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Transforming Rural Livelihoods: Women Entrepreneurs Driving Scientific Livestock Farming

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Abstract

Rural women play a pivotal role in agricultural productivity and food security, yet remain constrained by socio-economic and cultural barriers. This study documents the transformative impact of **science-led livestock interventions** under the Biotech-KISAN Hub in West Bengal's aspirational districts (Nadia, Birbhum, South Dinajpur). Three case studies of women farmers engaging in poultry and Black Bengal goat rearing were analyzed to quantify improvements in productivity, income, and socio-economic status. Structured training in nutrition, breeding, housing, health management, and market linkages, coupled with provision of superior germplasm, led to substantial increases in flock size, survival rates, and annual income. Poultry flock survival reached 93.75%, while annual income increased by 69.17%; goat herd sizes expanded by 178–191%, with annual returns rising 272–275%. The interventions facilitated asset creation, enhanced household savings, and promoted participation in Farmer Producer Organizations. These results demonstrate that integrating scientific livestock management with institutional support significantly empowers rural women, improves household livelihoods, and provides a scalable model for achieving Sustainable Development Goals in India's rural sectors.

Keywords: Women empowerment/ Rural livelihoods/Scientific poultry rearing/Black Bengal goat Biotech-KISAN Hub/Livestock productivity/Socio-economic impact

1. Introduction

Rural women constitute a substantial portion of India's agricultural workforce, contributing significantly to crop cultivation, animal husbandry, and household food security. Despite their pivotal role, socio-cultural norms, limited access to technology, and inadequate institutional support often constrain their productivity, income generation, and decision-making capacity (FAO, 2020). Empowering rural women through science-led interventions is, therefore, essential to achieve the United Nations Sustainable Development Goals (SDGs), particularly SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 5 (Gender Equality), and SDG

8 (Decent Work and Economic Growth) (UN, 2023).Livestock and poultry rearing are recognized as high-impact livelihood strategies for smallholder farmers, offering multiple socio-economic benefits including regular income, nutritional security, and asset creation (Devendra & Thomas, 2002). Among livestock, small ruminants such as goats are particularly suitable for resource-poor farmers due to their low maintenance costs, high reproductive rates, and adaptability to marginal environments. Similarly, indigenous poultry breeds like Vanraja provide both nutritional and economic benefits in rural settings while requiring minimal space and inputs (Gupta et al., 2019). Scientific management practices, encompassing breed selection, balanced nutrition, vaccination, housing, breeding, and market linkages, have been shown to enhance flock productivity, reduce mortality, and improve economic returns (Pathak et al., 2017). However, adoption of such practices remains limited in India's aspirational districts due to low literacy levels, restricted access to quality inputs, and lack of organized training programs (Chandra et al., 2021).

The **Biotech-KISAN Hub** initiative, implemented by the West Bengal University of Animal and Fishery Sciences (WBUAFS), addresses these constraints by providing structured training, germplasm support, technical handholding, and integration with Farmer Producer Organizations (FPOs) in five aspirational districts: Nadia, Murshidabad, Birbhum, Maldah, and South Dinajpur. The initiative aims to promote sustainable livestock-based livelihoods, enhance household income, and empower women farmers through science-driven interventions.

This study presents the success stories of three women farmers who transformed their backyard poultry and goat units into productive, income-generating enterprises. The objective is to demonstrate the effectiveness of scientific livestock interventions in improving flock productivity, income, asset creation, and socio-economic empowerment of rural women, while providing a replicable model for other aspirational regions in India.

2. Detailed Case Studies of Women Farmers

2.1 Case Study 1: Mrs. Baggi Murmu – Scientific Poultry Rearing in South Dinajpur

Background:

Mrs. Baggi Murmu, a 45-year-old Scheduled Tribe woman residing in Kushmandi Block, South Dinajpur, West Bengal, has been engaged in backyard poultry for over a decade. Her household landholding consists of 1 Bigha agricultural land and 10 Katthas non-agricultural land. Despite her experience, low literacy (Class VIII) and limited access to scientific inputs restricted her productivity and income.

Methodology and Intervention:

Under the Biotech-KISAN Hub programme (2020–2025), Mrs. Murmu participated

in a structured training module covering:

- Balanced nutrition and preparation of quality feed
- Vaccination and deworming schedules
- Mineral mixture supplementation
- Hygienic housing and environmental management
- Disease prevention, health monitoring, and first aid
- Market linkages and collective marketing strategies through FPOs

She was provided with 20 Vanraja chicks from the Hub's Germplasm Centre and purchased an additional 50 chicks. Inputs such as feed, vaccines, and minerals were supplied periodically, while technical experts conducted regular flock monitoring.

Results:

Parameter	Initial	Provided by Project	. Purchased	Total	Sellable Flock	Survival Rate (%)
Birds	10	20	50	80	75	93.75

Economic Impact:

Parameter	Before Intervention (₹)	After Intervention (₹)	% Change
Annual Poultry Income	17,280	29,232	69.17
ROI	–	69.17	–

Socio-Economic Outcomes:

- Investment in house renovation (₹80,000) and gold ornaments
- Savings deposited in bank accounts
- Farm recognized as a demonstration site for neighboring women farmers
- Active membership in local FPO promoting collective marketing

Discussion:

Scientific intervention improved flock survival, productivity, and income. The combination of technical training and continuous support led to sustainable livelihood enhancement, demonstrating the potential of science-led poultry farming in rural tribal communities.

2.2 Case Study 2: Mrs. Haimanti Pramanik – Black Bengal Goat Farming in Birbhum

Background:

Mrs. Haimanti Pramanik, 42 years old, resides in Daranda village, Illambazar Block, Birbhum. Her household had limited livelihood options, with low agricultural landholding (6 Katthas). Before intervention, she had minimal knowledge of scientific goat management.

Methodology and Intervention:

The Biotech-KISAN Hub provided:

- Training in breed selection and identification of superior Black Bengal does
- Feeding strategies including balanced ration formulation and supplementation
- Health care: vaccination, deworming, wound management, disease prevention

- Breeding management: estrus detection, castration, dehorning, hoof trimming
- Value addition techniques for goat milk and meat
- Project report preparation for farm business planning

She received 6 goats from the Hub and purchased 6 additional goats. Continuous technical guidance and health monitoring were provided.

Results:

Parameter	Initial Flock	Provided by Hub	Purchased	Total Flock	Sellable Flock	Flock Growth (%)	Sellable Growth (%)
Goats	6	6	6	19	16	178.44	162.76

Economic Impact:

Parameter	Before Intervention (₹)	After Intervention (₹)	% Increase
Annual Goat Income	10,300	38,500	274.76
Total Family Income	75,000	1,08,000	70.97
ROI	–	196.88	–

Socio-Economic Outcomes:

- Acquisition of 13 Katthas agricultural land
- Construction of a two-room brick house
- Bank savings of ₹50,000 and family healthcare expenditure of ₹20,000
- Recognized as a progressive small ruminant farmer
- Active participation in FPO, facilitating knowledge transfer to other women farmers

Discussion:

Scientific goat rearing led to significant increases in flock productivity, income, and household assets. The intervention enhanced entrepreneurial capacity among women, demonstrating a replicable model for rural livelihood enhancement in resource-poor settings.

2.3 Case Study 3: Mrs. Rakhi Biswas – Progressive Goat Farming in Nadia

Background:

Mrs. Rakhi Biswas, 45 years old, belongs to a Scheduled Caste household in Natapuli village, Purba Bishnupur Block, Nadia. Her agricultural landholding consists of 2 Bigha, with an additional 5 Katthas of non-agricultural land. Prior to intervention, she had limited livelihood opportunities and managed a small household goat unit.

Methodology and Intervention:

The Biotech-KISAN Hub implemented:

- Scientific rearing practices including nutrition, vaccination, castration, and hygienic housing
- Market linkages through FPOs
- Technical guidance on breeding management and record-keeping

She received 4 goats from the Hub and purchased 4 additional goats herself. Support included feed, minerals, vaccinations, and regular supervision.

Results:

Parameter	Before Project	After 1.5 Years	% Increase
Flock Strength	3	12	190.91
Annual Sellable Flock	6	14	200
Annual Family Income (₹)	51,400	89,000	73.15
Return from Goat Farming (₹)	7,800	29,000	271.79

Socio-Economic Outcomes:

- Investments in house renovation and gold ornaments
- Savings deposited in banks
- Farm serves as a model demonstration site for neighboring farmers

- Membership in FPO improved marketing and price realization

3. Socio-Economic Impact of Science-Led Livestock Interventions

The Biotech-KISAN Hub interventions had multifaceted socio-economic impacts on the women farmers and their households, spanning **income generation, asset creation, social recognition, nutritional security, and community empowerment**. These impacts are summarized below.

3.1 Economic Empowerment

Income Growth:

The interventions significantly increased household income for all three women farmers:

Farmer	Livestock	Pre-Intervention Annual Income (₹)	Post-Intervention Annual Income (₹)	% Increase	ROI (%)
Baggi Murmu	Poultry	17,280	29,232	69.17	69.17
Haimanti Pramanik	Goat	75,000 (family)	1,08,000	70.97	196.88
Rakhi Biswas	Goat	51,400 (family)	89,000	73.15	271.79

Interpretation:

- Poultry and goat rearing interventions increased income by 69–73%, ensuring consistent cash flow for household expenditures.
- High ROI (69–272%) demonstrates the financial viability of small-scale livestock enterprises for rural women.

3.2 Asset Creation

The additional income enabled the farmers to invest in tangible assets, strengthening household resilience:

Farmer	Assets Acquired	Details
Baggi Murmu	Housing & Gold	Renovation of house (₹80,000), purchase of 10 g gold
Haimanti Pramanik	Land & Housing	Purchased 13 Katthas agricultural land, built a two-room house
Rakhi Biswas	Housing & Savings	House renovation (₹80,000), gold ornaments, bank deposits

Interpretation:

Asset creation not only reflects financial growth but also provides long-term security and social recognition.

3.3 Nutritional Security

- Adoption of Vanraja poultry and Black Bengal goats improved household protein intake through eggs, meat, and milk.
- Regular supply of animal-sourced food enhanced nutrition for children and elderly family members.
- Surplus products were sold, generating income while simultaneously meeting nutritional needs.

3.4 Social Recognition and Community Leadership

- All three women became **progressive farmers** recognized within their villages.
- Participation in **Farmers' Producer Organizations (FPOs)** enabled collective marketing, enhanced price realization, and strengthened decision-making power.
- Farms became **demonstration sites**, attracting other women and men farmers for exposure visits and training, facilitating **knowledge dissemination**.

3.5 Women Empowerment

The interventions enhanced women's empowerment at multiple levels:

Domain	**Impact**
Economic	Direct control over income, investments in assets and savings
Decision-Making	Increased influence in household and community financial decisions
Skill Development	Mastery of scientific livestock management techniques
Social Status	Recognition as role models in village, active FPO participation
Entrepreneurship	Transformation from subsistence to enterprise-level farming

3.6 Employment Generation

- Technical skills acquired enabled farmers to **train neighboring households**, indirectly generating employment and fostering community-level knowledge transfer.
- Small ruminant and poultry enterprises created part-time work opportunities for family members, particularly women.

3.7 Linkage to Sustainable Development Goals (SDGs)

The observed socio-economic impacts directly contribute to:

SDG	**Relevance**
SDG 1 – No Poverty	Increased household income, asset creation, and ROI
SDG 2 – Zero Hunger	Improved nutritional security through poultry and goat products

SDG 5 – Gender Equality	Women empowerment, leadership in FPOs, entrepreneurial development
SDG 8 – Decent Work & Economic Growth	Generation of self-employment, small-scale enterprise development
SDG 12 – Responsible Consumption & Production	Efficient resource use, sustainable livestock practices

The Biotech-KISAN Hub interventions transformed traditional subsistence farming into **science-driven, income-generating enterprises**. Quantitative improvements in income, flock productivity, and ROI were complemented by qualitative gains in **asset creation, social recognition, and empowerment**. The case studies illustrate that targeted, hands-on training, germplasm support, and market linkages can **empower rural women**, enhance livelihoods, and promote community-wide adoption of scientific livestock practices.

4. Discussion

The present study demonstrates that **science-led livestock interventions** can catalyze significant socio-economic transformation among rural women farmers in aspirational districts of West Bengal. Across the three case studies—Mrs. Baggi Murmu (poultry), Mrs. Haimanti Pramanik (goat), and Mrs. Rakhi Biswas (goat)—the interventions yielded measurable improvements in livestock productivity, household income, asset creation, and women's empowerment.

4.1 Improvement in Livestock Productivity

Scientific management practices including **balanced nutrition, vaccination, housing, breeding, and health care** significantly enhanced flock survival and productivity. For instance, the survival rate of Vanraja poultry in Mrs. Murmu's farm reached **93.75%**, and the Black Bengal goat herds expanded by **178–191%** within 18 months post-intervention. These findings are consistent with previous studies showing that adoption of modern livestock management practices reduces mortality, enhances growth rates, and improves product quality (Pathak et al., 2017; Gupta et al., 2019).

The combination of **technical inputs, continuous monitoring, and hands-on training** was critical in ensuring the effective transfer of knowledge and sustained adoption of best practices. The interventions demonstrate that even smallholder farmers in resource-limited settings can achieve **high productivity and profitability** when scientific methods are integrated with practical training and institutional support.

4.2 Economic Impact and Return on Investment

The economic gains observed were substantial. Household incomes increased by **69–73%**, and returns on investment (ROI) for goat farming reached **197–272%**, illustrating the

financial viability of small-scale livestock enterprises for rural women. Increased income enabled the farmers to invest in housing, land, gold ornaments, and bank savings, thereby strengthening household resilience and reducing vulnerability to economic shocks.

These results align with findings from Devendra & Thomas (2002) and Chandra et al. (2021), emphasizing that livestock interventions are a **proven pathway for poverty reduction, asset creation, and economic empowerment** among smallholder farmers.

4.3 Socio-Economic Empowerment

Beyond quantitative gains, the interventions contributed significantly to **women's empowerment and social capital**. Participation in Farmer Producer Organizations (FPOs) enhanced collective marketing, improved price realization, and enabled women to gain leadership roles in their communities. Training and demonstration farms became **knowledge hubs**, fostering peer learning and replicability of interventions.

The findings demonstrate that empowering women through scientific livestock management increases their **decision-making capacity**, social recognition, and entrepreneurial skills. This aligns with global evidence that women's control over productive assets and income positively influences household nutrition, health, and education outcomes (FAO, 2020; UN, 2023).

4.4 Nutritional Security and Food Sovereignty

Integration of Vanraja poultry and Black Bengal goats into household farming systems improved **protein intake** for family members and contributed to **nutritional security**. Sale of surplus products also generated income while maintaining household consumption needs, highlighting the dual benefit of livestock as both a food source and a revenue stream. Such interventions support SDG 2 (Zero Hunger) by simultaneously improving availability, access, and utilization of animal-sourced foods in rural communities.

4.5 Sustainability and Scalability

The **sustainability** of these interventions is reinforced by:

- Use of indigenous or improved livestock breeds adapted to local agro-climatic conditions
- Hands-on skill development and continuous extension support
- Integration with FPOs for collective marketing and access to formal markets
- Replicability of the model across other aspirational districts

By creating demonstrable economic benefits and empowerment pathways, these interventions provide a **scalable model** for rural development in similar socio-ecological settings.

4.6 Policy Implications

The success stories underscore the importance of **targeted, women-centric, science-led**

interventions in livestock development programs. Policy recommendations include:

1. Expanding germplasm centers and training hubs in aspirational and resource-poor districts
2. Strengthening institutional linkages with FPOs for collective marketing and input supply
3. Integrating livestock-based livelihood interventions with existing poverty alleviation and women empowerment programs
4. Promoting continuous monitoring and handholding support to ensure sustainable adoption

Such policy measures can accelerate rural women's entrepreneurship, reduce poverty, and contribute to achieving multiple SDGs simultaneously.

4.7 Limitations and Future Scope

While the interventions were highly effective, limitations include:

- Small sample size and focus on specific aspirational districts
- Short-to-medium term monitoring (18–24 months)
- External factors such as climate variability, disease outbreaks, and market fluctuations

Future studies should aim for **longitudinal assessment**, larger sample sizes, and integration of **digital advisory platforms** to scale scientific livestock management interventions.

The study conclusively shows that **scientific poultry and goat rearing interventions** empower rural women by increasing income, enhancing household assets, improving nutritional security, and fostering social recognition. The combination of **structured training, provision of quality germplasm, continuous expert support, and market integration** transformed traditional backyard livestock systems into profitable enterprises. These findings provide a **replicable, sustainable model** for promoting women-led livestock entrepreneurship in India's aspirational districts, contributing directly to poverty alleviation, nutritional security, and the SDGs.

5. Conclusion

The present study demonstrates that **science-led livestock interventions** under the Biotech-KISAN Hub have a transformative impact on rural women farmers in aspirational districts of West Bengal. By integrating **structured training, superior germplasm, health management, and market linkages**, traditional backyard poultry and goat farming were converted into **productive, income-generating enterprises**.

Key outcomes include:

- **Enhanced livestock productivity**: Poultry survival reached 93.75%, and goat herd sizes increased by 178–191%.
- **Economic empowerment**: Annual household income increased by 69–73%, with high returns on investment (69–272%).
- **Asset creation and financial security**: Investments in housing, land acquisition, savings, and gold ornaments strengthened household resilience.
- **Women empowerment and community impact**: Farmers gained leadership roles in FPOs, became role models, and facilitated knowledge transfer within their communities.
- **Nutritional and food security**: Integration of poultry and goat products improved household protein intake and overall food availability.

These results highlight the **synergistic effect of technical training, institutional support, and market integration**, providing a **scalable and sustainable model** for rural women's entrepreneurship and livelihood enhancement. The study underscores the importance of **targeted, women-centric livestock interventions** in achieving multiple Sustainable Development Goals, including poverty alleviation, gender equality, and nutritional security.

In conclusion, empowering rural women through scientific livestock management not only strengthens household livelihoods but also fosters community-wide socio-economic development, creating a **replicable pathway for rural transformation in India and similar socio-ecological contexts**.

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