

Rapporteur's Report on Sustaining Livelihoods: The Role of Livestock, Poultry and Fisheries in Rural Economy

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I

The allied sectors, including livestock, poultry, and fisheries, are pivotal in supporting rural economies, providing essential livelihoods, and contributing significantly to national food security. These sectors complement crop agriculture and serve as critical sources of income, nutrition, and employment, especially for small and marginal farmers. Livestock and poultry play a crucial role at the micro-level for resource-poor rural households, providing insurance, investment, energy, and power for agricultural and household activities. It also contributes significantly to food and nutrition security, income, and wealth generation. India boasts one of the largest livestock populations globally. According to the 20th Livestock Census (DAHD, 2019), the country's total livestock population reached 536.76 million, marking a 4.82 per cent increase during the inter-census period (2012–2019). Globally, especially in developing countries, demand for livestock and livestock products - such as milk, meat, and eggs - is growing, driven by population growth, urbanization, rising incomes, and changing lifestyles. A recent report by NITI Aayog (2024) highlights a significant dietary shift in India, with a growing demand for animal-based proteins. This demand is expected to remain robust, offering substantial opportunities to increase the income of farmers, particularly resource-poor ones, and accelerate poverty alleviation efforts. Given that a large portion of livestock is concentrated in the hands of the poor, its role in reducing poverty and malnutrition in India and other developing economies cannot be overstated. Data from the Situation Assessment Survey (NSSO, 2019) reveal that more than 70 per cent, 58 per cent, and 52 per cent of total bovines, ovines, and poultry are owned by small and marginal farmers, representing the poorer segments of rural India. Consequently, the contribution of livestock to poverty reduction in rural areas is even more significant than that of the crop sector.

However, this sector faces several challenges, including a substantial yield gap that ranges from 28 per cent to 52 per cent (in the case of milk), with the gap being even larger (52 per cent to 79 per cent) when compared to experimental fields, showing considerable inter-regional variation (Birthal, 2018). Feed and nutrition are the primary contributors to this yield gap, followed by breeding, health, and management practices. Feed and fodder shortages present another challenge, with projected deficits of 12 per cent for dry fodder and 25 per cent for green fodder by 2030 (IGFRI, 2015). The

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scarcity is exacerbated by the shift in land use for urbanization and industrialization, further limiting the land available for fodder cultivation. Economic losses from endemic diseases in livestock and poultry remain significant. For example, the annual losses from Peste-des-Petits Ruminants (PPR) in sheep and goats (Bardhan et al., 2017) and Foot and Mouth Disease (FMD) in cattle and buffalo (Govindaraj et al., 2020) are estimated at INR 4,600 crores and INR 20,897 crores, respectively. The lack of a robust animal healthcare delivery system worsens this situation. Over 85 per cent of the annual budget of the Animal Husbandry Department is allocated to salaries and establishment costs, leaving insufficient funds for essential supplies, medicines, and preventive services (Ahuja et al., 2003a).

Additionally, over 75 per cent of veterinary dispensaries, hospitals, and polyclinics staff are dedicated to providing curative veterinary care and artificial insemination services. In comparison, only 3.5 per cent of professional staff are involved in disease control efforts (Ahuja et al., 2003b). Vaccination programs rely heavily on the limited input of para-veterinary staff. Only 8 per cent of rural households have more than four milch animals, and 39 per cent of the total milk produced is consumed locally. Of the remaining 61 per cent, which is marketed beyond local areas, only 37 per cent is handled by the organized sector (Rana, 2018). Furthermore, there are significant interstate disparities in milk procurement by dairy cooperatives, with a large share of milk being procured from just a few states, such as Gujarat and Rajasthan.

It would be valuable to review the insights and findings presented in the papers submitted for the conference to address some of the aforementioned questions and identify potential areas for further research. The chosen theme provided ample opportunities for researchers to explore various critical issues. Sixty papers were submitted under this theme, employing diverse methodologies, including primary surveys, secondary data analysis, case studies, and literature reviews. These papers focus on the significant role played by the livestock, poultry, and fisheries sectors in income generation, food security, and poverty reduction, particularly in rural areas, amid a shifting socio-economic environment. The challenges faced by these sectors have also been highlighted. The following sections summarise the key findings and insights from these papers, categorized into seven broad sub-themes.

II

NATIONAL AND STATE-LEVEL PERSPECTIVES ON THE LIVESTOCK ECONOMY

Eight papers were submitted under this sub-theme, offering a macro-level view of the sector's contribution to rural livelihoods and national economic growth. Virender Kumar *et al.*, in their paper, revealed significant shifts in livestock populations in the hilly state of Himachal Pradesh, with a decline in cattle and sheep and increases in buffalo and goat numbers, mainly due to crossbreeding programs and mechanization.

However, they pointed to the need for diversification within the livestock sector to ensure long-term sustainability. Kumari and Diwakar highlighted the increasing role of livestock in providing self-employment opportunities in India, particularly for marginalized households. The authors revealed the disparities in participation rates across states, which raise questions about how to enhance livestock-based livelihoods in regions where participation is lower. Dineshkumar *et al.* provided a national overview, highlighting steady increases in milk production driven by improved breeds and practices. However, the authors noted the potential for further growth in the meat sector, particularly given that per capita meat availability remains below recommended levels. In contrast, in Kerala, Sankar *et al.* noted modest growth rates in milk production, raising concerns about the sustainability of indigenous and buffalo species.

Jha *et al.* analysed national-level trends in livestock and poultry meat production from 2003 to 2023, forecasting continued growth in the poultry and buffalo sectors but a decline in pig production in the next decade, highlighting the need for targeted interventions in the pig sector. Similarly, Bhavana Kabber *et al.* used compound annual growth rate (CAGR) and ARIMA models to forecast positive growth in the population and productivity of in-milk animals in the next decade, with crossbred cattle showing the highest growth rates in milk production. However, concerns remain about indigenous breeds' sustainability and declining populations. Other papers by Jagadeesh *et al.* and A. Suresh *et al.* pointed to the critical role of livestock in reducing income inequality and improving nutritional security at the national level. However, regional disparities and low consumption of certain types of meat remain a concern.

The findings underscore the critical need to diversify livestock products, address regional disparities, and preserve indigenous breeds to ensure the long-term sustainability and resilience of the livestock economy. However, a notable gap in the existing research is the limited analysis of the long-term impacts of government policies on shifts in livestock populations and the role of indigenous knowledge in maintaining livestock diversity. These areas merit further investigation to provide a more informed basis for policy decisions. Additionally, additional research is required to explore how the benefits of livestock production can be extended to regions with lower participation rates. One key area that remains underexplored is the contribution of various factors—such as breed types, animal healthcare services, and feed & fodder availability—to the growth in livestock production. Moreover, the role of technological advancements, specifically through Total Factor Productivity (TFP) analysis, which accounts for productivity growth beyond simple increases in input use, has received insufficient attention. Key issues for discussion include strategies for enhancing productivity in regions where certain livestock species are experiencing population declines, addressing disparities in livestock-based self-employment opportunities across states, and promoting diversification of livestock products in areas heavily dependent on specific species. Sustainable approaches to improving milk and meat production must also be explored to ensure long-term viability across different regions.

III

FARM-LEVEL ECONOMICS: MICRO PERSPECTIVES

The 16 papers submitted under this sub-theme provide an in-depth analysis of various aspects of livestock enterprises at the farm level, addressing key issues such as cost and returns analyses, yield gaps, resource-use efficiency, technology adoption, and the economic viability of livestock-rearing systems. However, an overwhelmingly large proportion of the papers focused on dairying, with very few papers encompassing goats and pigs (sheep has not been addressed in any paper).

The paper by Feroze *et al.* explored the yield gap in milk production in East Khasi Hills of Meghalaya, revealing a significant 49 per cent yield gap driven by insufficient access to extension services, high concentrate feed costs, and a lack of green fodder. The yield gap between attainable and actual production was six times larger than between potential and attainable production, indicating that improving extension services and providing better fodder resources could reduce the gap significantly. Another paper by Horo and Singh examined resource use in Integrated Farming Systems (IFS) in Punjab and Haryana and found that farmers often overuse on-farm resources such as fodder and labour while using purchased inputs like concentrates more efficiently. The findings highlighted the need for farmers to adopt better management practices that recognize the value of on-farm resources to improve productivity. Similarly, Jakhar *et al.* used production function models to show that green fodder, dry fodder, and concentrates are underutilized, suggesting that improving resource allocation could enhance milk production and profitability. The role of livestock in sustaining rural livelihoods was examined in several papers. Longkumer and Jamir identified that mixed farming systems combining crops and livestock play a crucial role in providing income, particularly for small-scale farmers in the northeastern state of Nagaland. The paper highlighted the importance of farmer participation, education, and livestock ownership in determining income levels. Similarly, Pandey, from Mirzapur District of Uttar Pradesh, showed that households with livestock had higher overall incomes and lower poverty levels than those without livestock. The findings emphasize that livestock ownership is a significant contributor to poverty alleviation and income security in rural areas, though promoting diversified income sources could further enhance livelihood security. Integrated Farming Systems (IFS) were also a focal point of analysis. Prasanth and Ponnarasi examined how livelihood diversification impacts income inequality in the Thiruvannamalai district of Tamil Nadu. It revealed that income inequality decreases as households diversify their income sources, particularly livestock rearing and wage employment. Dam *et al.* demonstrated that the IFS model, which includes dairy farming, poultry, crop production, and other allied activities, is economically viable, generating strong returns and creating employment opportunities. However, high initial capital costs and market access challenges were identified as barriers to adoption, limiting the potential of IFS

models for broader adoption. In another IFS-based study from coastal West Bengal, Barman *et al.* found that dairy integrated with fish farming and crop production was the most profitable system. Still, farmers were not operating at full profit efficiency due to suboptimal resource use and management practices. The analysis revealed the positive impacts of fish farming and crop diversification on profitability but also highlighted the need for better veterinary services and input management to reduce inefficiencies. The economic challenges faced by dairy farmers were explored in papers focusing on cost and returns in milk production. Waghmare and Sale analyzed data from dairy farmers in Western Maharashtra, revealing that local cattle were unprofitable, whereas crossbred cattle generated significantly positive net returns due to higher yields and better price realization. Feed and labour were the major cost components for both breeds, and the study called for standardized methodologies for cost estimation to facilitate informed decision-making. Similarly, one paper from Punjab found that milk production from crossbred cows and buffaloes was profitable, with feed and fodder accounting for 79-80 per cent of the total variable costs. The study suggested that reducing fodder costs and increasing milk yields could significantly enhance net income, especially for local cows, which were less profitable. Better feed management practices and supportive policies were emphasized to improve profitability. Other papers highlighted the economic dynamics of livestock-rearing systems in specific regions. Soy examined four livestock systems—crop plus small ruminants (CSR), crop plus large ruminants (CLR), crop plus large and small ruminants (CLSR), and livestock only, in Telengana; finding that all systems were economically viable, but those with larger herd or flock sizes generated higher returns. Labour was the dominant cost component, followed by feed and fodder, indicating the need for tailored policies to address the unique challenges of each system. Singh and Chiphang focused on milk production in Northeast India, revealing that milk production is profitable for all stakeholders, with feed and fodder costs being the major expense. The study emphasized the potential for improving feeding practices by utilizing more green fodder and reducing reliance on concentrated feeds. Only one paper explored the role of goat farming in improving livelihood security. Poucheparadjou *et al.* reported from the Union Territory of Puducherry that goat rearing is economically viable, with a benefit-cost ratio of 3.3. However, challenges such as parasitic infestations, lack of insurance coverage, and low sale prices persisted, leading to an annual economic loss of Rs. 130,365 due to diseases in the sampled animals. The paper highlighted the need for improved disease management and better market linkages to increase the profitability of goat farming. Finally, Poucheparadjou *et al.* assessed the technical efficiency of dairy farmers in Puducherry using a stochastic frontier approach and revealed that dairy farming in the Union Territory is profitable, with a benefit-cost ratio of 1.77, but technical efficiency among farmers was only 78 per cent, indicating that less efficient farmers could increase production by 67 per cent to match the efficiency of the most efficient farmers. Under the area of technology adoption and its impact in this section, two papers addressed the economic and livelihood impacts of adopting

new technologies in rural India. Gowda *et al.* examine the use of "Jalkund," a low-cost rainwater harvesting technology, in Meghalaya, highlighting how Jalkund has increased income and employment opportunities by enabling farmers to cultivate high-value crops during the dry season to support poultry, piggery, and fisheries activities. The second paper by Choudhary *et al.* evaluates the impact of the "Aadarsh Chara Gaon" program on dairy farmers, revealing that the program improved livelihood security in areas like habitat, economic stability, and food security. However, its effects on health, education, and social security were less significant in the short term.

While several papers identified inefficiencies in using resources such as fodder, labour, and concentrates, there was insufficient analysis of the financial, logistical, and behavioural barriers preventing farmers from adopting more efficient practices. This gap points to a need for deeper insights into farmer perceptions, credit access, and extension services' role in promoting efficient resource use. Another gap in evidence concerns the long-term impact of diversified income sources on livelihood security. While several papers demonstrated the role of livestock income in improving livelihoods and reducing poverty, there is a lack of longitudinal studies that track the long-term effects of diversified income sources, including sustainability. The impact of high initial capital costs on adopting dairy-based integrated systems is underexplored. While high upfront costs were identified as a major barrier to adoption, there is insufficient analysis of the specific financial constraints faced by smallholders and how these can be overcome through better access to credit, subsidies, or support from financial institutions. Feed and fodder were identified as the largest cost components in dairy farming. Still, there was limited evidence of innovative feed management practices that could reduce costs and improve efficiency with a region-specific focus, such as using non-conventional feed resources, crop residues, or improved fodder varieties, which could help reduce costs and improve productivity. Moreover, technological gaps in livestock rearing remain a significant challenge. Papers highlighted technical inefficiencies, but there was little evidence of the specific technologies—such as mechanized milking, advanced breeding techniques, or digital tools—that could help close the efficiency gap. Disease-induced losses and veterinary services remain unexplored. Inadequate disease control and poor veterinary outreach were major challenges affecting the profitability of goat and dairy farming. Still, there is limited evidence on the economic burden of diseases, the effectiveness of disease control and the behaviour of farmers seeking animal healthcare. More research is required on how better veterinary services and livestock insurance schemes could mitigate risks for smallholders, mainly when diseases are prevalent and veterinary access is limited. There is also a need to adequately explore the challenges of scaling up innovative technologies beyond their local contexts, especially regarding financial feasibility and infrastructure requirements.

IV

SUSTAINABILITY IN LIVESTOCK PRODUCTION

This sub-theme was explored in six papers, addressing fodder deficits, methane emissions, water use, and the ecological impacts of changing agricultural practices. Wani *et al.*, in a study carried out in Jammu, Kashmir, and Ladakh, identified severe fodder deficits, especially in Ladakh (73 per cent), followed by Kashmir (40.6 per cent) and Jammu (18.6 per cent). The study also highlighted that livestock populations exceed these regions' carrying capacity of available fodder. Another paper by Borisagar *et al.* reported that while overall sustainability has improved in India, particularly in economic and social sustainability, there is declining ecological sustainability, especially in the northeastern and hilly regions. Suresh *et al.* highlighted the detrimental effects of industrial effluents on water quality in Tamil Nadu, which led to decreased livestock productivity and higher veterinary costs, particularly among marginal farmers. The study stressed the disproportionate impact on smaller farming households. Perumal *et al.* employed advanced machine learning techniques to predict future methane emissions from livestock. The study projected a continued rise in emissions, mainly from cattle and buffaloes, unless proactive measures such as improved feed efficiency and manure management are adopted. Rathore explored the decline in common lands and its effects on livestock rearing, particularly for smallholder farmers and landless households relying on these grazing resources. The study noted that the shift towards commercial livestock production and changes in land use patterns have disproportionately affected these vulnerable groups, further marginalizing them.

Although the papers have addressed crucial areas for research under this sub-theme, there is insufficient empirical data on the cost-effectiveness of mitigation strategies proposed to address fodder deficits and methane emissions. While innovative solutions such as hydroponics, improved feed efficiency, and manure management are recommended, the studies lack detailed analysis of their economic viability at the farm level. Moreover, there is a limited exploration of the long-term impact of declining common lands on smallholder livelihoods, particularly in terms of how these changes influence food security and income generation. More comprehensive research is needed into the effectiveness of regulatory frameworks and enforcement mechanisms designed to mitigate adverse impacts of industrial effluents. Additionally, the water footprint analysis presented for dairy farms in Punjab would benefit from more data on the long-term sustainability of water usage across different regions, particularly in drought-prone areas. Another notable gap in the sustainability papers is the limited exploration of indigenous knowledge systems in managing livestock sustainably, particularly in regions vulnerable to climate change. Addressing this gap could provide valuable insights into how traditional practices can be integrated into modern sustainability interventions.

V

GENDER PERSPECTIVE

Women constitute a significant share of the total workforce engaged in livestock production. However, only one paper by Gauraha *et al.* addressed this issue by focusing on the business performance of women Self-Help Groups (SHGs) involved in allied sectors in Chhattisgarh. The authors reported that SHGs focusing on poultry, goat rearing, and dairy farming significantly contributed to women's empowerment and income generation. However, challenges such as high raw material costs, delayed credit, and limited market access persist, limiting the scalability of these initiatives. However, further research needs to be given on how SHG models can be integrated into mainstream livestock value chains, which is crucial for promoting gender equity in the livestock sector.

VI

MARKETING AND TRADE OF LIVESTOCK PRODUCTS

This theme was explored in ten papers, focusing on market access and the efficiency of marketing channels. RC Mondal revealed from West Bengal that the goat marketing system is mainly unorganised, leading to exploitation by intermediaries. This was echoed by Udhayanithi *et al.* in their study of the pork meat market in Karur District of Tamil Nadu, when they found that marketing channels with fewer intermediaries were more efficient, providing a higher share of the final price to producers. However, despite these findings, the papers did not offer concrete solutions on how informal markets can be better integrated into formal value chains, a significant gap that needs to be addressed to improve smallholder livelihoods. Several papers, including Mondal *et al.*, examined the role of cooperatives in livestock marketing, finding that while they provide market access, they do not always offer the best prices. Another paper on challenges faced by cooperatives by Mohapatra and Sendhil identified distance from milk collection centres as an impeding factor. However, a notable gap is the lack of discussion on how cooperatives can be restructured to improve competitiveness and inclusivity, particularly for marginalized farmers. Vandana Sehgal *et al.*, in their study, carried out in Uttar Pradesh, examined the economic viability and market dynamics of dairy farming and revealed that while dairy farming is profitable for marginal and small farmers when considering only paid-out expenses, the inclusion of imputed costs reduces profitability, particularly for larger farms. The milk marketing landscape is diverse, with a mix of formal (cooperatives and private processors) and informal channels. Prices received for milk vary across different marketing channels and farm sizes, with private processors generally offering better prices than cooperatives. The study by Reddy *et al.*, in their research carried out in Andhra Pradesh, reveals that the majority of the surplus milk is channelled through

the unorganized sector, with the 'Producer - Milk Vendor – Consumer' channel being the most efficient. However, the study also highlights that organized channels play a crucial role in employment generation, procurement capacity, and processing facilities despite having lower marketing efficiency. Udit Chaudhary and R. Malhotra investigate the drivers and impacts of dairy farmer collectives in four regions of Saurashtra, Gujarat, and reveals that although membership in dairy collectives leads to significant cost reductions, particularly in labour and feed costs and higher net returns for local cow milk production; no significant impact on milk yield is observed. The study suggests that cooperative and producer company models should be encouraged and promoted to foster healthy competition and benefit member farmers. Only one paper addressed the issue of consumer preferences for dairy products (Mondal *et al.*). The study reveals that while most consumers purchase processed milk due to its wider availability, there's a latent preference for raw milk if accessibility improves. Consumers are willing to pay a premium for indigenous cow milk despite its limited availability, highlighting a potential market niche. The authors also find that raw milk is favoured for its taste, purity, and nutritional value, while processed milk is considered safer and more readily available.

Two papers are received on trade and its implications for livestock. Kalpana and Shivakumar investigate the relationship between bovine meat production, trade, and greenhouse gas (GHG) emissions. A strong positive relationship between bovine meat production and GHG emissions is revealed, but the authors highlight that the impact of exports on emissions is less clear. Arora *et al.* analyse India's dairy export competitiveness. India's share in global dairy exports remains small, with distance being a major barrier to trade. GDP and tariffs have varying impacts on different dairy products. The paper suggests that India can expand its dairy exports by addressing trade barriers and improving product quality.

The papers provide critical insights into marketing livestock products across the dairy, goat, and pig sectors. There are, however, needs to address some areas that require further exploration. There is a need to comprehensively analyse how to transition unorganized marketing systems, particularly in goat and pig markets, into more formalized and regulated systems to protect smallholder producers. Additionally, while dairy cooperatives play a significant role in milk marketing, they must focus on policy implications for their restructuring to offer better prices while maintaining market access. There is also limited exploration of the economic impact of reducing intermediaries in marketing chains, particularly for pork and dairy, and how such reductions might influence producer profits and market efficiency. There is a market niche for raw and indigenous cow milk, but further research is needed to understand how this demand can be met while ensuring food safety and quality standards. Regarding papers on trade, more focus needs to be given to how bovine meat exports impact GHG emissions (i.e. understanding the true environmental costs of meat trade). The long-term sustainability of India's dairy export growth also can be further explored, particularly in the context of global competition and changing trade regulations.

VII

POULTRY SECTOR

The four papers on the poultry sector examine key aspects such as profit efficiency, value chain dynamics, livelihood contributions, and technical efficiency. Lalrinsangpuii *et al.*, in their study, carried out in Mizoram on broiler farms, revealed significant profit inefficiencies, with feed costs negatively impacting profits and education positively influencing profit efficiency. The analysis highlights the potential for improved efficiency through better resource management. Chahal and Kaur, in their study of broiler value chain analysis in Punjab, found that non-contract farming systems generally provide a higher producer share. In contrast, contract systems are more efficient when intermediaries like wholesalers are involved. Optimizing value chains is crucial to enhance profitability. One paper on poultry farming in Tamil Nadu identified poultry as a marginally profitable supplementary income source for small and marginal farmers, with high feed and veterinary costs limiting returns. Finally, the paper by Gokulpriya *et al.* on economic analysis of layer farming in Namakkal, Tamil Nadu, demonstrated economies of scale in larger farms, with feed costs constituting the largest expense. Although layer farming is profitable, especially on larger farms, technical inefficiencies and high feed costs remain significant challenges.

The review of the papers revealed a limited understanding of the financial, logistical, and behavioural barriers that prevent smallholder farmers from optimizing resource allocation and increasing profit efficiency, particularly in broiler farming. There is insufficient evidence of alternative, cost-effective feed strategies that can reduce input costs without compromising production. Little evidence of the long-term sustainability of contract and non-contract broiler farming systems in changing market environments is highlighted. While disease outbreaks are noted as significant constraints, there is a limited exploration of the effectiveness of veterinary services and preventive measures in reducing mortality rates and economic losses.

VII

FISHERIES

The Fisheries sub-theme, which received 13 papers, covered various aspects of production efficiency, sustainability, and livelihood security. Qureshi *et al.* have examined the tension between by-catch in trawl fishing and the livelihoods of artisanal fishers in Tamil Nadu, finding that fishers in urban areas were more willing to reduce by-catch compared to those in remote areas, where alternative livelihoods are scarce. This calls for more nuanced policies that address the socio-economic realities of fishers in different contexts. Kuriachen *et al.* explored the factors influencing lease rents for village ponds in Central Gujarat, finding that pond size, water quality, and distance

from the village played significant roles. The gap here lies in understanding how to improve transparency in the auction process and ensure that smallholders can participate in leasing arrangements. Jahidul Haque *et al.* demonstrated from Assam that fish farming significantly outperforms traditional crop farming in terms of profitability, though it requires higher initial investments. The paper by Sridevi *et al.*, in a study in a village in Telangana, highlights the underutilization of fish as a nutrient source in rural diets despite its affordability and essential nutrients. The study also highlights challenges such as poor access to fresh fish and underdeveloped market infrastructure limiting this potential. Another key area of focus is sustainability and livelihoods, as demonstrated in the paper by Saha *et al.* from the Gulf of Mannar. The authors stress the importance of ecosystem services and gender equity in fisheries management. The study shows that while fishing communities depend heavily on natural resources, gender disparities in access and decision-making remain prevalent. Ket *et al.* performed a meta-analysis on the livelihood sustainability of fishermen in mangrove ecosystems in India and quantified the significant economic value of mangrove-dependent fisheries, underscoring the importance of mangrove conservation in supporting local livelihoods and achieving sustainability goals. Market dynamics were explored by Nandy *et al.*, who studied the dynamics of commercially important fish species and revealed significant price fluctuations and species-specific trends in the Chilika Lagoon fish markets, influenced by seasonal factors and fishing practices. This study indicates the need for policies that stabilize prices and manage fish stocks sustainably. Further, Selvi & Raj identify seaweed farming as a profitable alternative livelihood in Tamil Nadu, especially for women. However, challenges like seed material quality, pollution, and labour shortages during harvesting should be noted. Efficiency and profitability are key themes in several papers. Sundariya *et al.* find freshwater fish farming profitable in Puducherry, with significant scope for improvement in resource use efficiency. Similarly, Chandrasekar *et al.* assess the technical efficiency of fishing vessels in Goa, concluding that better resource management could lead to higher profitability. Avinash *et al.* map the value chain of the fishing industry in the Karaikal district in Puducherry, highlighting the profitability of marine fishing but pointing out inefficiencies in the value chain, especially in the domestic market, where local traders earn more through convenient marketing. Lastly, the paper by Dutta *et al.* assessed Assam's fish seed production gap and its implications on food security. It revealed the increasing gap between the state's fish seed demand and supply. It calls for investments in hatchery development, infrastructure, and extension services to boost production and support sustainable aquaculture.

The papers presented under this theme provide valuable insights into the role of fisheries in sustaining rural livelihoods. Despite the valuable insights provided by these papers, several areas require further research. Many papers highlight the profitability of various fisheries practices but lack sufficient data on their environmental sustainability. For example, there is limited exploration of the long-term ecological consequences of shrimp farming and by-catch in trawl fishing. Additionally, the

scalability of new technologies like seaweed farming and sustainable aquaculture practices has not been fully explored, particularly regarding infrastructure, market demand, and policy support. More focus is needed to address the social equity of resource access, particularly the roles of women and marginalized communities in fisheries management. While many papers suggest policy recommendations, there is little empirical evidence on the effectiveness of existing regulations and how they can be improved to support economic growth and environmental sustainability. Another critical area is to assess how to improve access to markets and infrastructure for small-scale fishers, particularly in rural areas, to enhance the availability of affordable fish and promote nutrition security. Focus is also required on addressing the efficiency of fishing vessels, the optimization of resource use, and the need for technological and financial support to improve efficiency in fish farming.

IX

RESEARCH AND POLICY ISSUES FOR DISCUSSION

Based on the review of the papers under the various sub-themes in the report, the research and policy issues for discussion are synthesized below:

1. How can the livestock, poultry, and fisheries sectors enhance their sustainability and resilience in the face of regional disparities? There is a need for strategies to promote diversification in these sectors and address regional imbalances in livestock production and participation.

2. What role can indigenous breeds and traditional knowledge play in the long-term sustainability of the livestock sector? There is a need to emphasise preserving indigenous breeds and integrating indigenous knowledge to sustain livestock diversity.

3. How can government policies be better analyzed to assess their long-term impact on shifts in livestock populations? There is a gap in evaluating how policy interventions have shaped livestock populations and production trends; thus, more research is needed.

4. What are the key drivers of livestock productivity, and how can factors such as breeds, feed & fodder, and animal healthcare services be optimized for growth? Understanding the contributions of these factors and their potential to enhance productivity remains underexplored. There is a need to focus on the role of technological advancements and total factor productivity analysis to capture productivity growth beyond simple input increases.

5. What strategies can enhance livestock production in regions experiencing population declines in specific species? Addressing the challenge of declining populations in certain livestock species and enhancing self-employment opportunities across states.

6. How can innovative, sustainable farming systems (like Integrated Farming Systems) be scaled up for wider adoption? Barriers such as high initial costs, access to credit, and market infrastructure need to be addressed for scaling such systems.

7. How can unorganized livestock markets, especially in goat and pig farming sectors, be better integrated into formal value chains? Discussion is needed on transitioning unorganized marketing systems into more structured and formalized channels for improved efficiency and farmer benefits.

8. What policy interventions are needed to restructure dairy cooperatives and collectives to offer better prices while maintaining market access? Focus on enhancing the competitiveness of dairy cooperatives and improving market efficiency for smallholders.

9. How can the environmental and economic sustainability of shrimp farming and trawl fishing practices be ensured? Addressing the long-term ecological consequences is needed for high-profit fisheries practices like shrimp farming and by-catch management in trawl fishing.

10. What role can gender equity play in livestock and fisheries value chains, and how can women's participation be strengthened?

11. What strategies can be adopted to enhance veterinary outreach and disease control in livestock farming? Research on improving veterinary services and the economics of disease and disease control would be critical for mitigating economic losses in livestock farming.

12. The rearing of migratory sheep and goats and the livelihoods of shepherds are crucial topics that warrant deeper discussion. Although only a few papers have focused on the issue of common property resources (CPRs), such as the rapid depletion of grazing lands and forest areas, this remains a pressing concern despite government regulations. It is essential to explore the impact of the diminishing CPRs on livestock species, particularly small ruminants, which hold significant livelihood importance for resource-poor migratory farmers.

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