models

Sustainability, as a concept, balances three aspects i.e. environmental, social, and economic sustainability. However, the agricultural development strategy for Bihar continues to focus on short term agricultural productivity and output, a characteristic of industrial monoculture systems that are often accused of producing high economic returns but compromising soil, biodiversity, and social sustainability. Bihar is a focus state for climate smart agriculture (CSA). Studies show that when women's knowledge of CSA increases through training or extension, adoption rates rise along with food security and male out-migration also declines as rural livelihoods become more resilient. However, gender gaps persist as men dominate decisions around new technologies or adaptation strategies while the women's awareness remains lower due to limited extension contacts or digital access. Contrary to the industrial monoculture systems, which often try to control complex systems, resulting in unforeseen consequences such as pollution, loss of soil fertility, and increased vulnerability to climate change. Women's agroecological systems, based on diversity, biology, and traditional knowledge, are known to enhance all three aspects of sustainability simultaneously. Soils, considered a living system, are essential for nutrient cycling, hence supporting economic, social, and environmental sustainability goals of SDG 13 and SDG 15.

Climate change and adaptation in Bihar

Climate change adaptation in agriculture is often constrained by short term political priorities that emphasise physical infrastructure such as embankments and irrigation works over community based and ecological solutions. This approach neglects the social



Inter-cultural activities (irrigation) by youth

dimensions of adaptation, despite evidence that climate impacts disproportionately affect women through increased labour, food insecurity, and livelihood precarity. The concept of 'climate smart villages' in Bihar, an initiative by the Department of Agriculture and partners like BISA/CIMMYT, aims to build climate resilience in 100+ villages across 38 districts by promoting sustainable, weather-ready agricultural practices and explicitly integrating gender equitable knowledge building as a pathway to sustainable farming and reduced migration. Sanitation and waste management initiatives like Lohia Swachh Bihar Abhiyan also position rural women as key actors in community led waste management and organic inputs such as vermicompost, linking agriculture to wider rural sustainability goals.

Women-led farming systems in Bihar challenge the model of short term political priorities by embedding adaptation within everyday practices like soil conservation, crop diversification, and local water management that enhance resilience without exacerbating ecological stress. Such practices also address concerns about declining nutritional quality and yield instability of staple crops under climate stress, an issue increasingly documented in agronomic and climate research.

From gender mainstreaming to feminist agroecology

Going forward, a paradigm shift is called for moving away from gender mainstreaming to feminist agroecology, which is situated within local socio-ecological realities and is clearly linked to SDG 5. The main policy pathways for feminist agroecology include:

- Legal empowerment through joint land titling, which promotes women's investment in soil fertility.
- Gender-sensitive and digital extension services, which are co-designed with women farmers to ensure their relevance and reach.
- Climate resilient value chains, which are situated within self-help groups to minimise women's market and climate-related risks, promoting their economic security.

These are all clearly linked to international frameworks such as the UN Framework Convention on Climate Change Gender Action Plan and are now widely agreed on by climate-gender scholars.

Need for data and accountability

The biggest hurdle in effective policy formulation is the lack of sex-disaggregated and ecology-informed data. The lack of detailed information regarding women's contributions to sustainable agriculture means that their role in policy formulation and evaluation remains invisible. This is in direct contradiction to the SDG's 'Leave No One Behind' principle.

In this background, the concept of Bihar Women Agroecology Index as an accountability tool is highly



Weeding activities by woman farmer

relevant. Targeted initiatives such as collaborative Farmer Producer Organizations (FPOs) and specialised training workshops at institutions like Bihar Agricultural University are bolstering women's technical knowledge and capacity in modern, climate-smart agro practices. Agroecology interventions supported by organisations like the Aga Khan Foundation leverage hands on training in regenerative practices, bi-inputs, and crop diversification to build resilience among smallholders. The index would include information regarding:

- Women's access to land, credit, and extension support.
- Women's decision making power.
- Ecological outcomes such as soil health, biodiversity, and reduction in chemical use.

By including value to crop yields as well as support to ecosystem services, the index would effectively capture the sustainability dividend from women's agro-ecological practices.

Constraints and future prospects

Despite high labour contributions, women in Bihar remain constrained by limited land ownership, wage discrimination, low participation in formal decision making, and restricted access to credit, extension and CSA knowledge. Social norms frequently reserve final decisions for men, even when women manage day to day farming. Triple burdens of farm, household and community work further limit their capacity to engage in training, markets and leadership roles. Evidence from Bihar and other regions suggests that women-led or women centered models like horticulture based homesteads, CSA programmes, dairy cooperatives and SHG/FPC based enterprises can simultaneously advance gender empowerment, food security and environmental sustainability when accompanied by secure resource rights, targeted training and collective platforms. Remaining gaps include systematic evaluation of explicitly 'sustainable' (organic, agroecological, low input) women-led farming systems in Bihar, long term environmental impacts, and the intersection of caste, tribe and gender in access to green technologies.

A case study of a women farmer

Mrs. Nirmala is resident of Yakubpur-Nagwan village which is around 4.5 km from All India Institute

of Medical Sciences in Bihar, located at Phulwari Sharif-Janipur Road. She came here after her marriage in 2001. She shared that with the establishment of AIIMS, Patna there has been gradual expansion of urban infrastructure towards her village which was once neglected at the outskirts of the main town. This development has significantly transformed the livelihood patterns of farming households within ten years. Back in 2001, whole family depended on cereal based agriculture and cattle farming and contributed in different ways in their own farm, but now, they have shifted toward diversified vegetable cultivation integrated with goat rearing and cattle farming. She revealed that she has witnessed the whole transition within these ten-twelve years after 2014. She shared that shrinking agricultural land, expanding urban boundaries, increasing climate uncertainty, irregular rainfall, and declining soil productivity and moreover nearness to urbanisation and changing market demands had been major underlying reasons.

She explained that their daily mobility has altered gender roles within agriculture. Men usually are more concerned with land preparation, irrigation and marketing while marketing strategies are discussed among both men and women. The neighbouring women also supported each other through collective participation in sowing, transplanting, weeding, harvesting, fodder collection, and livestock care. During the daytime, when men are out for work, they coordinate labour exchange and collectively supervise agricultural operations, reflecting strong community based management of resources.

The shift from cereal monocropping to vegetables such as tomato, brinjal, okra, chili, and leafy greens has also increased household income due to easier access to nearby urban markets and uninterrupted supply of produce throughout the year. Livestock integration has further strengthened livelihood resilience by providing milk, manure, and supplemental income through goat

sales. They also adopted agro-ecological practices such as recycling cattle waste into organic manure, mixed cropping, and maintaining local seed varieties to reduce input costs and cope with ecological degradation. She shared that 'The reduced distance between village and city has improved access to education, healthcare, and market opportunities, and they are also constructing pucca house for better living'.

The case demonstrates that the peri-urban women farmers have emerged as active agents of change, by not merely supporting agriculture but actively shaping resilient rural livelihoods through diversified cropping systems, agro-ecological adaptation, and collective resource management in the face of rapid socio ecological change.

SUMMARY

The women centric model of sustainable agriculture in Bihar showcases the potential for gender justice and sustainability as mutual. Sustainability is not limited to conservation of resources, but extends to creating systems where ecological, social, and economic well-being is mutually reinforcing. The acceptance of women as agents of change rather than change agents is the key to going beyond the current development paradigm, where growth is defined by short term economic returns rather than long term ecological and social well-being. The gender justice at the heart of state climate and agriculture policies could result in the development of productive, sustainable, and regenerative agriculture systems. The year 2026 emphasised as the International Year of Woman Farmers, can offer a global platform strengthening the identity of women farmers, ensuring equitable access to resources by promoting women centered agricultural policies leading to SDGs 5, 13, and 15.

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