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Review

Challenges and Solutions for Small Dairy Farms in the U.S.: A Review

Syed H. Jafri [1], K. M. Mehedi Adnan [2], Stefan Baimbill Johnson [2], Anzalin Ali Talukder [2], Mark Yu [2] and Edward Osei [2,*]

[1] Department of Accounting, Finance, and Economics, Tarleton State University, Stephenville, TX 76402, USA; jafri@tarleton.edu

[2] Division of Agribusiness and Agricultural Economics, Department of Agricultural Education and Communication, Tarleton State University, Stephenville, TX 76402, USA; kadnan@tarleton.edu (K.M.M.A.); stefan.baimbilljohnson@go.tarleton.edu (S.B.J.); anzalinali.talukder@go.tarleton.edu (A.A.T.); yu@tarleton.edu (M.Y.)

* Correspondence: osei@tarleton.edu

Abstract: Small-sized dairy farms (SSDFs) are integral to the agricultural landscape, providing economic, social, and environmental benefits to rural communities. However, they face growing challenges, including market volatility, rising production costs, labor shortages, and complex regulatory demands. This review synthesizes the current literature on the economic and environmental obstacles confronting SSDFs and explores strategies to enhance their sustainability and competitiveness. Key barriers include limited access to capital, high feed and energy expenses, and difficulties in adopting new technologies due to financial constraints. SSDFs also struggle to compete with larger farms benefiting from economies of scale and increased market power. Potential solutions include strengthening cooperative models, implementing diversification strategies, and leveraging policy support for targeted financial assistance and technology adoption. Case studies of successful SSDFs show that transitioning to organic production, adopting climate-smart techniques, and focusing on niche markets can significantly improve profitability and resilience. This review emphasizes the need for tailored policy frameworks, innovative financial models, and collaboration among stakeholders to support SSDFs. Future research should prioritize understanding SSDF-specific financial dynamics, assessing the cost-effectiveness of technology adoption, and developing strategies to enhance market access and long-term sustainability in the U.S. dairy sector.

Keywords: small-scale dairy operations; challenges; interventions; policy adjustments; economic issues; U.S. dairy sector

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1. Introduction

The dairy farming sector has been a foundational element of American agriculture, significantly contributing to rural community development, ensuring food security, and preserving agricultural landscapes across the United States [1,2]. Despite their historical significance, small-sized dairy farms (SSDFs), defined as those operating with fewer than 100 cows, are increasingly at risk due to a growing number of economic, environmental, and structural challenges that threaten their sustainability [3,4]. SSDFs constitute the majority of dairy operations in the United States but contribute a disproportionately small share of national milk production due to their limited scale and resource constraints [5,6]. While these farms are essential for preserving rural economies and supporting local supply chains, the number of small dairy farms has sharply declined over the past few decades, raising concerns about their future viability and the broader implications for rural communities [7,8]. The decline in small-sized dairy farms is driven by a combination of economic pressures, regulatory challenges, and shifts in consumer demand. Between 2007 and 2022, the number of small dairy farms in the United States dropped by over 50%, with many forced to exit the

industry due to persistent financial instability and an inability to compete with larger-scale operations [8,9]. Large-scale farms have been able to leverage economies of scale, thereby lowering production costs per unit and increasing overall productivity. These operations benefit from greater access to capital, enabling significant investments in feed management, herd health, and advanced technologies, which allow them to achieve higher milk yields and operational efficiency [10,11]. In contrast, small farms struggle to compete, often operating on slim profit margins and facing limited financial flexibility [12]. Most of them survive either through off-farm income or through federal subsidies [13].

The financial challenges faced by small dairy farms are further compounded by volatile milk prices that fluctuate based on global market conditions, consumer preferences, and trade policies [14]. Unlike larger operations, which can mitigate the impact of price fluctuations through diversified revenue streams and financial reserves, small farms are highly vulnerable to such shocks. Moreover, rising production costs—especially for feed, labor, and energy—pose a serious threat to their profitability [15]. Feed costs alone can represent up to 60% of total production expenses, leaving small farms highly exposed to shifts in feed prices caused by global commodity trends and adverse weather conditions [16]. Labor shortages exacerbate these issues further, as many small farms struggle to attract and retain workers due to their limited ability to offer competitive wages and benefits [17]. Environmental and regulatory pressures also pose significant obstacles for SSDFs. Compliance with stringent environmental regulations, such as those related to nutrient management and greenhouse gas emissions, often requires substantial investments in technology and infrastructure that many small farms can ill afford [18]. While programs like the USDA's Environmental Quality Incentives Program (EQIP) offer financial support for conservation efforts, small farms often struggle to navigate the complex application processes and meet eligibility requirements [19]. This results in a disparity in access to resources, placing small farms at a disadvantage compared to larger operations that can more readily capitalize on available support [20]. In addition to economic and regulatory hurdles, small dairy farms face increasing pressure to adopt advanced technologies to enhance sustainability and productivity. Innovations such as automated milking systems, precision agriculture tools, and advanced herd management software have the potential to transform dairy operations by reducing labor needs and improving efficiency [21]. However, the high start-up costs associated with these technologies, combined with limited access to affordable credit, create significant barriers to adoption for small farms [22]. Thus, small farms often lag in implementing sustainable practices, contributing to environmental challenges and limiting their ability to compete in an increasingly technology-driven industry [23].Given these multifaceted challenges, it is crucial to develop a comprehensive understanding of the factors influencing the viability and sustainability of SSDFs. Most existing research has predominantly focused on large-scale operations, leaving significant gaps in understanding the unique challenges faced by small farms [24]. This study aims to address these gaps by analyzing the specific economic, social, and environmental factors that threaten the sustainability of SSDFs. The research will identify key challenges, propose practical solutions, and offer policy recommendations to support small farms in navigating a highly competitive agricultural landscape.

The primary objective of this study is to critically evaluate the multifaceted challenges faced by small-scale dairy farms (SSDFs) in the United States and to propose strategic interventions that enhance their sustainability and competitiveness. It aims to identify the key economic, environmental, and operational constraints that hinder the viability of SSDFs while systematically exploring innovative solutions and best practices to address these barriers. Additionally, the research seeks to develop evidence-based policy recommendations tailored to the unique needs of small dairy farms, providing actionable insights for overcoming challenges such as fluctuating market conditions, rising production costs, labor shortages, and environmental regulations. By integrating findings from the existing literature and empirical analysis, the study endeavors to present a comprehensive framework that aligns proposed strategies with long-term sustainability goals, ultimately

supporting the resilience and growth of small dairy farms in the U.S. agricultural sector. Small dairy farms are integral to the health and resilience of rural economies and regional food systems [15]. However, without targeted interventions and innovative solutions, many of these farms will continue to face significant threats to their survival. By comprehending the unique challenges and exploring feasible solutions, stakeholders can develop strategies that ensure the long-term sustainability and growth of small dairy farms, thereby preserving the diversity, resilience, and sustainability of the U.S. dairy industry.

2. Market Dynamics of the U.S. Dairy Industry

The U.S. dairy industry has seen a significant structural shift over recent decades, moving toward larger operations that capitalize on economies of scale and advanced technologies [25]. From Table 1, it can be seen that small dairy farms (shown in the table as operations with 1–99 cows), once the industry backbone, are increasingly outpaced by medium (represented in Table 1 as operations with 100–499 cows) and large farms (500–2000+ cows) due to economic pressures, labor shortages, and higher production costs. Small farms have lower yields per cow, producing between 15,751 and 17,432 lbs. of milk per year, partly due to limited access to technologies like automated milking systems and optimized feed practices [25]. These farms experience high feed costs, which constitute 55–65% of their total production expenses, and face higher production costs of USD 34.58–42.71 per CWT, resulting in negative gross returns between USD −12.60 and USD −23.57 per CWT. The absence of economies of scale, combined with rising operational costs, has forced many small farms either to expand or leave the industry, eroding their former prevalence. Medium-sized farms fill a middle ground, achieving moderate economies of scale and higher yields of 19,991–22,377 lbs. per cow annually. They operate on 200–500 acres and face lower feed costs, comprising 50–60% of total production costs, with per-CWT costs of USD 22.70–30.71. These farms are somewhat sustainable, with gross returns from USD −9.52 to USD 0.42 per CWT, yet they also face pressure to expand to remain competitive. In contrast, large dairy farms, which account for 55% of the total U.S. milk cow inventory, achieve the highest productivity with yields per cow between 21,498 and 24,895 lbs. per year. By investing USD 5000–6000 per cow in advanced technologies and operating on 500–2000 acres with a stocking rate of 5–7 acres per animal unit, large farms maintain the lowest production costs (USD 20.11–25.21 per CWT) and enjoy gross returns ranging from USD −0.98 to USD 2.71 per CWT, allowing them to continue expanding while smaller farms fall behind. This shift toward larger farms have profound socio-economic implications, especially in rural areas [26].

Table 1. Economic comparison of small, medium, and large dairy farms in the U.S. (2000–2023).

Items	Small Dairy Farms (1–99 Cows)	Medium Dairy Farms (100–499 Cows)	Large Dairy Farms (500–2000+)
Average farm size (acres)	50–200	200–500	500–2000
Stocking rate on pasture land (acres/Animal Unit)	1–3	3–5	5–7
Total U.S. milk cow inventory (%)	21.6	23.4	55
Milk yield per Cow (lbs/year)	15,751–17,432	19,991–22,377	21,498–24,895
Capital investment per cow (USD)	2500–3500	3500–5000	5000–6000
Feed costs over total production cost	55–65%	50–60%	45–55%
Cost of production (USD/CWT)	34.58–42.71	22.70–30.71	20.11–25.21
Gross return (USD/CWT)	−23.57 to −12.60	−9.52 to 0.42	−0.98 to 2.71

Source: USDA, Economic Research Services data, 2024 [4].

In the U.S., dairy cow inventory is divided across farm sizes: small farms hold 21.6%, medium farms 23.4%, and large farms dominate with 55%. This distribution reflects the

growing trend of consolidation, where larger farms, benefiting from economies of scale, house the majority of dairy cows while small and medium farms contribute significantly to local markets. Historically, small farms provided local employment and contributed to the social fabric and economic stability of rural communities [27]. As larger farms consolidate production and increasingly rely on wage labor instead of family labor, rural communities face a potential decline in population and economic activity, changing community dynamics [28]. Environmental challenges, such as water scarcity and heat stress, especially impact small farms in regions like Texas and the Southern Great Plains [29]. Without targeted support through technical assistance and research, these farms struggle to adapt to the compounded pressures of climate and resource limitations. Practices like water conservation, heat stress management, and innovative feed solutions could help mitigate these challenges, offering small farms a path to viability amid these structural industry shifts [30].

Figures 1–3 illustrate the current trends of farm size, per head milk production, and total milk production in the U.S. dairy industry. Over the past two decades, smaller dairy farms have sharply declined, while larger farms have increased in number. This shift is driven primarily by the need for efficiency, forcing small farms to either scale up or exit. Meanwhile, milk production per cow has steadily increased, reflecting the industry's focus on maximizing productivity [4]. As indicated above, Table 1 highlights the economic differences between small, medium, and large dairy farms in the U.S. It shows that small farms operate on fewer acres—though perhaps greater acreage per cow—and produce lower milk yields, leading to higher production costs and lower profit margins. In contrast, large farms enjoy lower production costs and significantly higher profit margins due to greater efficiency and economies of scale. Overall, the U.S. dairy industry is marked by a growing divide between large-scale operations and smaller farms. While large farms lead in productivity gains, small farms remain essential for sustaining rural communities and upholding the traditions of family farming. However, without targeted support and intervention, the future of small dairy farms is at risk, and ongoing industry consolidation could profoundly affect both the economic stability and social fabric of rural America [31].

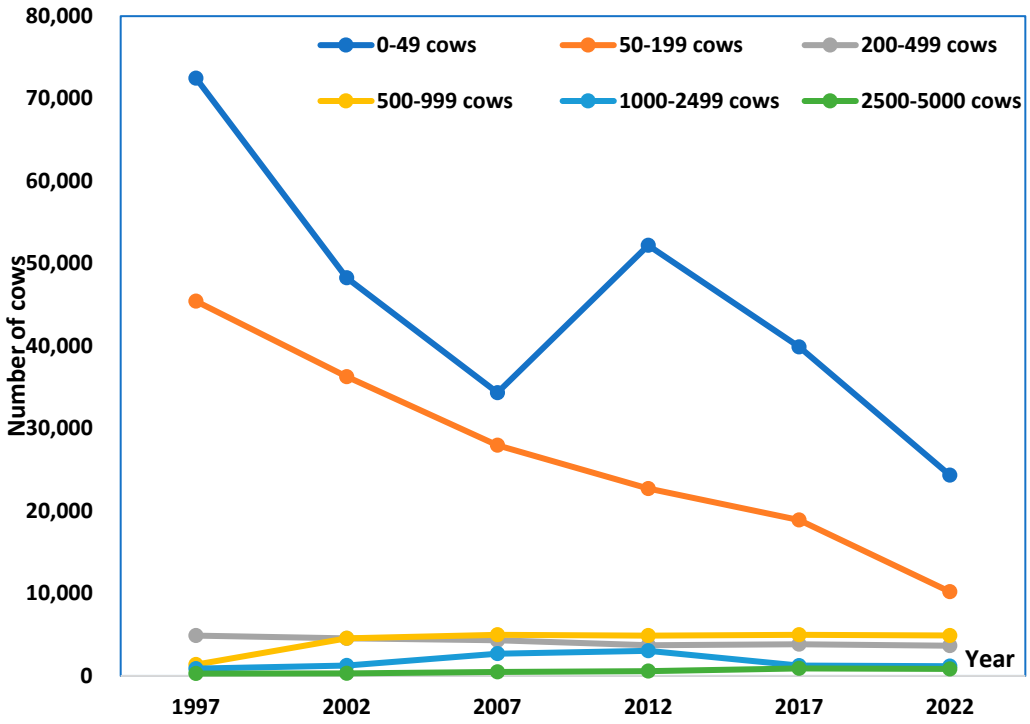

Figure 1. U.S. dairy operations (by size) trend. Source: USDA, Economic Research Services data, 2024 [4].

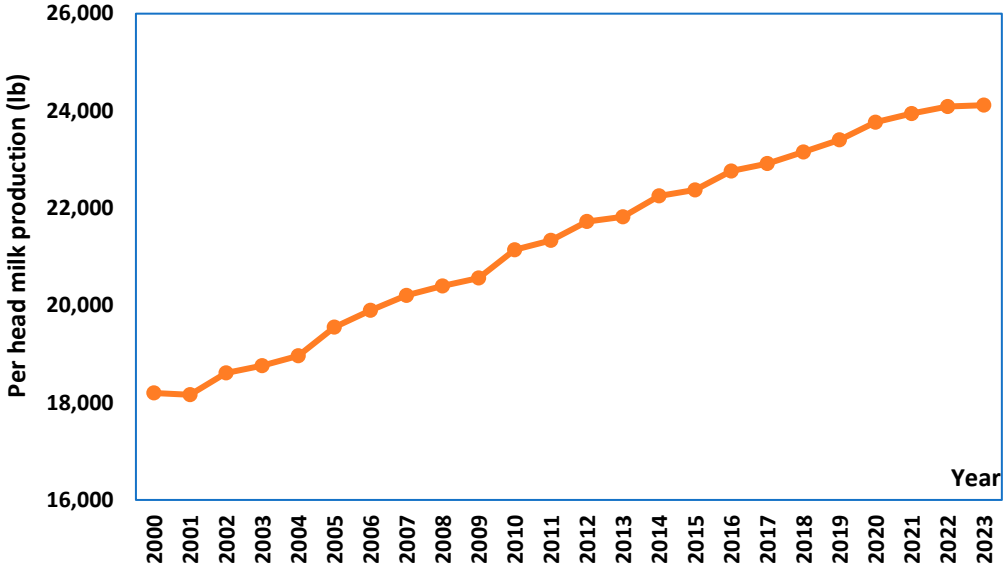

Figure 2. Per head milk production trend in the U.S. Source: USDA, Economic Research Services data, 2024 [4].

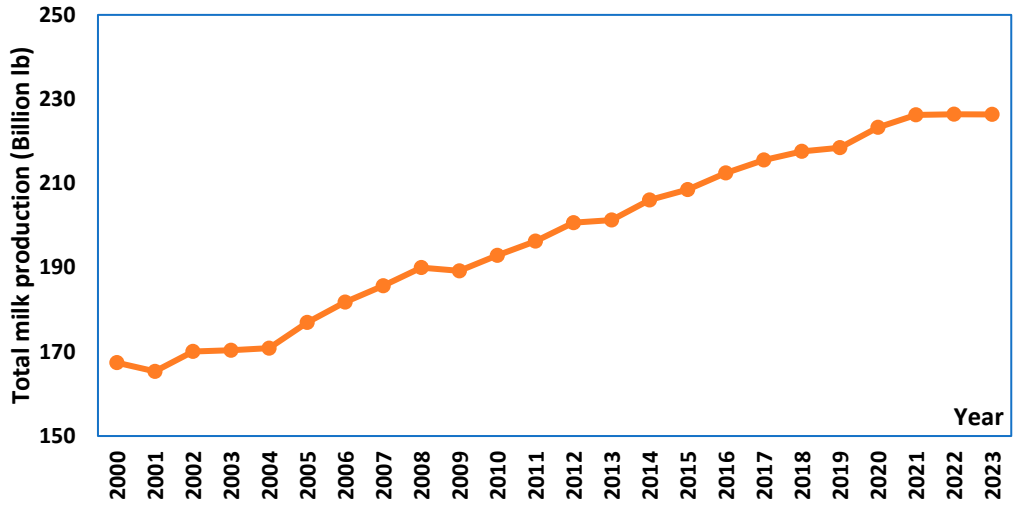

Figure 3. Total milk production trend in the U.S. Source: USDA, Economic Research Services data, 2024 [4].

In the next section, we highlight the major challenges facing small dairy farms in more detail. This is followed by a discussion of options for sustainable growth, and a subsequent section outlines lessons from successful management of small dairy farms.

3. Major Challenges Confronting Small Dairy Farms

Small-scale dairy farms in the U.S.A. face a myriad of challenges that threaten their profitability and long-term sustainability [32]. Compared to large-scale enterprises, these smaller farms are particularly vulnerable to fluctuations in production costs, market prices, and operational inefficiencies, including high input costs, labor shortages, and compliance with stringent environmental regulations [33]. Market access challenges, industry consolidation, changing consumer preferences, and limited access to affordable financing further diminish their competitive edge in a rapidly evolving dairy industry [34]. To highlight these issues, Table 2 presents a synthesis of a literature review detailing the obstacles faced by small-sized dairy operations and their potential solutions. Without proactive intervention through policy support, innovation, and cooperative frameworks, these farms

risk displacement by larger enterprises, leading to rural economic decline. However, by adopting innovative practices, improving operational efficiencies, and leveraging market opportunities, small farms can navigate the complexities of the modern dairy landscape and enhance their sustainability, ensuring they remain vital contributors to local economies and the dairy industry [35]. In the following sections, we further investigate the specific challenges and solutions proposed in the academic literature for small-scale dairy farms in the USA.

3.1. Market Volatility and Financial Pressures

Milk price volatility continues to be a major financial burden for small dairy farms. Unlike larger operations that benefit from economies of scale, small farms find it difficult to absorb price fluctuations caused by changing trade policies, consumer preferences, and unpredictable market conditions [36]. Global shifts in the demand and supply of dairy products, such as those caused by the COVID-19 pandemic, have disproportionately impacted small farms, leaving many with unsold milk and financial losses [37]. The rising cost of key inputs—especially feed—further intensifies financial pressures. Fluctuations in global grain prices, driven by climate variability and energy policies, directly increase feed costs, making it difficult for small farms to maintain profitability [38]. Additionally, small farms are often forced to rely on government subsidies like the Dairy Margin Coverage (DMC) program to remain viable. However, these subsidies offer only short-term relief and do not address the structural challenges of the industry [39]. Participating in cooperatives is essential to helping small farms stabilize milk prices, improve bargaining power, and access larger markets [40]. Cooperatives can also provide collective access to processing facilities and reduce operational costs through shared services. Additionally, small farms can mitigate risks by diversifying their income through value-added products such as yogurt, cheese, or organic dairy, which command higher prices in niche markets [13,41]. Educating farmers about price risk management tools, including forward contracts and insurance programs, is critical to helping them stabilize income during volatile market cycles [42–44].

Table 2. Literature review of challenges and its potential solutions of small size dairy industry in U.S.

Dairy Segment	Challenges of Small-Scale Dairy Farms	Potential Solutions	References
Profitability	High costs, price volatility, limited expansion, and financial instability.	Adopt cost-saving practices, optimize management, and enhance productivity.	[13,36–40,42,43,45]
Volatile Market Prices	Market volatility, price fluctuations, and dependency on subsidies.	Use risk management tools, join cooperatives, and diversify income sources.	[8,13,36–46]
Grazing Practices	Low yields, limited land, and high infrastructure costs.	Promote sustainable practices, provide financial support, and incentivize grazing.	[47–52]
Rising Feed Costs	High feed prices and nutrient management inefficiencies.	Optimize feeding strategies, reduce supplement use, and enhance grazing.	[53–56]
Manure and Waste Management	Regulatory challenges, nutrient runoff, and high operational costs.	Implement digesters, improve nutrient management, and develop cooperatives.	[28,57–65]
Adoption of New Technology	High technology costs, limited capital, and inefficiencies.	Promote affordable technologies, provide training, and explore cost-sharing.	[49,66–76]

Table 2. *Cont.*

Dairy Segment	Challenges of Small-Scale Dairy Farms	Potential Solutions	References
Efficiency and Productivity	Low efficiency, high costs, and reduced competitiveness.	Invest in management, scale up operations, and adopt pasture systems.	[5,46,49,75,77–83]
Economies of Scale	Limited economies of scale, high transaction costs, and inefficiencies.	Expand herd sizes, reduce costs, and implement integrated practices.	[8,25,75,77,84–91]
Environmental Sustainability	Environmental issues, green house gas emissions, and regulatory pressures.	Adopt BMPs, use adaptive management, and comply with nutrient plans.	[63,92–98]
Workforce Development and Labor Efficiency	Limited training access, language barriers, an aging workforce, labor shortages, rising wages, and dependency on migrant workers.	Provide bilingual training, leverage online platforms, promote cooperatives, streamline workflows, implement visa programs, and adopt labor-saving technologies.	[21,99–109]
Financial and Credit Management	Financial strain, limited credit, and high start-up costs.	Leverage low-interest loans, enhance financial literacy, and diversify income.	[110–114]
Market Competition	Price volatility, limited market access, and competition from imports.	Adopt direct-to-consumer channels, use subsidies, and invest in infrastructure.	[6,12,51,78,115–120]
Rural Economic Development	Market dependency, limited digital infrastructure, and youth attrition.	Encourage local marketing, improve digital access, and support young farmers.	[119,121–124]
Enhancing Agriculture Through Collaboration	High costs, market limitations, and challenges with manure management.	Promote certifications, enhance networks, and use innovative marketing.	[6,101,112]
Consumer Preferences and Branding	Rising popularity of plant-based milk alternatives like almond, oat, and soy milk reflects a shift toward sustainable and health-conscious eating habits, creating challenges for standing out amidst strong competition from major producers.	Promote organic certification, sustainable farming, and animal welfare through a strong brand identity, community programs, and locally sourced products. Highlight the use of seasonal ingredients and collaborate with local restaurants and cafes.	[24,25,48,87,101,112]
Sustainability	Limited marketing resources compared to larger operations.	Participate in food fairs, farm-to-table initiatives, and educational workshops.	[24,101]

3.2. Rising Production Costs and Labor Challenges

High input costs, particularly for feed and fertilizers, remain one of the greatest challenges facing small dairy farms. Feed accounts for over 55% of total production costs, and rising grain prices driven by global market trends leave small farms vulnerable [54]. Fertilizer prices have also surged due to supply chain disruptions, making it more expensive to maintain soil fertility and pasture quality [53]. Additionally, many small farms face challenges with nutrient management, resulting in higher operational costs. Inefficient use of phosphorus and nitrogen contributes to environmental degradation and can result in regulatory penalties [55]. Adopting better nutrient management strategies, such as precision feeding, can improve efficiency, but many small farms lack access to these technologies due to high investment costs [106]. Labor shortages pose another serious challenge, as the dairy industry traditionally depends on skilled migrant labor. Recent

immigration restrictions and rising labor costs have worsened workforce shortages, leaving many small farms understaffed [109]. These market-led shortages have forced several operations to rely heavily on family labor, which is not sustainable in the long term [105]. Collaborative labor-sharing models with neighboring farms can offer some relief by pooling workforce resources [108]. Although automated milking systems and other labor-saving technologies can enhance operational efficiency, the high upfront costs deter adoption [107]. Government programs that offer low-interest loans or subsidies for automation are crucial to supporting small farms as they transition to modern farming practices [104].

3.3. Environmental and Regulatory Pressures

Environmental regulations impose additional financial and operational burdens on small dairy farms. Regulatory mandates governing manure management, nutrient runoff, and greenhouse gas emissions require costly investments in infrastructure and advanced technologies [28]. Managing manure efficiently is particularly challenging for smaller operations, as improper disposal leads to phosphorus and nitrogen runoff, which also contributes to water pollution [63]. Anaerobic digesters, which convert manure into biogas, offer a sustainable solution; however, their high installation costs make them unaffordable for many small farms [60]. Community digesters (where multiple farms share the infrastructure and operational expenses) can offer a more viable alternative [65]. Adopting rotational grazing systems is yet another effective strategy for reducing environmental impact. Rotational grazing improves soil health and reduces reliance on chemical fertilizers by optimizing pasture utilization [51]. Management-Intensive Grazing (MIG) has demonstrated significant benefits, both in terms of environmental outcomes and profitability, by reducing feed costs and increasing herd health. Expanding government programs that promote nutrient recycling and lagoon cleaning can further support small farms in meeting regulatory requirements [64].

3.4. Market Access and Competitive Dynamics

Access to markets is a persistent challenge for small dairy farms. Larger producers dominate the industry as their high-volume production at a lower unit cost (due to economies of scale) makes it difficult for the smaller farms to secure favorable contracts with processors and retailers [117]. High transportation costs further limit the small producers their ability to compete in both national and/or export markets [115]. Small farms can benefit from direct-to-consumer channels, such as farmers' markets or community-supported agriculture (CSA) programs, which allow them to capture higher profit margins by bypassing intermediaries [122]. Many small farms also lack the resources or marketing expertise in developing successful branding strategies [12]. Engaging in agritourism and producing value-added products like artisanal cheese or grass-fed dairy can diversify revenue streams and enhance profitability [27]. Participation in cooperatives is essential for small farms to access larger markets by pooling resources and reducing transaction costs [6,116]. These collaborative efforts also improve access to specialized markets, such as organic and sustainable dairy products, which are increasingly favored by environmentally conscious consumers [99].

3.5. Technological Adoption and Infrastructure Gaps

Infrastructure gaps present significant obstacles for small dairy farms, reducing operational efficiency and hindering their ability to scale. Many small farms operate with outdated facilities that are ill-equipped for modern dairy production, leading to inefficiencies in milking, feeding, and waste management. Limited access to veterinary care further exacerbates health issues within herds, as timely medical intervention is crucial for maintaining animal health and productivity [68]. The struggle to find local veterinary services can lead to delayed treatments, increasing mortality rates among livestock [74,75]. Inadequate transportation networks further complicate operations. Small dairy farms often rely on efficient logistics to deliver products to market; however, limited transportation

options hinder timely delivery, impacting product freshness and increasing transportation costs, thereby reducing competitiveness. Investing in advanced technologies—such as automated milking systems, computerized feeding tools, and data management software—is essential for improving efficiency [70]. These technologies can streamline operations and enhance animal care while reducing labor costs. However, many small farms lack the financial flexibility to make these investments due to limited access to credit and financing options. High upfront costs associated with modern equipment deter upgrades. Cooperative purchasing models can help by pooling resources and sharing costs among multiple farms, enabling small operations to acquire modern technologies at reduced prices [73]. Government-supported grants and low-interest loan programs targeted at small farms can alleviate financial burdens associated with adopting new technologies [72]. Educational programs offering technical assistance and improving digital literacy are vital for easing the transition to new technologies. These programs can equip farmers with the knowledge and skills needed to effectively utilize advanced technologies, maximizing the benefits of their investments [70]. Workshops, training sessions, and on-farm demonstrations can empower farmers to make informed decisions about technology adoption and improve overall management practices [66].

3.6. Financial and Credit Management

Financial and credit management is a critical issue for dairy farmers, often facing constant financial strain from low milk revenue, rising feed, and labor costs, along with limited affordable financing and high-interest loans [81]. Small-scale farmers face challenges such as limited collateral, market instability, and a lack of economies of scale, all of which can threaten profitability [113,114]. Regulatory compliance costs, high land expenses, and low net returns for small herds contribute to an increased risk of farm closures [110]. Limited financial literacy and lack of awareness about available support programs can negatively impact financial stability. Strategies like reducing feed spoilage, culling low-yield cows, and utilizing government assistance programs such as Milk Income Loss Contract (MILC) and Dairy Margin Coverage (DMC) can help alleviate financial strain [111]. Farmers can benefit from USDA and dairy indemnity fund (DIF) low-interest loans, tax credits, and cooperative lending models while diversifying income sources through niche markets, agritourism, and value-added production [49,91]. Enhanced financial literacy, relationships with lenders, and advocacy for inclusive lending practices can foster resilience in the face of these financial challenges.

3.7. Consumer Preferences and the Rise of Alternative Products

The rising popularity of plant-based milk alternatives poses significant challenges for small dairy farms [101]. As consumers increasingly prioritize health, sustainability, and environmental impact, traditional dairy products face growing competition from non-dairy options such as almond milk, oat milk, and soy milk. This shift reflects a broader societal movement toward sustainable and health-conscious consumption [51,78]. These alternatives, often marketed as healthier and more environmentally friendly, have captured substantial market share [12], intensifying the need for small dairy farms to adapt and innovate. To remain competitive, small dairy farms can implement several strategic initiatives:

- Differentiate Products: Farms can enhance their appeal by obtaining organic certification, adopting sustainable farming practices, and emphasizing animal welfare. These steps align with the values of ethically conscious consumers and help carve a niche in the market [24].
- Develop Strong Branding: Establishing a clear brand identity and compelling marketing narrative can foster consumer loyalty. Highlighting unique attributes, such as local sourcing or farm-to-table connections, can resonate with target audiences [87].
- Innovative Product Offerings: Incorporating local and seasonal ingredients into dairy products can create unique offerings that distinguish small farms from larger com-

petitors. Collaboration with local restaurants and cafes to develop signature dishes featuring farm products can further reinforce their market presence [112].

- Community Engagement: Participating in food fairs, farm-to-table initiatives, and educational workshops strengthens connections with consumers who value locally sourced, high-quality products. Partnerships with local food movements provide additional platforms to showcase commitment to sustainability [25]. Small dairy farms must also address broader challenges like market volatility, rising input costs, labor shortages, and environmental regulations. Key strategies to enhance resilience and profitability include:
- Investing in Cooperatives: By joining cooperatives, small farms can benefit from shared resources, reduced costs, and increased market access [48].
- Adopting Labor-Saving Technologies: Innovations such as automated milking systems and precision agriculture tools can improve efficiency and reduce labor dependency.
- Accessing Government Support: Expanding programs offering grants, subsidies, and technical assistance is critical for long-term viability.

With these interventions, small dairy farms can strengthen their competitiveness and contribute to a sustainable and diverse dairy sector. Their adaptability and innovative approaches will be instrumental in shaping the future of dairy farming in the United States.

4. Pathways to Sustainable Growth for Small Dairy Producers

Small dairy farms in the United States face numerous challenges, including price volatility, high production costs, labor shortages, and competition from larger operations. This section explores solutions to help small farms thrive by focusing on policy reforms, cooperative models, diversification strategies, technological adoption, workforce development, environmental sustainability, access to capital, and consumer awareness. These strategies aim to enhance profitability and ensure long-term sustainability. Table 3 represents the pathways to sustainable growth for small dairy producers in U.S.

Table 3. Overview of policy reforms and support programs for small dairy farms in the U.S.A.

Policy/Strategies	Target Group	Key Features	Benefits	Drawbacks
Policy Reforms and Support Programs				
Margin Protection Program (MPP)	Small dairy farms facing price volatility	Risk management for milk price fluctuations Subsidized premiums	Financial Stability: Provides support during market downturns. Risk Mitigation: Helps farmers manage volatile milk prices.	Complexity: Difficult to navigate and understand program details. Coverage Gaps: May not fully cover small farm needs.
Farm-to-School Initiative	Local dairy farms and schools	Establishes supply contracts with schools Promotes locally sourced food	Market Expansion: Opens new revenue streams through school partnerships. Community Support: Enhances local awareness and support for small farms.	Distribution Logistics: Requires efficient delivery mechanisms. Regulatory Compliance: Must meet school food safety standards.

Table 3. *Cont.*

Policy/Strategies	Target Group	Key Features	Benefits	Drawbacks
Tax Incentives for Sustainable Practices	Environmentally conscious dairy farmers	Grants for implementing eco-friendly practices Tax deductions for sustainable investments	Cost Reduction: Lowers expenses for sustainability projects. Environmental Compliance: Encourages adoption of green farming methods.	High Initial Costs: Upfront expenses may be prohibitive for small farms. Limited Access: May not be accessible to all small-scale producers.
Price Stabilization Mechanisms	Small and medium dairy farms	Minimum price guarantees Production quota systems	Income Security: Protects against extreme price drops. Market Predictability: Provides a stable income base.	Potential Overproduction: Risk of surplus production. Regulatory Constraints: Could face resistance in deregulated markets.
Cooperative Development Grants	Dairy cooperatives and small farmers	Funding for cooperative formation Support for joint marketing and processing	Collective Bargaining Power: Enhances negotiating capacity and market access. Resource Sharing: Reduces individual costs for processing and marketing.	Grant Competition: Highly competitive application process. Cooperative Management: Requires effective governance and coordination.
Impact of Diversification Strategies				
Traditional Dairy Farming	General milk consumers	Fluid milk production Bulk sales channels	Stable Revenue: Provides a consistent, albeit low, revenue stream. Established Market: Long-standing distribution networks.	Competitive Market: Low-profit margins due to market saturation and competition with larger producers. Price Volatility: Vulnerability to fluctuations in milk prices.
Organic Dairy Farming	Health-conscious consumers	Certified organic practices Higher production standards	Higher Profit Margins: Organic products command premium prices. Growing Market: Increasing consumer demand for organic foods.	Costly Certification: Requires significant investment in organic certification. Operational Complexity: Requires compliance with strict regulations.
Specialty Cheese Production	Gourmet and niche food markets	Artisan cheese production Branding and marketing for niche appeal	High Profit Potential: Specialty cheeses often yield higher profit margins. Consumer Loyalty: Unique products can foster strong brand loyalty.	High Initial Investment: Requires capital for equipment and skilled labor. Niche Market Limitations: Demand may fluctuate based on economic conditions.

Table 3. *Cont.*

Policy/Strategies	Target Group	Key Features	Benefits	Drawbacks
Agritourism Initiatives	Tourists and local communities	Farm tours Workshops On-site retail and experiential events	Supplemental Income: Generates additional revenue beyond traditional dairy sales.Consumer Engagement: Builds a direct relationship with customers, enhancing brand visibility.	Variable Revenue: Income depends on tourism trends and seasonal demand. Regulatory Hurdles: May face zoning, safety, and insurance requirements.
Labor Solutions and Workforce Development Programs				
Apprenticeship Programs	Agricultural students	Structured training programs Mentorship opportunities	Skill Development: Provides hands-on training, ensuring students acquire essential skills in modern dairy practices. Stable Labor Supply: Creates a reliable source of labor for farms, as apprentices often pursue full-time employment post-training.	Recruitment and Retention Issues: Attracting participants can be challenging, and retaining them after training may lead to increased competition for skilled workers.
H-2A Visa Streamlining	Seasonal laborers	Simplified visa application processRegulatory compliance support	Access to Needed Labor: Simplifies the hiring process, ensuring that farms can secure seasonal labor during peak production periods, which is crucial for operational efficiency.	Complexity of Visa Process: The intricacies of visa applications and compliance with regulations can deter some farmers from utilizing the program effectively.
Competitive Wages	All employees	Attractive salary packages Performance incentives	Improved Retention Rates: Offering attractive wages leads to higher employee satisfaction, reducing turnover and the associated costs of hiring and training new workers.	Increased Operational Costs: Higher wages can strain budgets, especially for small farms, necessitating careful financial planning to sustain profitability.
Capital and Financial Services				
FSA Low-Interest Loans	Beginning and transitioning farmers	Affordable financing with competitive interest rates	Lower Interest Rates: Provides cost-effective borrowing options. Accessible Terms: Tailored for farmers with varying credit histories, promoting inclusivity.	Potential Paperwork: Requires thorough documentation and adherence to application procedures, which can be time-consuming. Eligibility Criteria: May limit access for some applicants based on specific conditions or requirements.

Table 3. *Cont.*

Policy/Strategies	Target Group	Key Features	Benefits	Drawbacks
Cooperative Development Grants	Small dairy cooperatives	Funding for infrastructure improvements and collective initiatives	Capital for Growth: Enables cooperatives to enhance facilities, leading to improved operational efficiency. Strengthened Collaboration: Encourages member engagement and supports community-driven projects.	Limited Availability: Funds may be scarce, creating intense competition among applicants. Competitive Application Process: Necessity for detailed proposals can discourage participation from less experienced cooperatives.
Financial Planning Services	All small dairy farms	Comprehensive business planning and risk management support	Expert Guidance: Provides tailored advice from financial experts, helping farms navigate complex financial landscapes. Risk Mitigation Strategies: Equips farmers with tools and techniques to manage risks effectively, enhancing long-term sustainability.	Cost Associated: Services may involve fees, which can be a financial burden for some farmers. Dependency on External Advisors: Farmers may rely heavily on outside expertise, which could hinder the development of in-house financial management skills.

Source: Authors' literature review.

4.1. Policy Reforms and Support Programs

Government support plays a vital role in stabilizing small dairy farms, addressing economic challenges, and promoting sustainability. Programs like the Margin Protection Program (MPP) help mitigate risks from milk price fluctuations and feed costs, while the Dairy Margin Coverage (DMC) program provides payments when margins fall below defined thresholds [54]. Tailored adjustments to these programs could better address the unique needs of small farms, creating a stronger financial safety net. State-level initiatives, such as tax incentives and grants, encourage sustainable practices and eco-friendly methods [13]. Adopting price stabilization mechanisms, like Canada's production quotas, could reduce market volatility for U.S. producers [125]. Programs like the Farm-to-School Initiative also create new revenue streams by connecting small farms with educational institutions [126]. For infrastructure support, USDA Rural Development grants and loans assist in building livestock facilities and acquiring modern equipment. The Farm Service Agency (FSA) offers low-interest loans for land purchases and upgrades. Initiatives like the Beginning Farmer and Rancher Development Program (BFRDP) and youth-focused FSA loans support young farmers, ensuring a generational pipeline for the industry [51,125,126]. These programs collectively strengthen small dairy farms by improving financial stability, fostering sustainability, and enabling succession planning, ensuring their role in U.S. agriculture is preserved.

4.2. Cooperative Models, Collective Bargaining, and Infrastructure Solutions

Cooperatives empower small dairy farms by pooling resources, negotiating better prices, and providing access to essential processing facilities [6]. They expand market reach, offer education on trends and best practices, and support niche product development, such as artisanal cheeses and specialty goods. This approach emphasizes organic certification and sustainable practices, appealing to consumers seeking ethical and high-quality products [127]. Addressing land and infrastructure challenges is vital for scaling up production [13]. Low-interest loans and grants can help small farms acquire land, while initiatives improving leasing opportunities ensure fair access [43]. Infrastructure improvements, supported by subsidies and cooperative purchasing programs, enable farms to adopt modern milking and feeding systems, enhancing productivity. Shared infrastructure models, like communal milking facilities, offer cost-effective solutions [6]. Together, cooperative strategies and targeted support allow small dairy farms to scale operations and strengthen competitiveness in the U.S. dairy industry [127].

4.3. Diversification and Value-Added Products

Diversifying into specialty items, such as organic milk or artisan cheese, can open new markets and create stable revenue streams [128]. By developing unique products and targeting niche markets, small farms can stand out in a crowded marketplace. Collaborating with local chefs or food artisans can also lead to the creation of exclusive products that highlight regional flavors. Agritourism, such as farm tours and dairy tastings, offers supplemental income while fostering a stronger consumer–producer connection [129]. This strategy not only generates additional revenue but also promotes awareness and appreciation for local dairy farming practices, building consumer loyalty and support.

4.4. Enhnance Technological Adoption and Aid Infrastructure Development

Implementing precision agriculture technologies and renewable energy solutions offers significant benefits, but successful adoption relies on strong educational support [130]. Simplified extension programs can guide small farmers in adopting new technologies, addressing practical concerns, and building familiarity. Investment in technology, although initially costly, becomes more accessible through government-backed loans and grants, allowing small farms to take advantage of these innovations [73,102,119,123]. Additionally, developing a socio-economic profile that considers demographics, educational attainment, and technology exposure can identify gaps in readiness, enabling tailored support and a smoother transition [100]. These preparatory steps help small farms advance in sustainability, appealing to eco-conscious consumers and positioning the industry for future success.

4.5. Workforce Development and Labor Solutions

Labor shortages are a persistent issue for small dairy farms. Apprenticeship programs in partnership with local agricultural colleges can provide farms with a stable workforce and offer students hands-on experience [28,106]. Streamlining visa programs, such as the H-2A, can also ensure access to seasonal labor during peak production periods. Offering competitive wages and comprehensive training improves retention, reducing turnover and enhancing productivity [131]. Training programs should focus on technical skills, safety, and fostering a respectful work environment [32]. By investing in employee well-being and professional development, farms can build a reliable workforce capable of meeting modern dairy farming demands.

4.6. Environmental Sustainability and Conservation Practices

Adopting sustainable manure management techniques, such as composting and anaerobic digestion, can reduce environmental impact and generate biogas for additional income. Grants and financial incentives can help offset initial costs, making these systems more accessible [132]. Implementing effective manure management systems also helps farms comply with regulations and reduces liabilities associated with waste disposal. Pasture-

based and rotational grazing systems reduce feed costs, improve animal welfare, and enhance milk quality [50]. Allowing livestock to graze naturally promotes herd health and soil sustainability, fostering a resilient farming ecosystem [133]. Financial support for transitioning to pasture-based systems can make these sustainable practices accessible to more farmers.

4.7. Access to Capital and Financial Planning

Access to low-interest loans from agencies like the Farm Service Agency (FSA) is crucial for small farms aiming to invest in technology, infrastructure, or herd expansion [134,135]. Simplifying the loan application process and offering tailored financial products can help more small dairy farms access the capital they need. Partnerships between financial institutions and agricultural organizations can develop comprehensive services tailored to small farms' needs [7]. Providing access to comprehensive financial planning and risk management services is essential for helping small farms navigate market complexities and build long-term resilience. Programs that connect farmers with experienced financial advisors can offer invaluable guidance on business planning, risk mitigation strategies, and succession planning, ensuring that farms are prepared for future challenges and opportunities [68,110]. This support can significantly reduce financial burden [136].

4.8. Consumer Awareness and Community Support

Raising consumer awareness of the benefits of locally produced dairy products can increase demand for small farm offerings [41,121]. Educational campaigns and community engagement programs can build a strong local consumer base, supporting small farms. Programs like farm-to-table initiatives and local food movements emphasize sustainability and local heritage, attracting consumers willing to pay premium prices for ethically produced goods.

Thus, the challenges confronting small dairy farms in the United States are complex and multifaceted. However, numerous solutions exist to help these farms not only survive but thrive in a rapidly changing agricultural landscape. By implementing policy reforms, enhancing cooperative models, adopting diversification strategies, embracing technology, and promoting consumer education, small dairy farms can significantly improve their economic sustainability [137]. Collaboration among farmers, policymakers, researchers, and consumers is essential for the successful execution of these strategies. By working together, stakeholders can create a more resilient dairy sector that not only supports small farmers but also contributes to the vitality of rural communities. Ultimately, strengthening small dairy farms will yield substantial benefits for the entire agricultural ecosystem, ensuring that these farms can continue to provide quality dairy products while maintaining their commitment to sustainability and community engagement.

As consumers become increasingly aware of the importance of supporting local agriculture, small dairy farms have the potential to play a pivotal role in the broader movement toward sustainable food systems. The path forward requires not only innovation and adaptability but also a collective commitment to fostering an environment in which small dairy farms can flourish. By prioritizing local partnerships, investing in technology and training, and advocating for policies that benefit these vital operations, we can safeguard the future of small dairy farming in the United States. A flowchart is presented to make a clear view of the small-scale dairy sustainability roadmap (Figure 4). This collective effort will not only enhance the profitability and sustainability of small dairy farms but also enrich our communities, protect our environment, and ensure that future generations can enjoy the wholesome and nutritious products that these farms provide.

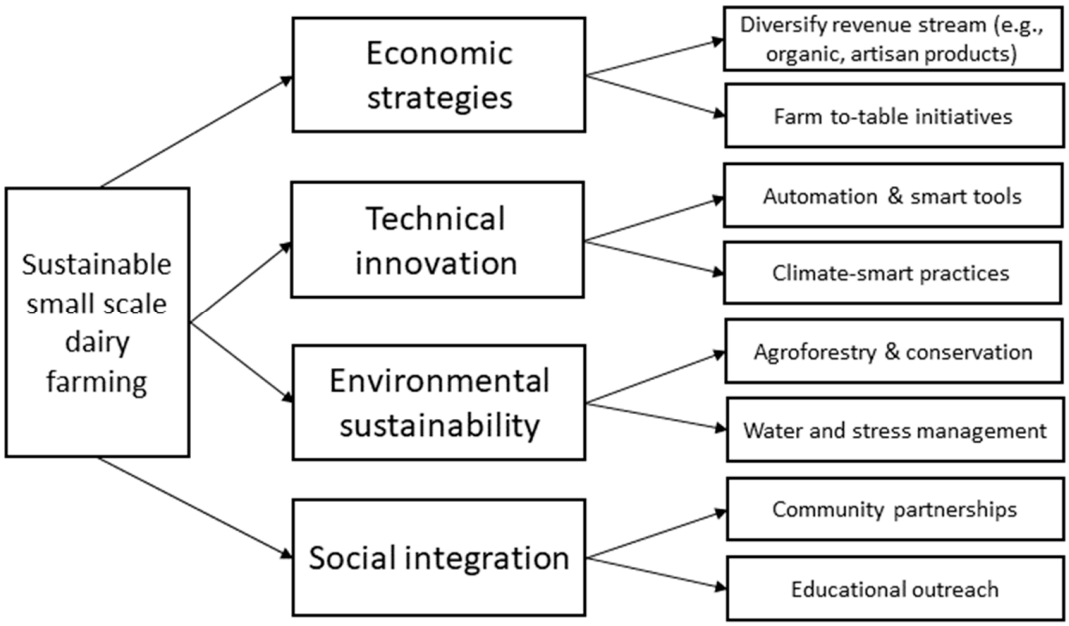

Figure 4. Framework for resilient small-scale dairy operations in the U.S.

5. Lessons from Successful Management of Small Dairy Farms

Small dairy farms in the U.S.A. face significant challenges in achieving profitability and sustainability in a competitive market. In response to evolving consumer preferences, environmental regulations, and economic constraints, many small farms have adopted innovative practices that differentiate their products and establish stable income streams. This section presents case studies of small dairy farms that have successfully implemented strategies such as organic farming, cooperative models, niche product development, climate-smart agriculture, agroforestry, and diversification. These examples provide insights into how targeted approaches can enhance the financial and environmental sustainability of small and medium-sized dairy operations.

The transition to organic dairy farming is exemplified by Maple Hill Creamery, a New York-based farm founded in 2009. Specializing in 100% grass-fed organic milk, Maple Hill has capitalized on rising demand for sustainable, ethically produced food. Organic certification has enabled the farm to command premium prices, while strong branding and marketing strategies that emphasize sustainability and animal welfare have built a loyal customer base. Partnering with local grocery stores and health food retailers has created direct-to-consumer sales channels, boosted profit margins, and driven revenue growth [138].

Similarly, Organic Valley, a farmer-owned cooperative founded in 1988, highlights the benefits of the cooperative model for small dairy farms. With over 2000 family farms across the U.S., Organic Valley leverages collective marketing and branding to build consumer loyalty. The cooperative also provides shared resources such as veterinary services and feed purchases, reducing costs and improving operational efficiency. Its ability to negotiate stable prices ensures steady income for members, minimizing risks from market fluctuations and supporting long-term financial sustainability [139].

Grafton Village Cheese in Vermont has established a niche in the specialty cheese market by focusing on artisanal, handcrafted cheeses. By collaborating with local dairy farms and utilizing traditional cheese-making techniques, Grafton Village appeals to consumers seeking high-quality, authentic products. Through direct sales at farmers' markets, online platforms, and local retailers, Grafton Village has minimized reliance on larger distribution networks and positioned itself as a premium brand in niche markets [140].

Baird Family Farm in Wisconsin offers an example of climate-smart agricultural practices integrated into dairy farming. Precision feeding techniques and nutrient management

plans optimize feed efficiency while anaerobic digesters convert manure into biogas, providing renewable energy and reducing greenhouse gas emissions. These practices, along with diversification into crop production, have enhanced farm resilience and environmental sustainability [141].

Silver Oak Dairy in California has successfully implemented agroforestry practices through a silvopasture model. Integrating fast-growing trees and shrubs into forage and livestock production, Silver Oak has improved animal welfare by providing natural shade, reducing heat stress, and enhancing milk yields. The inclusion of trees also enhances biodiversity, provides additional fodder, and sequesters carbon, demonstrating the potential for combining agroforestry with dairy farming to achieve both environmental and economic benefits [142].

Finally, Hilltop Dairy in Colorado illustrates the benefits of diversification within organic dairy farming. Alongside its organic dairy production, Hilltop has incorporated poultry and crop farming, which expands its revenue streams. The addition of organic eggs and specialty grains provides greater financial stability, while integrating poultry for pest control and nutrient recycling improves soil health. This multifunctional approach enhances farm resilience, making Hilltop less vulnerable to market or environmental disruptions [143].

In conclusion, these case studies showcase diverse strategies for achieving profitability and sustainability in dairy farming through organic transitions, cooperative models, niche marketing, climate-smart practices, agroforestry, and diversification. Each farm has tailored its approach to its specific context, demonstrating that small and medium-sized dairy farms can thrive by prioritizing both environmental stewardship and financial sustainability. The successful application of these practices provides a roadmap for other small-scale dairy operations seeking to remain viable and resilient in a challenging agricultural landscape.

6. Practical and Financial Implications

The proposed interventions for small dairy farms offer a combination of short- and long-term benefits, addressing immediate challenges while laying the groundwork for sustainable growth. In the short term, measures such as government subsidies, cooperative models, and low-interest loans alleviate financial pressures. Programs like the Dairy Margin Coverage (DMC) provide a financial safety net against milk price volatility, while cooperatives, exemplified by Organic Valley, enable farmers to pool resources, reduce costs, and improve market access. These initiatives strengthen bargaining power and help address challenges such as feed costs, labor shortages, and technology adoption. In the long term, these interventions promote sustainability and structural transformation. Investments in advanced technologies, such as anaerobic digesters and automated milking systems, are critical. Anaerobic digesters convert manure into biogas, reducing greenhouse gas emissions and generating renewable energy, which provides an additional income stream. Automated milking systems enhance efficiency by reducing labor dependency and stabilizing milk yields. Innovations like Silver Oak Dairy's integration of agroforestry practices, including silvopasture, demonstrate how environmental benefits, such as carbon sequestration, can align with improved animal welfare and profitability. Similarly, Organic Valley's cooperative model and Maple Hill Creamery's transition to 100% organic production highlight the scalability and market differentiation potential of targeting niche markets and achieving economies of scale. To ensure widespread adoption, targeted support is essential. Educational initiatives, extension services, and on-farm demonstrations help farmers adopt advanced practices by reducing uncertainty and showcasing tangible benefits. Financial incentives, such as subsidies and low-interest loans, offset the upfront costs of innovation. Collaborative training programs with agricultural colleges address skill gaps and foster hands-on learning. Overcoming cultural and operational resistance requires clear evidence of benefits through case studies, streamlined access to financial support, and platforms for peer-to-peer learning where farmers can share experiences and best practices. Stakeholders play a pivotal role in implementing these strategies. Policymakers

are essential for developing financial assistance programs, streamlining regulations, and incentivizing sustainable practices through grants and subsidies. Researchers provide critical insights, conduct longitudinal studies, and facilitate knowledge transfer through workshops and accessible resources. Agricultural organizations act as intermediaries, supporting cooperative models, offering technical assistance, and enhancing market access via direct-to-consumer channels and collective bargaining. Collaboration among these stakeholders through partnerships and pilot projects ensures the successful implementation of proposed changes. This integrated approach enables small dairy farms to adapt to evolving market dynamics and environmental demands, ensuring their competitiveness and sustainability. With collective efforts and sustained support, these farms can maintain agricultural diversity, support rural economies, and contribute to sustainable food systems.

7. Research Gaps and Future Directions of Research

Small dairy farms in the United States face unique challenges, necessitating targeted research to enhance their economic viability, sustainability, and resilience. Although various issues have been studied, significant gaps persist in understanding economic modeling, sustainability practices, labor dynamics, policy impacts, market access, and technology adoption. Addressing these gaps will be vital to supporting small farms in a highly competitive environment. Economic viability is a primary concern, as existing financial analyses typically focus on larger operations, neglecting the unique dynamics of small farms [6,20,22,24]. Future research should create models that account for varying input costs, market volatility, and labor constraints specific to smaller farms. This would involve examining cost structures and successful strategies, such as niche marketing, to provide effective business models [144].

Longitudinal studies would help identify economic trends and guide sustainable policy recommendations [145,146]. Sustainability practices and the environmental impact of small dairy farms also require more research. There are limited data on greenhouse gas emissions and climate-smart practices suited to small operations [98]. Future studies should investigate low-cost, high-impact sustainability practices and assess how technologies like precision agriculture and automated systems can enhance productivity while minimizing environmental harm [147]. Understanding the cost–benefit ratios of these technologies is critical to support adoption among small-scale farms facing tight financial constraints. Labor dynamics and workforce development are key issues, as labor shortages and high turnover rates hamper productivity [21]. Research is needed to identify factors influencing labor retention and develop training programs specific to small dairy operations [62,100]. Extension services and technical assistance should also be studied for their effectiveness in improving workforce stability and productivity.

The aging population of dairy farmers in the United States adds to the challenges facing small-scale operations. The average age of small dairy farm operators is in the late 50s or early 60s, with many nearing retirement and lacking successors [27]. This issue arises as younger generations increasingly move away from agriculture due to economic challenges, lifestyle shifts, and a perceived lack of opportunities in farming. Efforts to address this issue include farm transition programs that facilitate succession planning and provide resources to help retiring farmers transfer their operations to the next generation [33]. Apprenticeship and mentorship programs are also being implemented to attract young farmers, offering hands-on experience and financial incentives. These initiatives aim to bridge the generational gap, ensuring the continuity and sustainability of small dairy farms in the U.S.

Policy analysis and advocacy often overlook the needs of small-scale dairy farms, favoring larger operations. Future research should examine how existing policies, such as subsidies and market restrictions, impact small farms and propose targeted solutions like customized subsidies and technical support [148]. Engaging small farm stakeholders in policymaking will ensure regulations reflect their unique challenges. Market access and local food systems need further exploration to enhance small farm competitiveness. Cooperative

models and direct marketing show promise, but barriers to implementing these strategies need further study [127]. In future iterations of this research, we propose including direct consultation with dairy farmers through surveys, focus groups, and participatory workshops. This approach will help validate the feasibility of proposed solutions and refine strategies to align better with farmers' operational realities and priorities. Understanding consumer preferences for local and sustainable dairy products can help develop marketing strategies emphasizing quality and sustainability [117]. Finally, addressing technology adoption barriers is crucial, as economic and social obstacles often limit small farms' use of new technologies [28]. Identifying these barriers and offering targeted support programs will be essential for empowering small farms to leverage modern advancements, ensuring their long-term sustainability and resilience.

8. Conclusions

Small-scale dairy farms (SSDFs) are indispensable to the economic, social, and environmental fabric of rural communities and local food systems in the United States. This study successfully achieved its objectives by identifying critical challenges, such as market volatility, escalating production costs, regulatory pressures, and labor shortages, that undermine the sustainability of SSDFs. By systematically analyzing these barriers, the research provides targeted strategies to address them, offering valuable insights into the sustainability of these farms. The proposed interventions include fostering affordable access to advanced technologies like precision agriculture and automated milking systems to enhance efficiency and reduce costs. Strengthening cooperative frameworks is another key strategy, enabling resource sharing, enhancing market power, and improving access to broader markets. Diversification into value-added products, such as organic dairy and artisanal cheese, offers promising avenues for stabilizing income and building resilience. Furthermore, environmental sustainability measures—such as manure management, renewable energy integration, and rotational grazing—align economic viability with ecological benefits. To translate these findings into actionable outcomes, the study underscores the importance of tailored financial support programs, streamlined regulatory frameworks, and incentives for sustainable technology adoption. Investments in workforce development, including targeted training initiatives and infrastructure improvements, are vital for addressing labor shortages and attracting a new generation of dairy farmers.

Additionally, this research lays the foundation for future exploration into the lived experiences of small-scale dairy farmers. Incorporating personalized data collection methods, such as surveys, can provide deeper insights into the specific challenges farmers face and validate the relevance of the strategies proposed in this study. This approach ensures that solutions are not only theoretically sound but also practically applicable, aligning closely with farmers' realities. In conclusion, this research highlights the interconnected economic, environmental, and operational challenges faced by SSDFs and provides a comprehensive roadmap for fostering their sustainability. By implementing the proposed strategies and policy interventions, stakeholders can safeguard the future of SSDFs, ensuring their continued contribution to rural development, food systems, and environmental stewardship. This integrated approach not only strengthens small dairy farming but also promotes broader sustainability and resilience within the U.S. dairy industry.

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