Financial Strategies for Management of Farm and Dairy Business

Zoya Jafar[1], Sidra Abbas[1], Sikandar Hayat[2], Ghazanfer Ali[3], Tashifa Naheed[1], Sidra[2] and Sabeeha Sarfaraz[4]

[1]Department of Zoology, University of Jhang, Jhang, Pakistan
[2]Department of Zoology, Institute of Molecular Biology and Biotechnology, The University of Lahore, Lahore, Pakistan
[3]Faculty of Science, Institute of Biological Sciences, Universiti Malaya, 50603 Kuala Lumpur, Malaysia
[4]Department of Zoology, Lahore College for Women University, Lahore, Pakistan
*Corresponding author: zoyajafar21@gmail.com

Abstract

For the economies of nations, rural incomes and food security in emerging nations like as Pakistan, dairy farming is a major sector. It is, however, hampered by severe financial restrictions resulting from poor farm management techniques, low milk yields and increasing environmental hazards powered by climate change. Integrated financial solutions offered in this chapter help dairy farm companies become more financially sustainable. Key difficulties acknowledged include milk price unpredictability, increasing input costs, disease epidemics, climatic shocks, regulatory compliance, market volatility, labor shortages and high debt levels. This chapter proposes strategic solutions in the form of risk management, debt management, cost reduction, source diversification and prudent financial planning in reaction to these problems. Important factors are the adoption of climate-resistant methods, improved farm output and application of contemporary management techniques. The chapter also discusses the need of financial literacy, group action, succession planning and policy advocacy for change. Through the application of these solutions, dairy farms can enhance their profitability and long-term sustainability. The financial intricacies of the dairy sector can be managed by stakeholders through the assistance of this chapter's useful and well-researched guide.

Keywords: Dairy farming, Financial management, Cost control, Climate resilience, Risk mitigation, Farm sustainability

Cite this Article as: Jafar Z, Abbas S, Hayat S, Ali G, Naheed T, Sidra and Sarfaraz S, 2025. Financial strategies for management of farm and dairy business. In: Farooqi SH, Kholik K and Zaman MA (eds), One Health Horizons: Integrating Biodiversity, Biosecurity, and Sustainable Practices. Unique Scientific Publishers, Faisalabad, Pakistan, pp: 342-348. https://doi.org/10.47278/book.HH/2025.478

A Publication of Unique Scientific Publishers

Chapter No: 25-045

Received: 30-Jan-2025
Revised: 15-Apr-2025
Accepted: 21-May-2025

Introduction

A dairy farm is a specialized farm business committed to the long-term milk production from domestic animals, primarily cows but also buffalo, goats and sheep and sometimes other species (Lakhani et al., 2023). Among the many essential nutrients found in dairy products are high-quality protein, calcium, vitamin D, phosphorus, potassium and several B vitamins including riboflavin and B12. At all stages of life, these vitamins are absolutely vital for general well-being, nerve function, muscular growth and bone health (Sultana et al., 2020).

Numerous nations with distinct production methods and consumer markets make up the global dairy industry. The average number of cows per farm worldwide is between one and two, but the average herd size and consequent labor force rise as a farm's business model shifts from sustenance to market production (Żbik et al., 2024). Milk is produced every day of the year, making dairy production a special kind of agricultural product. Farm sizes are growing globally as a result of new technologies like the milking parlor. The United States has the largest farms, but when compared to other countries, the European Union produces the most milk (Antoshchenkova & Kravchenko, 2022).

A major part of Pakistan's economy, dairy farming helps to national Gross Domestic Product (GDP), job creation and family food security. The livestock industry by itself makes up a significant 14.36% of GDP, highlighting its importance especially in rural areas (Khan, 2021). The industry struggles continuously, though, in spite of its significance and limits on its full potential. Prime areas of worry are low milk yields, poor farm management and growing environmental vulnerability resulting from climate change (Hussain et al., 2020). Low milk yield, poor farm management and rising environmental vulnerability due to climate change all impact each other to create a significant negative effect on the bottom line of a dairy farm. Financial management practices for dairy and farm operations will be discussed in this chapter.

1. Poor Farm Management and Low Milk Production

Based on Hussain et al. (2022), these tend to be interconnected issues in dairy farming brought about by an elaborate interplay of variables. Improper nutritional management, through low calorie consumption, imbalanced meals that are lacking major nutrients and low-quality forages, adversely affects a cow's capacity to produce milk (Sattar, 2020). Genetic constraints brought about by breed choice and inefficient breeding practices also limit the natural production capacity of the herd. Some of the animal health issues that drain energy from milk production and may result in serious production losses are mastitis, metabolic disease and lameness (Shahzad, 2022). Also, improper management practices create stressful conditions that are adverse to the health and productive ability of the animals. Heat stress, incorrect milking process, poor housing, lack of comfort and poor transition cow management are some of these practices (Warriach et al., 2024). By not addressing the root causes of low output, bad farm management through inexperience, reluctance towards new technology, lack of planning

and ineffective resource allocation increase these problems (Džermeikaitė et al., 2023). If the farmer is not keeping records and analyzing them, farmers cannot make decisions, such as in relation to nutrition, breeding and health. Finally, a downward spiral of deteriorating output and profitability due to inability to employ best practices and maximize the use of resources impedes the viability of the dairy farming industry (Snider et al., 2022).

2. Climate Change's Increased Environmental Sensitivity

This has threatened the financial viability of dairy farming in several ways. Higher temperatures and frequency of heat waves subject dairy cattle to direct stress, leading to a decline in the amount and quality of milk production, eventually impacting profitability (Abbas et al., 2022). Precipitation pattern changes that is, the frequency of floods and droughts adversely influence the quantity and quality of pasturage and feed grains, therefore compelling farmers to use more expensive substitutes and increasing input costs (Papakonstantinou et al., 2024). Additionally, weather extremes have the potential to damage agricultural infrastructure including dairy parlors and barns, hence necessitating expensive repairs or replacement (Creutzinger et al., 2021). Higher frequency of diseases and parasites, made possible by changes in climatic conditions, results in extra veterinary cost and possible loss of cattle (Ramos de Robles et al., 2025). Additionally, high capital investment is needed for the installation of adaptive solutions including efficient water management facilities, improved cooling equipment, and feed management changes. This adds additional pressures on farm finances and enhances the risk and uncertainty of dairy farming in general (Kelly et al., 2020).

3. Significant Financial Crises in the Dairy Industry

Dairy farming is susceptible to several recessions due to the inherent volatility of agricultural markets and peculiar difficulties encountered by the industry. Among the most important options are:

i. A Steep Drop in Milk Prices

An excessive supply in the market (regionally or worldwide), decreased consumer demand as a result of dietary changes or recessions and trade conflicts can all cause this. Farmers experience large losses when milk prices drop below their cost of production (Wolf & Karszes, 2023).

ii. Significant Rise in Input Expenses

Profit margins can be severely eroded by unforeseen increases in the cost of vital inputs such as fertilizers, energy (fuel, electricity), veterinary supplies, feed (because to drought, political instability, or increasing global demand for grains) and fertilizers (Shamsuddoha et al., 2023).

iii. Losses of Livestock and Disease Outbreaks

Severe loss of animals due to major epidemics of diseases might affect milk supply, need large unanticipated veterinarian bills and perhaps result in culling expenditures (Vinitchaikul et al., 2023).

iv. Extreme Weather Conditions

Droughts (which lower forage availability and raise feed costs), floods (which damage infrastructure and affect animal health) and heatwaves (which lower milk yields and increase animal stress) are all becoming more frequent and intense due to climate change, which puts a financial strain on society (Henchion et al., 2022).

v. Regulatory Burdens and Compliance Expenses Increased

Operating expenses might result from new or more stringent environmental rules (such as emissions standards or waste management) or animal welfare requirements that call for large expenditures in techniques and infrastructure (El Benni et al., 2022).

vi. High Debt Burden and Rising Interest Rates

Rising interest rates may have a particularly negative impact on farms with heavy debt loads, as they can reduce cash flow and increase the cost of loan repayments. Poor investment choices or too much leverage can increase this risk (Gołaś, 2020).

vii. Challenges with Entering the Market

If businesses are denied access to significant markets when supply chains are disrupted, trade barriers are erected, or there is a lack of innovation, they can face significant losses in revenue (Verburg et al., 2022). Although trade barriers increase the cost or difficulty of exporting goods, natural disasters or unforeseen geopolitical events can disrupt supply chains (Wakjira & Kant, 2022). Companies need to innovate and adapt to changing consumer tastes to safeguard revenue streams. Companies have to build strong supply chains and deal with trade barriers on a permanent basis (Chmelíková et al., 2021).

viii. Shortage of Workers and Increasing Labor Costs

Increased labor demands and operational inefficiencies due to a lack of skilled personnel could have an impact on profitability (Arvidsson Segerkvist et al., 2020; Rose et al., 2025).

ix. Problems Concerning Farm Transfer Fees and Succession

The monetary impacts of handing over the farm to the future generation, including inheritance tax and possible reshaping expenses, can lead to financial troubles for the retiring generation or inheritors (Firman et al., 2023).

4. Strategies for Managing Financial Crises in Dairy Farming

In order to regulate and contain financial crises, early and effective efforts are significant (Figure 1).

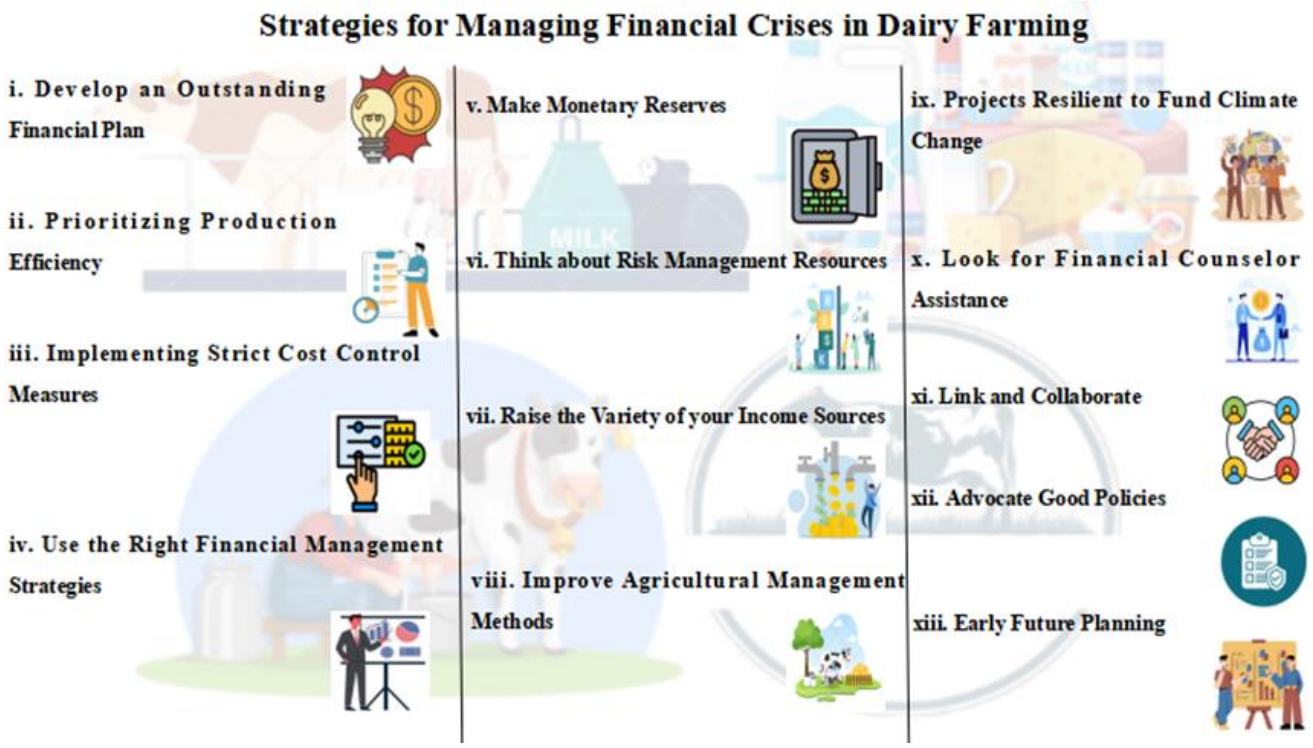

Figure 1: Strategies for Managing Financial Crises in Dairy Farming

i. Develop an Outstanding Financial Plan

A sound financial plan is paramount to long-term profitability and viability of a dairy operation. Begin by meticulously preparing a budget that accounts for all anticipated income and outgoings, such as labor, feed, veterinary care, equipment maintenance, and loan repayments (Azooz et al., 2020). Employ short-term and long-term cash flow projections to track cash supply and seasonal shifts in income and outgoings (Sarkar & Datta, 2020). Employ scenario planning to determine the effects of possible setbacks such as declining market prices, rising input prices, or disease outbreaks (Khanna et al., 2022). This minimizes risks in the initial stages. Compare actual outcomes with projections and alter the plan accordingly to remain within budget confines. Employ accounting software and expert consultation to maximize decision-making and precision (Kühl et al., 2020). Tracking key financial indicators like break-even points and profit margins can inform operational changes. A nimble financial plan enhances overall farm resilience and maximizes resource utilization (Cockburn, 2020).

ii. Prioritizing Production Efficiency

The productive milk production principles are typified by lower input costs and higher yield per cow (Huerta-Soto et al., 2025). This is accomplished by supplying cows with nutrition specific to every stage of lactation, so that they get enough energy, protein and minerals (Medeiros et al., 2022). Good health management practices, such as frequent veterinary visits, vaccination and disease control, are important to enhance productivity while minimizing losses caused by disease. Selective breeding, as indicated by Nazar et al. (2025), improves genetic qualities and cows become healthier, with more milk production. Monitoring performance indicators such as milk production, feed conversion ratio and somatic cell counts; training staff to treat animals consistently; and monitoring early warning signs of health or production issues (Faverdin et al., 2022) is important. Maximizing farm operations is also important in the attempt to reduce waste and maximize productivity. Emphasizing these areas enhances sustainability, increases profitability and reduces the cost per unit of milk produced (Gross, 2022).

iii. Implementing Strict Cost Control Measures

Successful cost management is necessary to ensure dairy firms' financial sustainability. This requires perpetual monitoring and optimization of every input cost to keep abreast of competition and enhance working efficiency (Koutouzidou et al., 2022). Through practices such as forward contracting, bulk buying and diet-formulation concentrating on nutrients, the cost of feed frequently the most significant cost must be managed ahead of time to control volatility and wastage (Farooq et al., 2022). Energy use can be reduced by making energy-efficient equipment investments and implementing policies that reduce utility usage without sacrificing output. Labor efficiency must be increased through employee training programs, efficient processes and equitable job allocation (Monteiro et al., 2021). With regular audits and industry benchmarking, cost-benefit analyses maximize investment return, ensure smart decision-making for significant purchases and identify inefficiencies (Awasthi et al., 2022). All things being equal, a systematic cost-cutting approach promotes long-term viability and bigger margins (Akhigbe et al., 2021).

iv. Use the Right Financial Management Strategies

For agricultural enterprises to achieve operational and financial sustainability, effective debt management is essential (Gehlot et al., 2022). Sound debt management includes components like acquiring loans that may be repaid by the farm, negotiating loans, keeping a healthy debt-to-asset ratio and matching debt levels with projected cash flows (Mishra & Sharma, 2023). Long-term financial planning ensures company continuity by means of debt repayment plans and risk management techniques; financial tools improve debt management (Folajinmi et al., 2020).

v. Make Monetary Reserves

Long-run financial sustainability and farm risk management depend on financial buffers (Stoliarchuk et al., 2021). Dairy companies can find as a safety net in case of hardship as milk price drops, bad weather, disease outbreaks, or equipment failures (Gurjar et al., 2023). Optimizing buffer levels based on farm size, varied cash flows and past risk exposure improves credit worthiness, financial stability and decisionmaking during unpredictable times (Mngumi et al., 2022).

vi. Think about Risk Management Resources

Among the formal risk management tools that help stabilize agricultural income and reduce market volatility are hedging agreements, forward contracts and milk price insurance (Jubaedah et al., 2024). The technologies let dairy farmers precisely hedge their income and protect themselves from the price volatility of the commodity market. Risk coverage for production is offered by feed crop insurance (Wang et al., 2025). Empirically shown is the notion that using risk management solutions enhances operational and financial robustness (Khan et al., 2023).

vii. Raise the Variety of your Income Sources.

A deliberate strategy to boost financial resilience and reduce reliance on volatile milk prices, income diversification aims to do both (Lokier et al., 2021). Value-added processing, such making cheese or yogurt, lets dairy farmers increase the market worth of their products and diversify their offerings (Harishankar et al., 2022). Agritourism, direct marketing and the sale of additional feed or manure all provide new sources of income and promote community involvement (Alvarez et al., 2021).

viii. Improve Agricultural Management Methods

Effective farm management methods should be implemented in areas including resource use, animal health and nutrition in order to improve operational efficiency. Evidence-based treatments on herd health and feed optimization help to lower disease incidence and production costs (Simitzis et al., 2021). Animal care, production and farm profitability would all improve with these combined techniques (Cabrera & Fadul-Pacheco, 2021).

ix. Projects Resilient to Fund Climate Change

Dairy farming must embrace climate-resilient methods (Singh, 2023) in order to offset the damaging consequences of climate fluctuation and foster long-term sustainability. To protect soil health and productivity, it's imperative to use sustainable land management techniques, lower heat stress in cattle and conserve water (Pankaj et al., 2024; Reddy et al., 2024). These actions increase environmental stewardship and adaptive capacity (Samuel et al., 2021). Opportunities for financing of climatesmart agriculture could lighten the change and lower expenses for farmers (Bonilla-Cedrez et al., 2023).

x. Look for Financial Counselor Assistance.

Finding guidance from qualified agricultural finance experts and accountants (Kassahun et al., 2022) is required for the development of a complete and adaptable financial strategy. Experts can provide advice on budgeting, tax planning, investment analysis and regulatory framework negotiation all of which are growing more complex in modern agricultural context (Baker & Bush, 2025). With the aid of specialized financial planning (Mills et al., 2021), producers can effectively control risk, maximize long-term profitability and make intelligent decisions. Their work is extremely helpful when there are financial uncertainties or significant changes taking place in agriculture (Moojen et al., 2024).

xi. Link and Collaborate

For information sharing, negotiating power and access to resources to be increased, farmer cooperatives, sector associations and peer networks have to carefully cooperate (Hayden et al., 2021). These networks help with learning from one another, best practice sharing, and improved market intelligence. Combining their resources helps farmers (Onyiriuba et al., 2020) get unique services, bargain for better terms in input and product markets and lower input costs. Development of social capital and cooperation promotes a strong sense of teamwork, therefore significantly enhancing the resilience and competitiveness of the agricultural sector.

xii. Advocate Good Policies

Together with lawmakers and farmer organizations, legislation tackling the structural and financial difficulties dairy farmers encounter must be created (Arends-Kuenning et al., 2021). Advocacy can affect the creation of risk management plans, specialized subsidies and fair pricing contracts (Molossi et al., 2023) in order to raise farm profitability. Even while institutional intervention is vital for industry resiliency and the protection of rural livelihoods during crises (Vaintrub et al., 2021), contributions to policy platforms guarantee farmers have a voice in decisionmaking.

xiii. Early Future Planning

Early succession planning is vital for farms' long-term viability and economic resilience, according to Susanty et al. (2021). Starting the transition process early ensures that decisions about ownership transfer, management succession and asset allocation are made in a methodical

manner (Torres et al., 2022). By enabling successors to advance their skills, it also preserves institutional memory and operational acumen (Gunn et al., 2022). Only lately has the study recognized the value of succession planning for the long-term survival of family farms (Brook et al., 2022; Quesada-Román et al., 2023).

Conclusion

Dairy farming in emerging economies such as Pakistan is still a pillar of rural incomes and national food security, but it is radically constrained by financial instability, poor productivity and climate-related risks. This chapter has underlined the interconnected challenges varying from unstable milk prices and increasing input prices to animal disease outbreaks and environmental shocks that erode the sector's viability. These problems require an integrated financial response with strategic planning, effective resource utilization, climate-resilient agriculture and multiple sources of income. Improving financial literacy, building collective action and policy advocacy are also essential to structural change. With evidence-based farm and financial management practices, backed by technical consultation and institutional support, dairy businesses can enhance profitability, resilience and long-term viability. As such, this framework provides a complete guide to managing the industry's financial intricacies and promoting climate-resilient dairy development in vulnerability-prone areas.

References

Abbas, Q., Han, J., Bakhsh, K., Ullah, R., Kousar, R., Adeel, A., and Akhtar, A. (2022). Adaptation to climate change risks among dairy farmers in Punjab, Pakistan. *Land Use Policy*, *119*, 106184. https://doi.org/10.1016/j.landusepol.2022.106184

Akhigbe, B. I., Munir, K., Akinade, O., Akanbi, L., and Oyedele, L. O. (2021). IoT technologies for livestock management: a review of present status, opportunities, and future trends. *Big Data And Cognitive Computing*, *5*(1), 10.

Alvarez, A., García-Cornejo, B., Pérez-Méndez, J. A., and Roibás, D. (2021). Value-creating strategies in dairy farm entrepreneurship: A case study in northern Spain. *Animals*, *11*(5), 1396.

Antoshchenkova, V., and Kravchenko, Y. (2022). Current trends in milk production and consumption in the world in the conditions of globalization. *Ekonomichnyy Analiz*, *32*(2), 7-14.

Arends-Kuenning, M., Kamei, A., Garcias, M., Romani, G. E., and Shikida, P. F. A. (2021). Gender, education, and farm succession in Western Paraná State, Brazil. *Land Use Policy*, 107, 105453. https://doi.org/10.1016/j.landusepol.2021.105453

Arvidsson Segerkvist, K., Hansson, H., Sonesson, U., and Gunnarsson, S. (2020). Research on environmental, economic, and social sustainability in dairy farming: A systematic mapping of current literature. *Sustainability*, *12*(14), 5502.

Awasthi, S. K., Kumar, M., Sarsaiya, S., Ahluwalia, V., Chen, H., Kaur, G., and Awasthi, M. K. (2022). Multi-criteria research lines on livestock manure biorefinery development towards a circular economy: From the perspective of a life cycle assessment and business models strategies. *Journal of Cleaner Production*, *341*, 130862. https://doi.org/10.1016/j.jclepro.2022.130862

Azooz, M. F., El-Wakeel, S. A., and Yousef, H. M. (2020). Financial and economic analyses of the impact of cattle mastitis on the profitability of Egyptian dairy farms. *Veterinary World*, *13*(9), 1750.

Baker, C. N., and Bush, S. A. (2025). Stress and Succession: Farmer Stress and Support Needs of Agricultural Advisors during Transition Planning. *Journal of Agromedicine*, 1-10. https://doi.org/10.1080/1059924X.2025.2467964

Bonilla-Cedrez, C., Steward, P., Rosenstock, T. S., Thornton, P., Arango, J., Kropff, M., and Ramirez-Villegas, J. (2023). Priority areas for investment in more sustainable and climate-resilient livestock systems. *Nature Sustainability*, *6*(10), 1279-1286.

Brook, R., Forster, E., Styles, D., Mazzetto, A. M., Arndt, C., Esquivel, M. J., and Chadwick, D. (2022). Silvopastoral systems for offsetting livestock emissions in the tropics: a case study of a dairy farm in Costa Rica. *Agronomy for Sustainable Development*, *42*(5), 101.

Cabrera, V. E., and Fadul-Pacheco, L. (2021). Future of dairy farming from the Dairy Brain perspective: Data integration, analytics, and applications. *International Dairy Journal*, *121*, 105069. https://doi.org/10.1016/j.idairyj.2021.105069

Chmelíková, L., Schmid, H., Anke, S., and Hülsbergen, K. J. (2021). Nitrogen-use efficiency of organic and conventional arable and dairy farming systems in Germany. *Nutrient Cycling in Agroecosystems*, *119*, 337-354. https://doi.org/10.1007/s10705-021-10126-9

Cockburn, M. (2020). Application and prospective discussion of machine learning for the management of dairy farms. *Animals*, *10*(9), 1690.

Creutzinger, K., Pempek, J., Habing, G., Proudfoot, K., Locke, S., Wilson, D., and Renaud, D. (2021). Perspectives on the management of surplus dairy calves in the United States and Canada. *Frontiers in Veterinary Science*, *8*, 661453. https://doi.org/10.3389/fvets.2021.661453

Džermeikaitė, K., Bačėninaitė, D., and Antanaitis, R. (2023). Innovations in cattle farming: application of innovative technologies and sensors in the diagnosis of diseases. *Animals*, *13*(5), 780.

El Benni, N., Ritzel, C., Heitkämper, K., Umstätter, C., Zorn, A., and Mack, G. (2022). The cost of farmers' administrative burdens due to cross-compliance obligations. *Journal of Environmental Planning and Management*, *65*(5), 930-952.

Farooq, M. S., Sohail, O. O., Abid, A., and Rasheed, S. (2022). A survey on the role of iot in agriculture for the implementation of smart livestock environment. *IEEE Access*, *10*, 9483-9505. 10.1109/ACCESS.2022.3142848.

Faverdin, P., Guyomard, H., Puillet, L., and Forslund, A. (2022). Animal board invited review: Specialising and intensifying cattle production for better efficiency and less global warming: contrasting results for milk and meat co-production at different scales. *Animal*, *16*(1), 100431.

Firman, A., Daud, A. R., and Arief, H. (2023). Succession Process for Sustainability of Family Dairy Farming. AGRARIS: *Journal of Agribusiness and Rural Development Research*, *9*(2), 299-315.

Folajinmi, A. F., and Peter, A. O. (2020). Financial management practices and performance of small and medium scale poultry industry in Ogun State, Nigeria. *Journal of Finance and Accounting*, *8*(2), 90.

Gehlot, A., Malik, P. K., Singh, R., Akram, S. V., and Alsuwian, T. (2022). Dairy 4.0: Intelligent communication ecosystem for the cattle animal welfare with blockchain and IoT enabled technologies. *Applied Sciences*, *12*(14), 7316.

Gołaś, Z. (2020). Impact of working capital management on business profitability: Evidence from the Polish dairy industry. *Agricultural*

Economics/Zemědělská Ekonomika, *66*(6).
Gross, J. J. (2022). Limiting factors for milk production in dairy cows: perspectives from physiology and nutrition. *Journal of Animal Science*, *100*(3), skac044.
Gunn, K. M., Skaczkowski, G., Dollman, J., Vincent, A. D., Short, C. E., Brumby, S., and Turnbull, D. (2022). Combining farmers' preferences with evidence-based strategies to prevent and lower farmers' distress: co-design and acceptability testing of ifarmwell. *JMIR Human Factors*, *9*(1), e27631.
Gurjar, M. D., Makwana, A. K., Prajapati, M. C., and Kamani, K. C. (2023). Dairy entrepreneurship scenario in Gujarat state. *The Pharma Innovation Journal*, *12*(2), 1090-1094.
Harishankar, K., Ashok, K. R., Saravanakumar, V., Shalander, K., Duraisamy, M. R., and Maragatham, N. (2022). Determinants of Income Diversification among Dairy Farm Households in Tamil Nadu. *Asian Journal of Agricultural Extension, Economics & Sociology*, *40*(6), 109-115.
Hayden, M. T., Mattimoe, R., and Jack, L. (2021). Sensemaking and the influencing factors on farmer decision-making. *Journal of Rural Studies*, *84*, 31-44. https://doi.org/10.1016/j.jrurstud.2021.03.007
Henchion, M. M., Regan, Á., Beecher, M., and MackenWalsh, Á. (2022). Developing 'smart'dairy farming responsive to farmers and consumer-citizens: A review. *Animals*, *12*(3), 360.
Huerta-Soto, R., Ramirez-Asis, E., Tarazona-Jiménez, J., Nivin-Vargas, L., Norabuena-Figueroa, R., Guzman-Avalos, M., and Reyes-Reyes, C. (2025). Predictable inventory management within dairy supply chain operations. *International Journal of Retail & Distribution Management*, *53*(3), 1-17.
Hussain, A., Akhtar, W., and Jabbar, A. (2022). Risk management for small farmers in Pakistan: A review. *Pakistan Journal of Agricultural Sciences*, *59*(2). 10.21162/PAKJAS/22.334
Hussain, M., Butt, A. R., Uzma, F., Ahmed, R., Irshad, S., Rehman, A., and Yousaf, B. (2020). A comprehensive review of climate change impacts, adaptation, and mitigation on environmental and natural calamities in Pakistan. *Environmental Monitoring and Assessment*, 192, 1-20. https://doi.org/10.1007/s10661-019-7956-4
Jubaedah, S., Hilmi, I., and Ximenes, M. E. D. R. P. (2024). In-depth Analysis of Business Risks in the Cattle Livestock Industry: Comprehensive Literature Review. *Journal of Social Science*, *5*(4), 955-961.
Kassahun, A., Bloo, R., Catal, C., and Mishra, A. (2022). Dairy farm management information systems. *Electronics*, *11*(2), 239.
Kelly, P., Shalloo, L., Wallace, M., and Dillon, P. (2020). The Irish dairy industry-Recent history and strategy, current state and future challenges. *International Journal of Dairy Technology*, *73*(2), 309-323.
Khan, W., Khan, S., Dhamija, A., Haseeb, M., and Ansari, S. A. (2023). Risk assessment in livestock supply chain using the MCDM method: a case of emerging economy. *Environmental Science and Pollution Research*, *30*(8), 20688-20703.
Khan, Z. U. (2021). The legal structure and role of livestock in Pakistan's economy. *Pakistan Vision*, *22*(2), 59.
Khanna, A., Jain, S., Burgio, A., Bolshev, V., and Panchenko, V. (2022). Blockchain-enabled supply chain platform for Indian dairy industry: Safety and traceability. *Foods*, *11*(17), 2716.
Koutouzidou, G., Ragkos, A., and Melfou, K. (2022). Evolution of the Structure and Economic Management of the Dairy Cow Sector. *Sustainability*, *14*(18), 11602.
Kühl, S., Flach, L., and Gauly, M. (2020). Economic assessment of small-scale mountain dairy farms in South Tyrol depending on feed intake and breed. *Italian Journal of Animal Science*, *19*(1), 41-50.
Lakhani, M. O., Tauseef, S., and Chattha, W. A. (2023). Assessing the financial sustainability of a rural livestock practice: a case of Pakistan. *Agricultural Finance Review*, *83*(2), 286-298.
Lokier, J., Morris, W., and Thomas, D. (2021). Farm shop diversification: Producer motivations and consumer attitudes. *The International Journal of Entrepreneurship and Innovation*, *22*(4), 215-228.
Medeiros, I., Fernandez-Novo, A., Astiz, S., and Simões, J. (2022). Historical evolution of cattle management and herd health of dairy farms in OECD countries. *Veterinary Sciences*, *9*(3), 125.
Mills, K. E., Koralesky, K. E., von Keyserlingk, M. A. G., and Weary, D. M. (2021). Social referents for dairy farmers: who dairy farmers consult when making management decisions. *Animal*, *15*(10), 100361.
Mishra, S., and Sharma, S. K. (2023). Advanced contribution of IoT in agricultural production for the development of smart livestock environments. *Internet of Things*, *22*, 100724. https://doi.org/10.1016/j.iot.2023.100724
Mngumi, F., Sun, N., Huang, L., and Shaorong, S. (2022). A green finance strategy plan to integrate livestock sectors sustainability in Tanzania. *Journal of Livestock Science*, (13). 10.33259/JLivestSci.2022.267-278
Molossi, L., Hoshide, A. K., de Abreu, D. C., and de Oliveira, R. A. (2023). Agricultural support and public policies improving sustainability in Brazil's beef industry. *Sustainability*, *15*(6), 4801.
Monteiro, A., Santos, S., and Gonçalves, P. (2021). Precision agriculture for crop and livestock farming-Brief review. *Animals*, *11*(8), 2345.
Moojen, F. G., Grillot, M., de Faccio Carvalho, P. C., and Ryschawy, J. (2024). Farm advisors play a key role in integrating crop-livestock at the farm level: perceptions and experiences in Brazil and France. *The Journal of Agricultural Education and Extension*, *30*(5), 683-707.
Nazar, H., Ullah, S., Nasir, S., and Bilal, M. (2025). Exploring the potential determinants to favour available entrepreneurial strategies among dairy farmers of southern Punjab in Pakistan. *The Journal of Agricultural Education and Extension*, *31*(1), 71-89.
Onyiriuba, L., Okoro, E. O., and Ibe, G. I. (2020). Strategic government policies on agricultural financing in African emerging markets. *Agricultural Finance Review*, *80*(4), 563-588.
Pankaj, P. K., Prasad, J. V. N. S., Singh, V. K., Nirmala, G., and Reddy, K. S. (2024). Climate resilient livestock farming systems. *In Engineering Applications in Livestock Production* (pp. 159-178). Academic Press. https://doi.org/10.1016/B978-0-323-98385-3.00003-7

Papakonstantinou, G. I., Voulgarakis, N., Terzidou, G., Fotos, L., Giamouri, E., and Papatsiros, V. G. (2024). Precision livestock farming technology: applications and challenges of animal welfare and climate change. *Agriculture*, *14*(4), 620.

Vinitchaikul, P., Punyapornwithaya, V., Seesupa, S., Phuykhamsingha, S., Arjkumpa, O., Sansamur, C., & Jarassaeng, C. (2023). The first study on the impact of lumpy skin disease outbreaks on monthly milk production on dairy farms in Khon Kaen, Thailand. *Veterinary World*, *16*(4), 687. https://doi.org/10.14202/vetworld.2023.687-692

Quesada-Román, A., Umaña-Ortíz, J., Zumbado-Solano, M., Islam, A., Abioui, M., Tefogoum, G. Z., and Pupim, F. (2023). Geomorphological regional mapping for environmental planning in developing countries. *Environmental Development*, 48, 100935. https://doi.org/10.1016/j.envdev.2023.100935

Ramos de Robles, S. L., Barbosa Carmona, X., Gallard Martínez, A. J., and Gran Castro, J. A. (2025). Climate change education as an adaptative strategy for dairy farmers: A sociocultural perspective. *ECNU Review of Education*, *8*(1), 53-78.

Reddy, D. A., Garai, S., Veldandi, A., Maiti, S., and Meena, B. S. (2024). Exploring the Determinants of Higher Level of Adoption of Climate-Resilient Dairy Farming Practices. *Indian Research Journal of Extention Education*, *24*(3), 111-119.

Rose, D. C., Schillings, J., Breen, J., and Morrison, R. (2025). A RESET of dairy farmer animal health planning behaviour: symbiotic advisory relationships and knowledge brokering in HerdAdvance. *The Journal of Agricultural Education and Extension*, *31*(2), 285-308.

Samuel, J., Rao, C. A. R., Raju, B. M. K., Reddy, A. A., Pushpanjali, Reddy, A. G. K., and Prasad, J. V. N. S. (2021). Assessing the impact of climate resilient technologies in minimizing drought impacts on farm incomes in drylands. *Sustainability*, *14*(1), 382.

Sarkar, A., and Dutta, A. (2020). Challenges and opportunities of dairy sector in India vis-à-vis world: a critical review. *Exploratory Animal & Medical Research*, *10*(1).

Sattar, E. (2020). Can small farmers survive?: problems of commercializing the milk value chain in Pakistan. *Journal of Food Law & Policy*, *16*(2), 7.

Shahzad, M. A. (2022). The need for national livestock surveillance in Pakistan. *Journal of Dairy Research*, *89*(1), 13-18.

Shamsuddoha, M., Nasir, T., and Hossain, N. U. I. (2023). A sustainable supply chain framework for dairy farming operations: a system dynamics approach. *Sustainability*, *15*(10), 8417.

Simitzis, P., Tzanidakis, C., Tzamaloukas, O., and Sossidou, E. (2021). Contribution of precision livestock farming systems to the improvement of welfare status and productivity of dairy animals. *Dairy*, *3*(1), 12-28.

Singh, R., Maiti, S., and Garai, S. (2023). Sustainable Intensification–Reaching Towards Climate Resilience Livestock Production System–A Review. *Annals of Animal Science*, *23*(4), 1037-1047.

Snider, M. A., Ziegler, S. E., Darby, H. M., Soder, K. J., Brito, A. F., Beidler, B., and Niles, M. T. (2022). An overview of organic, grassfed dairy farm management and factors related to higher milk production. *Renewable Agriculture and Food Systems*, *37*(6), 624-632.

Stoliarchuk, N., Kozak, O., Serhieieva, N., Kozak, M., Bilochenko, A., and Semendiak, V. (2021). Search for Reserves to Increase the Livestock Production Efficiency Based on the Sustainable Development Strategy. *Environmental Research, Engineering and Management*, *77*(4), 19-32.

Sultana, M., Ahmed, J. U., and Shiratake, Y. (2020). Sustainable conditions of agriculture cooperative with a case study of dairy cooperative of Sirajgonj District in Bangladesh. *Journal of Co-operative Organization and Management*, *8*(1), 100105.

Susanty, A., Puspitasari, N. B., Prastawa, H., and Renaldi, S. V. (2021). Exploring the best policy scenario plan for the dairy supply chain: a DEMATEL approach. *Journal of Modelling in Management*, *16*(1), 240-266.

Torres, B., Andrade, V., Heredia-R, M., Toulkeridis, T., Estupiñán, K., Luna, M., and García, A. (2022). Productive Livestock Characterization and Recommendations for Good Practices Focused on the Achievement of the SDGs in the Ecuadorian Amazon. *Sustainability*, *14*(17), 10738.

Vaintrub, M. O., Levit, H., Chincarini, M., Fusaro, I., Giammarco, M., and Vignola, G. (2021). Precision livestock farming, automats and new technologies: Possible applications in extensive dairy sheep farming. *Animal*, *15*(3), 100143.

Verburg, R. W., Verberne, E., and Negro, S. O. (2022). Accelerating the transition towards sustainable agriculture: The case of organic dairy farming in the Netherlands. *Agricultural Systems*, *198*, 103368. https://doi.org/10.1016/j.agsy.2022.103368

Wakjira, G. G., and Kant, S. (2022). Assessment of challenges and prospects of local milk supply on market performance: a case of Ethiopia, horn of Africa. *Jurnal Peternakan Sabana*, *1*(2), 102-109.

Wang, M., Islam, S., and Yang, W. (2025). Supply chain risks in the dairy industry. *Benchmarking: An International Journal*. https://doi.org/10.1108/BIJ-12-2023-0874

Warriach, H. M., Ayre, M., Nettle, R., Height, K., Iqbal, H., Aziz, A., and McGill, D. M. (2024). Strengthening the role of innovation brokers in the livestock advisory services system of Pakistan. *Animal Production Science*, *64*(8). https://doi.org/10.1071/AN23398

Wolf, C. A., and Karszes, J. (2023). Financial risk and resiliency on US dairy farms: Measures, thresholds, and management implications. *Journal of Dairy Science*, *106*(5), 3301-3311.

Żbik, K., Onopiuk, A., Górska-Horczyczak, E., and Wierzbicka, A. (2024). Trends and Opportunities in the Dairy Industry: A2 Milk and Processing Methods. *Applied Sciences*, *14*(15), 6513.