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ENHANCING THE SMALL RUMINANT VALUE CHAIN USING SWOT ANALYSIS IN MAFRAQ GOVERNORATE, JORDAN

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Abstract

This study investigated the small ruminant value chain to identify key factors influencing its effectiveness and sustainability. Surveys were conducted on 156 out of 5824 farmers and semi-structured interviews were carried out with other stakeholders in the value chain to gather qualitative data in 2021. The analysis revealed that small ruminant activities were predominantly managed by medium and small farmers primarily engaging in cash sales. Although 45.51% of the farmers surveyed expressed interest in expanding their production systems, they faced challenges such as limited access to inputs, ineffective production management, and inadequate marketing infrastructure, all of which adversely impacted productivity and income. Additionally, environmental factors, including climate change and the Syrian refugee crisis, further strained grazing lands and increased production costs. The study highlighted that insufficient infrastructure and limited bargaining power, exacerbated by political

and environmental challenges, hindered the overall performance of the value chain. Recommendations derived from SWOT analysis include forming cooperatives, enhancing production efficiency, and developing strategies to stabilize local and regional markets to address these issues and improve the sustainability of the value chain.

Keywords: Small ruminant, Value Chain analysis, Arid and semi-arid region, Jordan, Mafraq.

تعزيز سلسلة القيمة للمجترات الصغيرة باستخدام التحليل الرباعي (SWOT) في محافظة المفرق، الأردن

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الخلاصة

تهدف هذه الدراسة إلى تقييم سلسلة قيمة المجترات الصغيرة وتحديد العوامل الرئيسية التي تؤثر على فعاليتها واستدامتها. أجريت المسوحات مع 156 من أصل 5824 مزارعًا، كما أجريت مقابلات شبه منظمة مع أصحاب المصلحة الآخرين في سلسلة القيمة لجمع البيانات النوعية في عام 2021. كشف التحليل أن أنشطة المجترات الصغيرة يديرها في الغالب المزارعون المتوسطون والصغار، الذين انخرطوا في المقام الأول في المبيعات النقدية. على الرغم من أن 45.51٪ من المزارعين أعربوا عن اهتمامهم بتوسيع أنظمة إنتاجهم، إلا أنهم واجهوا تحديات مثل محدودية الوصول إلى المدخلات، وإدارة الإنتاج غير الفعّالة، والبنية التحتية التسويقية غير الكافية، وكلها أثرت سلبًا على الإنتاجية والدخل. بالإضافة إلى ذلك، أدت العوامل البيئية، بما في ذلك تغير المناخ وأزمة اللاجئين السوريين، إلى زيادة إجهاد أراضي الرعي وزيادة تكاليف الإنتاج. وسلطت الدراسة الضوء على أن البنية التحتية غير الكافية والقوة التفاوضية المحدودة، والتي تفاقمت بسبب التحديات السياسية والبيئية، أعاقت الأداء العام لسلسلة القيمة. واقترحت التوصيات المستمدة من تحليل نقاط القوة والضعف والفرص

والتهديدات تشكيل تعاونيات، وتعزيز كفاءة الإنتاج، وتطوير استراتيجيات لتحقيق الاستقرار في الأسواق المحلية والإقليمية لمعالجة هذه القضايا وتحسين استدامة سلسلة القيمة.

كلمات مفتاحية: المجترات الصغيرة، تحليل سلسلة القيمة، المنطقة القاحلة وشبه القاحلة، الأردن، المفرق.

Introduction

Livestock farming, especially small ruminant production, plays a crucial role in addressing the nutritional and economic needs of communities in arid and semi-arid regions (34). These regions face significant challenges that impede agricultural productivity, including limited water resources, high temperatures, and a scarcity of vegetation and fodder (47). Understanding the complexities of the small ruminant value chain in such environments is essential for developing sustainable strategies to enhance productivity, generate income, and improve the overall welfare of local populations (22). The value chain encompasses the diverse stakeholders, activities, services, and barriers involved in the movement of small ruminant products from resource providers and farmers to end consumers (44).

The Mafraq Governorate in Jordan offers a unique opportunity to study this value chain and its implications for local livelihoods and agricultural sustainability. Despite the harsh climatic conditions and limited resources in Mafraq (12), it is recognized as a key agricultural zone in Jordan, covering approximately 14% of the nation's total cultivated land for field crops (31). Notably, the governorate has the highest concentration of small ruminants in Jordan, with 837,550 heads reported at the end of 2021, accounting for 23.29% of the national total (39). Local communities have historically depended on small ruminant farming as a vital livelihood source (6).

Nevertheless, research specifically addressing small ruminant rearing and breeding in this region remains limited. Notably, only two studies have analyzed the small ruminant value chain in the Al-Ruwaished District and northeastern Badia of Mafraq (6 and 7). While valuable, these studies are geographically and conceptually restricted, revealing significant gaps in understanding the comprehensive dynamics of small ruminant production across the entire governorate. Expanding the value chain analysis to cover more areas within Mafraq would provide a nuanced understanding of the sector's opportunities and challenges, leading to insights that could improve efficiency and profitability for small ruminant producers.

Addressing variations and disparities across different climatic districts within Mafraq is crucial for enabling targeted interventions and strategic decision-making that promote sustainable development. By examining various stages of the value chain, such as input supply, production, processing, marketing, and consumption, this study identifies key bottlenecks and proposes actionable improvements to enhance both the efficiency and sustainability of the small ruminant sector in Mafraq Governorate. Additionally, the research provides critical insights into the socio-economic impacts of small ruminant farming on local communities, such as income generation, employment opportunities, and food security. By elucidating value chain dynamics, this study aspires to inform policymakers, researchers, and stakeholders, enabling them to develop evidence-based strategies that promote inclusive growth,

strengthen market linkages, and bolster the resilience of small ruminant production systems in the arid and semi-arid regions like Mafraq.

Materials and Methods

This study was conducted in Mafraq Governorate, located in northeastern Jordan (32° 20' 59.99" N, 36° 11' 60.00" E; Fig. 1), which is characterized by a semi-arid climate (Sharaf, 2020). Covering an area of 26,551 km², it is the second largest governorate in Jordan and is divided into four districts: Mafraq Qasaba, Ruwaished, North-eastern Badia, and North-western Badia (17). The region's diverse terrain and climate make it significant for small ruminant farming (4). Notably, Mafraq has the highest population of sheep and goats in northern Jordan (17). This abundance of small ruminants positions Mafraq as a vital area for livestock farming in the country.

Fig. 1: Study area in the Mafraq Governorate of Jordan.

This study employed the differentiation advantage approach to examine the small ruminant value chain (40), focusing on various activities and stakeholder roles. A sample of 156 small ruminant owners, representing approximately 3% of the larger population in the study area, was surveyed. Following (32), a structured random sampling technique was used to identify clusters of small ruminant owners, ensuring a diverse representation of farming practices and demographics. To mitigate potential biases from indoor surveys, local agricultural engineers and drivers facilitated communication with farmers, thereby improving access to a wide range of farming practices.

The survey investigated several aspects of the small ruminant value chain, including input supplies, husbandry, processing, marketing, consumption, and the impacts of environmental factors and the Syrian refugee crisis. In addition to the surveys, individual interviews were conducted with 14 animal health suppliers, 26 processors, and 40 traders to gather comprehensive insights. Data were analyzed

using SPSS Statistics (version 27) for quantitative analysis, while qualitative data were subjected to thematic analysis. A SWOT analysis was performed to identify challenges and opportunities within the small ruminant value chain, highlighting areas for potential intervention and development.

Results and Discussion

Assessment of small ruminant value chain performance in Mafraq Governorate: The small-ruminant value chain mapping holds significant prominence within its analysis process, as it serves as a crucial means to avoid interventions that yield no impact, squander resources, or result in interventions producing more detrimental than advantageous outcomes (3). Figure 2 illustrates the five primary stages in the small ruminant value chain within the study area, namely input supply, production, marketing, processing, and consumption. Each stage involves specific entities actively participating in the value chain process.

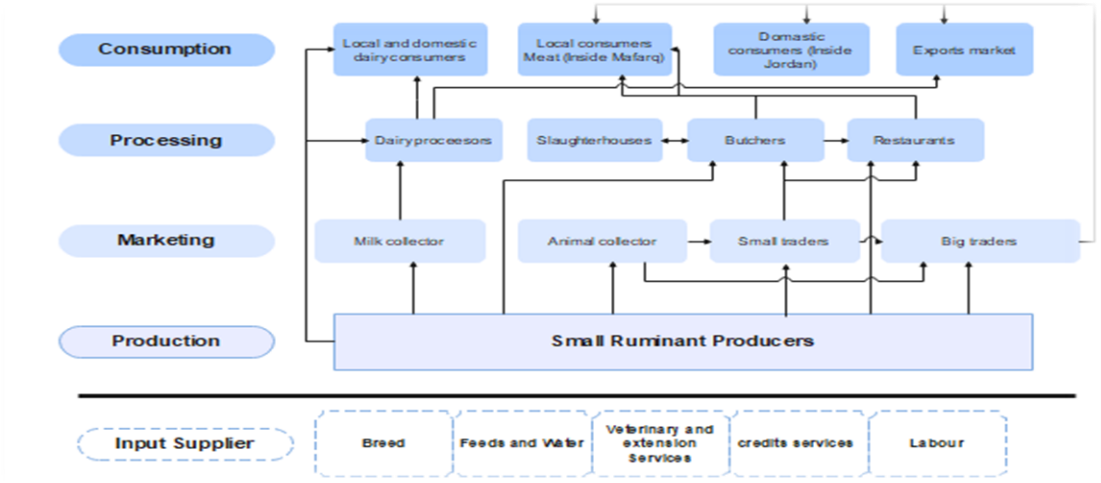

Fig. 2: Small ruminant value chain in the Mafraq Governorate, Jordan.

Analysis of the value chain dynamics:

Input Supplies: The data showed that 91.67% of small ruminant owners sourced their breeding stock from their own flocks, with only 10.9% exclusively raising goats. Awassi sheep were predominant, comprising 94.5% of the population, while Baladi goats accounted for 89.8%. Large flocks were more common in the eastern districts; for example, 45% of owners in Ruwaished managed flocks of 500 or more, compared to under 4% in the western districts such as North-West Badia and Mafraq Qasaba. Notably, all goat owners were smallholders with fewer than 100 goats per flock. These results are consistent with the adaptability of Awassi sheep to arid and semi-arid environments, making them particularly suitable for the sedentary sheep farming practiced in Jordan's Badia (20).

The extensive open lands in northeastern Badia facilitate large-scale sheep herding and contribute to the higher sheep populations in this region (2). This contrasts with urban areas, where factors such as land availability and use conflicts limit sheep holdings. In contrast, the lower number of goat holdings and the prevalence of small-scale farming can be attributed to the arid climate and restrictive cultural practices. Goats, while valuable and affordable, are less suited to harsh desert conditions

compared to sheep and are thus more commonly raised in rural areas with more favorable climates (1). This results in smaller, more concentrated goat farming operations in less suitable environments.

Veterinary and extension services in the study area were predominantly provided by the Ministry of Agriculture through four agricultural directorates and two veterinary centers. These government agencies were responsible for implementing regulations, controlling diseases, and organizing vaccination campaigns at no cost to farmers (12). Additionally, private veterinary clinics, particularly in the central and western regions, were generally effective and adequate. Agricultural cooperatives also supported these services by conducting training sessions and workshops, often in collaboration with the Ministry of Agriculture and non-governmental organizations.

Nevertheless, the Al-Ruwaished District suffers from insufficient service coverage, as noted by (7). Despite the availability of free government services, 64.5% of sheep and goat owners preferred private veterinary clinics, while 14.28% opted for government services, primarily due to their no-cost nature. These findings reflect the issues raised by (16), which noted that government agencies often face resource constraints and bureaucratic delays that can degrade service quality. Private clinics tend to offer more personalized and responsive care, fostering long-term relationships with clients to better address the unique challenges of individual herds, whereas government agencies typically provide more standardized and transactional services.

The results show that concentrated and formulated feeds were not widely utilized for small ruminants. The study found that the primary feed options available were wheat bran and barley. These feeds were supplied through a subsidy program by the Jordanian Ministry of Industry and Trade. Specifically, barley was priced at $247 per ton, with farmers receiving 20 kg per head of sheep or goat per month. Wheat bran was priced at $108.50 per ton, with a provision of 500 g per head per month. However, study participants reported that these quantities were insufficient to meet the nutritional needs of their animals. The study revealed that 43.5% of the sheep and goat owners cultivated barley. Recent persistent arid conditions had hindered rangeland growth, and the presence of Syrian refugee camps in the northern and western areas of the governorate further compounded the challenge. The establishment of these camps in rangeland areas restricted the availability and quality of pastures, as noted by (6). Additionally, over 40% of the farmers had to purchase water tanks for their animals, with costs varying based on proximity to artesian wells and seasonal factors.

The findings indicate that family labor comprised a substantial portion (65.38%) of the workforce in small ruminant farming. This high reliance on family labor was due to the relatively minimal labor requirements for managing small ruminants, which allowed for easy management within households (33). The study also found that Syrian workers represented the largest share of paid labor, particularly in the Qasabah and Western Badia Districts, reflecting the significant Syrian refugee population in Mafraq. Syrian workers earned lower wages compared to other nationalities, with Sudanese and Egyptian workers receiving approximately $704.83 per month, while Syrian workers earned around $422.90 per month for similar tasks.

The results show that to address feed shortages, 17.95% of the study participants received credit services in the form of interest-free loans, which allowed them to purchase feed up to a maximum of $3,523.65. Only one participant obtained a loan with a 9% interest rate, amounting to $14,094.61, for the acquisition of additional animals. These loans were primarily provided by the Agricultural Credit Corporation, a government agency, and a cooperative association. The corporation requires collateral in the form of land or residential property, which prevents small ruminant owners who lack such assets from securing the necessary financial support.

The study findings indicate that small ruminant owners in the Mafraq Governorate experienced significant challenges related to feed availability and financial constraints, consistent with issues reported in India, northeastern Syria, and Jordan (6, 14 and 15).

Production Management: The study found that small ruminant production was predominantly managed by medium-sized holders owning between 100 and 500 animals. This group accounted for over 50% of small ruminant owners. The animals were primarily raised for cash sales, as illustrated in Figure 3. This could be attributed to factors such as resource availability, adaptation to harsh environmental conditions, and the specific needs and practices of the respective habitats (53).

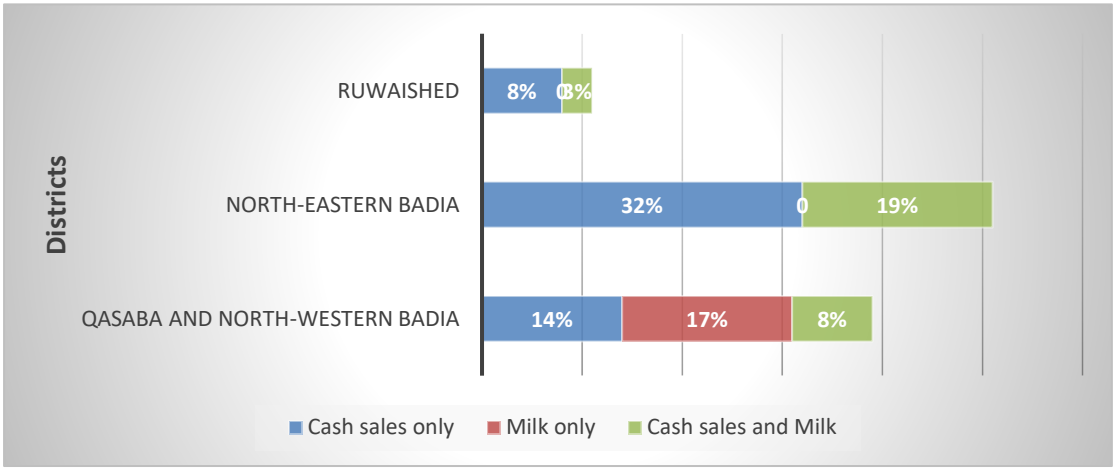

Fig. 3: Reasons for retaining small ruminant breeding females in the Mafraq Governorate during 2021.

In desert regions, small ruminant herding was observed to be commonly practiced in a nomadic or extensive manner, with herders relocating their flocks over large areas to find favorable grazing conditions (24). Thus, focusing on the number of births per gestation was crucial for expanding and managing herd size. Conversely, rural and urban areas had a higher demand for milk production to meet local consumption needs. Sheep's milk was used for various purposes, including direct consumption, cheese-making, and other dairy products, making milk production a significant factor for sheep farming in these regions.

Regarding housing, the study found that 40.39% of sheep and goat farmers used fenced structures, with 65.08% of these opting for closed barns. The data indicated that 45.51% of farmers preferred an extensive production system to locate water sources or ensure adequate feed for their flocks, while 42.95% chose a semi-extensive

system. Only 11.54% of farmers utilized an intensive production system, predominantly in the western part of the governorate.

The study highlighted that veterinary services were a significant concern. According to (19), livestock diseases were a major production hindrance. In the study area, farmers and animal health providers reported that veterinary services were financially burdensome and inadequate. About half of the small ruminant farmers expressed difficulties in accessing veterinary care, mainly due to geographical distance from clinics, which posed a significant challenge, especially for those in remote or nomadic situations. Reported health issues included enterotoxaemia, PPR, brucellosis, as well as cases of sheep and goat pox, pneumonia, foot and mouth disease, mastitis, newborn diarrhea, acetonemia, *Taenia multiceps*, and Pasteurella.

Breeding practices in the study area were found to be predominantly natural, with only 25.6% of farmers engaging in controlled breeding. This preference was attributed to the superior performance of traditional uncontrolled breeding systems (51) and communal grazing practices (26).

The results, as shown in Figure 3, indicate that fewer than half of the small ruminant breeders engaged in milk production. The distance between production and consumption areas was identified as a notable obstacle. Additionally, breeders did not adhere to formal record-keeping or direct measurement methods for production quantities, relying instead on estimates based on the amount of milk supplied to dairy processors. The average daily milk production for sheep was estimated at approximately 300 grams per head, with higher yields observed during periods of abundant feed, particularly in March and April. Wool production was infrequent, as there was no market for wool from local breeders.

Marketing: The marketing system comprises various interrelated and generally consistent frameworks that facilitate the economic processes of production, distribution, and consumption (5). This finding aligns with (43), who emphasized that marketing includes all activities essential for transferring products from producers to consumers. In the study area, different methods were employed to market sheep and goats (Fig. 4). Merchants typically used intermediaries to collect lambs from farmers, particularly those located farther from the central markets. This system was advantageous for many smallholder farmers, as it alleviated the burden of transporting animals to the markets and often resulted in more favorable pricing compared to direct market prices. Intermediaries and small traders generally purchased lambs aged two to three months during production seasons at an average price of approximately $155 per head. These lambs were primarily resold to larger farmers for fattening before export to the Arabian Gulf, particularly Saudi Arabia. The main venue for small ruminant trade was the local livestock market, open on Tuesdays and Fridays. This market catered to both local and external traders and butchers. Additionally, the Al-Manara Market served the Salhiya and Naifa municipalities, while the unofficial Ruwaished Market catered to the Ruwaished District. These markets lack formal regulations, as reported by stakeholders. Feedback from stakeholders indicated that market prices were largely influenced by traders and fluctuated seasonally, with increases during Spring (March to May).

Prices also varied with the opening and closing of export opportunities, rising when exports were permitted based on supply and demand. These seasonal variations and export-related price changes posed challenges that smallholders often struggled to navigate effectively (21). Traders reported an average profit margin of no more than 35%.

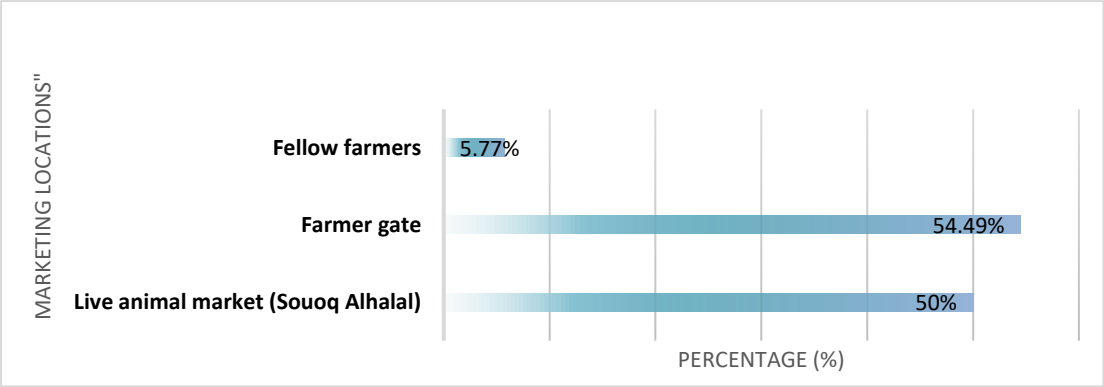

Fig. 4: Small-ruminant marketing and breeder locations in the Mafraq Governorate.

Butchers primarily sourced their livestock from nearby farmers or local fattening farms, especially in the Khalidiya area, though they also utilized markets to supplement their inventory.

In the surveyed area, fewer than 20% of farmers produced milk solely for personal consumption. Most dairy producers sold sheep milk to processors, who offered an average price of $0.99 per liter. Sales of goat milk were relatively rare. Milk collection was typically done directly from producers by processors, who used small, non-refrigerated vehicles for transportation. In the eastern regions, milk was collected and processed into white cheese at the production site before being sent to distribution centers. Conversely, the Eabq Asahra' Cooperative Association in the Al-Sarhan area employed mobile coolers to collect milk from local producers, which was then transported to their dairy processing facility. The producers and processors identified significant challenges in promoting sheep milk, primarily due to the geographical distance between production sites and marketing points, as well as the seasonal availability of milk. This concern directly impacted their ability to effectively market sheep milk.

(42) highlighted broader structural issues within the dairy sector, such as a declining number of young farmers, low education levels, and inadequate cooperative support, which further discouraged participation and complicated operational dynamics. Additionally, the dominance of intermediaries in the market underscored the need to foster direct relationships between farmers and consumers to improve profitability, as suggested by (10). Although transportation costs were not identified as a barrier by farmers, their reliance on intermediaries diminished their bargaining power, leading to reduced returns on their products, as noted by (5). To enhance financial outcomes and strengthen positions within the sheep and goat value chain, implementing strategies to improve direct marketing and market access for smallholder farmers is crucial, as recommended by (8).

Processing: According to the results of our market survey, meat processing in the study area primarily involved local butchers, restaurants, consumers, and the Mafraq Municipal slaughterhouse. The survey found sheep often slaughtered at home for family gatherings, ceremonial meals, or religious festivities. Typically, lambs weighing between 25 and 30 kg are selected for slaughter. Butchers, as reported in the survey, offer raw meat for sale either as whole carcasses or in various cuts, with prices averaging $14.10 per kilogram. Edible internal organs are also available, at approximately $8.46 per kilogram. All processing establishments, including restaurants and butchers, operate under the supervision of the Jordanian Ministry of Health, ensuring adherence to food safety standards, as indicated by our survey data. In a comparative context, it is noteworthy that in Pakistan's Chakwal district, processing and slaughtering of small ruminants occur in certified slaughterhouses at the district level. However, the transportation of carcasses to retail shops is often criticized for lacking proper hygienic and safety protocols (49). This highlights potential vulnerabilities in the meat supply chain that are pertinent to food safety concerns.

Sheep dairy products are typically produced either by individual producers for personal use and sale in dairy shops, or by dairy processors. According to the processors, the dairy processing industry in Mafraq is well-known for its traditional techniques, which have been handed down through generations, thus ensuring the preservation of the authentic flavors specific to the region. The primary ingredient used in the production of various dairy products is white cheese and Jameed, a Middle Eastern dish made from hardened, dried yogurt derived from sheep's milk and a key component of Mansaf, Jordan's national dish. There is only a single dairy manufacturer in the governorate that specializes in Awassi sheep products.

The production of these items primarily takes place during the spring season, particularly after mid-March, when sheep milk is readily available. The sales of these products rely heavily on the trust and reputation established by both producers and consumers, meeting the demand for them, especially in the capital city. The reliance on traditional techniques and the emphasis on regional authenticity in Mafraq's sheep dairy products illustrate how local producers build consumer trust and meet demand. This is supported by (54), which highlights that consumer trust in food safety and quality can be reinforced through product assurance and the credibility of food system actors, particularly when geographical origin and production methods align with consumer values and expectations.

Consumption: The local community relies heavily on homemade dairy products and those sold at nearby dairy shops. These dairy products were predominantly consumed within the country, with dairy processors primarily marketing their products in the capital city. Notably, specific products such as Jameed and white cheese were also exported from Jordan. Stakeholder responses indicated that consumers in the study area preferred locally sourced meat over imported alternatives, with a particular preference for sheep meat compared to veal or white meat. However, due to challenging economic conditions, the consumption of local sheep meat had declined in recent years, particularly around the governorate center.

Despite this, a significant surge in demand for local sheep meat was observed during the holy month of Ramadan. This increase was attributed to the cultural significance of Ramadan, which led to more elaborate feasts and a greater variety of dishes prepared for Iftar. This pattern of increased demand for sheep meat during Ramadan was consistent with similar trends observed before significant religious events, such as Eid Al-Adha, and in other countries like Pakistan and Indonesia (28 and 49).

Assessment and addressing small ruminant value chain performance in Mafraq governorate: Recognizing and understanding the limitations in sheep production are a fundamental step in resolving issues and enhancing sheep productivity (11). Therefore, using SWOT analysis is crucial in formulating strategies to strengthen the value chain, capitalize on prospects, manage potential risks, and make well-informed decisions to boost competitiveness and ensure sustainable growth (30). The SWOT for the small ruminant value chain in the designated study region is shown in Table 1.

Table 1: SWOT analysis for the small ruminant value chain in the Mafraq Governorate, Jordan.

Strengths	Weaknesses
S1. A sizable population of small ruminants along with a significant number of breeders, who benefit from vast expanses of grazing lands.	W1. Seasonality negatively impacts small ruminant product availability and sales.
S2. Well-established market demands, ensuring a reliable and consistent market for small ruminant products.	W2. Limited connection and collaboration among stakeholders within the small ruminant value chain hinder its overall development.
S3. The existence of a development zone with franchises that stimulate investment.	W3. Insufficient supply and high input costs.
S4. Small ruminant production represents the primary source of livelihood for residents in Mafraq, guaranteeing the sustainability and long-term stability of this sector.	W4. Ineffective production management practices leading to inefficiencies within the small ruminant value chain.
S5. Adequate availability of labor.	W5. Destruction of the rangelands due to the presence of Syrian refugees.
Opportunities	**Threats**
O1. Climatic suitability provides a readily available source of forage for small ruminants and reduces the incidence of diseases that commonly affect small ruminants in humid areas.	T1. Political instability of neighboring countries, which may disrupt and pose risks to sheep production and export activities.
O2. Availability of land provides an opportunity for small ruminant farmers to increase their production and income.	T2. Unpredictable weather patterns, and increased frequency of extreme weather events
O3. Trade opportunities offered by the governorate's proximity to other countries can facilitate trade agreements.	T3. Unexpected increases in production costs.
O4. Utilizing the plentiful sheep production and implementing a branding system.	T4. Shifts in consumer demand to imports.
O5. Growth of self-employment and entrepreneurship	T5. Farmer’s willingness to seek fixed-income job opportunities.
	T6. Unfavorable government policy.

To address the identified challenges within the small ruminant value chain and to capitalize on its strengths and opportunities, a series of potential interventions can be proposed. These interventions aim to enhance productivity, improve market access, and strengthen overall resilience within the value chain (48). A thorough assessment of the feasibility of these interventions is essential, as well as an exploration of the potential challenges that may arise during their implementation. By systematically evaluating these factors, stakeholders can develop targeted strategies that optimize outcomes for small ruminant producers and associated industries (9).

Below is a comprehensive review of each intervention:

1. Creating Cooperative Systems: Creating cooperatives allows small ruminant farmers to benefit from economies of scale, reduce costs associated with purchasing inputs in bulk and leverage on collective bargaining power. This can lead to significant savings and a stronger negotiating position with suppliers (13). However, establishing and managing a cooperative can be complex, requiring strong organizational skills and trust among members (27).
2. Assisting Small Ruminant Farmers in Accessing Financing Options: Access to financing enables farmers to purchase necessary inputs, improve infrastructure, and expand their operations (5). Small ruminant farmers face high-interest rates or stringent loan conditions due to perceived risks (50). Additionally, many farmers lack the collateral needed to secure loans, making it challenging to access necessary funds (7).
3. Implementing Training Programs and Providing Technical Support: Training programs can significantly improve farming practices, leading to better production management and increased efficiency (45). Peer learning can also enhance the impact of these programs (41). However, the success of these programs requires accurate identification of farmers' needs, qualified trainers and adequate resources (38).
4. Developing and executing sustainable plans for grazing management: Sustainable grazing management can enhance pasture health, boost productivity, and benefit the environment by promoting more responsible land use (23). Farmers may lack knowledge about sustainable grazing practices, and initial implementation might require significant investments in infrastructure and training. Additionally, grazing plans need to be adaptable to varying environmental conditions and climatic changes (18).
5. Introducing Strategies for Breeding and Husbandry Practices: Improved breeding strategies can enhance productivity and ensure year-round availability of products, while better husbandry practices can lead to healthier livestock and increased yields (51). Implementing these practices may requires specialized knowledge and can be costly. Additionally, these strategies must be adapted to local environmental and market conditions to be effective.
6. Educating Farmers on Effective Marketing Techniques: Effective marketing education helps farmers better position their products, manage seasonality impacts, and grow their businesses, thereby increasing their market access and profitability (36).

7. Conducting Market Research: Market research provides valuable insights into consumer demand and preferences, allowing farmers to align their production with market needs and make informed business decisions. Conducting market research can be expensive and time-consuming, and interpreting and applying the findings can be complex. Additionally, consumer preferences and market conditions can change rapidly, potentially making research findings less relevant over time (46).
8. Analyzing Political Situations: Understanding the political landscape can aid in strategic planning and risk management, helping farmers navigate potential risks and make informed decisions related to production and export. Political situations can be complex and unpredictable, requiring continuous monitoring and analysis, which can be resource-intensive. The inherent uncertainty in political environments can pose ongoing challenges.
9. Expanding Import and Export Markets: Expanding into new markets diversifies income sources, reduces reliance on local markets, and opens new revenue streams, offering opportunities for growth. Navigating trade barriers, tariffs, and regulations can be complex and challenging. Establishing a presence in new markets requires significant investment and effort, and these markets may also have their own political and economic risks.
10. Establishing plans to Minimize Impact of Extreme Weather: Implementing systems such as weather forecasting and contingency plans can enhance resilience to extreme weather events, protecting livestock and ensuring continuity in production (25). Despite planning, extreme weather events remain unpredictable and can still pose significant risks.
11. Initiating Dialogue and Advocacy with Government Stakeholders: Engaging with government stakeholders can foster collaborative solutions and support for the value chain, and address specific issues and concerns faced by farmers. Effective dialogue requires clear communication and understanding of various stakeholder interests. Achieving meaningful engagement demands political will and sustained effort, as advocacy often involves long-term commitment and perseverance (37).

While each intervention offers significant potential benefits for small ruminant farmers, realizing these benefits requires careful planning, effective stakeholder engagement, and addressing specific challenges.

Impact of climate change and Syrian asylum on the small ruminant value chain in the Mafraq Governorate: Climate change presents serious challenges to raising animals, especially for small ruminants like sheep and goats (52). These challenges are especially important for small ruminant farming systems. Climate-related issues, such as drought and plant species, significantly undermine these farming systems by reducing grazing land, harming the health of livestock, and increasing food insecurity for pastoralist communities that depend on livestock for their livelihood (35). The results of our study showed that rising temperatures and fluctuating rainfall patterns in the study area negatively affected all sheep and goat breeders, leading to a reduction in pasture areas and subsequently higher production costs.

The Syrian refugee crisis has exacerbated these challenges. Over half of the surveyed sheep and goat breeders reported detrimental impacts due to the influx of refugees. This situation has led to higher production costs, driven by rising prices for animal feed and increased rental fees for agricultural land. The establishment of refugee camps has diminished the availability of grazing lands, further stressing the resources required for sustainable livestock production. These findings are consistent with the assertion by (29) that the presence of refugees intensifies resource competition within host communities, resulting in various negative economic, social, and environmental outcomes.

Conclusions

This study offered a comprehensive assessment of the small ruminant value chain in the Mafraq Governorate of Jordan, highlighting the critical interplay between agricultural practices, socio-economic dynamics, and environmental challenges in arid and semi-arid regions. The findings reveal that small ruminants, particularly Awassi sheep (representing approximately 94.5% of the local population) and Baladi goats (accounting for nearly 90%), are vital to the livelihoods of local communities, providing significant economic benefits and nutritional security.

Despite their importance, the value chain faces substantial challenges. Limited feed availability is a major issue, with over 43% of sheep and goat owners growing barley to supplement their livestock. The reliance on traditional management practices, with approximately 65.4% of the workforce being family labor, further complicates the situation. Additionally, only 64.5% of producers reported satisfaction with veterinary services, indicating gaps in care and support that could impede productivity. Climate change exacerbates these problems, with rising temperatures and drought conditions reducing pasture areas and increasing production costs.

The SWOT analysis highlighted both strengths and weaknesses within the sector. The presence of over 837,000 small ruminants underscores significant market potential, while challenges such as product seasonality and rising feed costs - partly due to increased competition from Syrian refugees - pose critical issues. Proposed interventions include establishing cooperatives to improve economies of scale for the 91.7% of farmers reliant on self-sourced breeding stock and implementing targeted training programs to enhance production practices. These measures aim to boost productivity and resilience in the small ruminant sector.

Fostering collaboration among stakeholders and effectively utilizing available resources can help mitigate challenges related to variable climatic conditions and socio-economic pressures. This research underscores the need for informed policymaking that addresses local contexts, bridges gaps in the value chain, and enhances the adaptability of small ruminant producers. The insights from this study can guide government bodies, NGOs, and industry stakeholders in developing evidence-based strategies to strengthen the small ruminant industry in Mafraq, improve livelihoods, enhance food security, and support the long-term sustainability of agricultural practices in arid regions. Strengthening the small ruminant value chain will ultimately contribute to the socio-economic stability of the region amid ongoing challenges.

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No Supplementary Materials.

Author Contributions:

R. Awad, A. Mohamed-Brahmi, and A. Gasmi-Boubaker participated in the conception and design of the study; R. Awad collected data and drafted the first version of the manuscript; H. Titi participated in the design; R. Awad and M. Jaouad performed statistical analyses; H. Titi and A. Mohamed-Brahmi critically reviewed the manuscript. All authors have read and agreed to the published version of the manuscript.

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References

1. Abd-Allah, S., Mohamed, M. I., Shoukry, M. M., Salman, F. M., and Abd-El Rahman, H. H. (2019). Assessment of the traditional goat production systems in rural areas of the Nile Delta in Egypt. Bulletin of the National Research Centre, 43: 1-13. https://doi.org/10.1186/s42269-019-0153-3.
2. Abdulai, I. A. (2022). Rearing livestock on the edge of secondary cities: examining small ruminant production on the fringes of Wa, Ghana. Heliyon, 8(4). https://doi.org/10.1016/j.heliyon.2022.e09347.
3. Ahiagbe, M., Shaibu, M., Avornyo, F., Ayantunde, A. A., and Panyan, E. (2021). A guide to developing the small ruminant value chain in northern Ghana: A value chain approach. International Institute of Tropical Agriculture. Ghana. p: 42.
4. Al-Mayouf, F. (2019). The situation of spatial development in Al-Mafraq governorate. An-Najah University Journal for Research-B (Humanities), 35(12): 1925-1950. https://doi.org/10.35552/0247-035-012-001.
5. Al-Mohammedy, M. F., A., & T. Abdul-Rahaman, Y. (2024). The Impact Of Biotin And Hcg On The Levels Of Estradiol-17β, Progesterone And Sheep

Pregnancy Associated Plasma Protein B (Pappb) In Local Iraqi Ewes. Anbar Journal Of Agricultural Sciences, 22(1), 106–114. https://doi.org/10.32649/ajas.2024.183704.

6. Awad, R., Brahmi, A. M., Titi, H., Jaouad, M., and Boubaker, A. G. (2024). Exploring the value chains in the small ruminant sector: A brief review of the literature. Journal of Agricultural, Environmental and Veterinary Sciences. 8(1): 61-38. https://doi.org/10.26389/AJSRP.R091123.
7. Awad, R., Mohamed-Brahmi, A., Titi, H., Jaouad, M., and Gasmi-Boubaker, A. (2023). Assessing the small ruminant value chain in arid regions: A case study of the North-Eastern Badia Basalt Plateau in Jordan. J. Glob. Innov. Agric. Sci, 11(4): 549-560. https://doi.org/10.22194/JGIAS/23.1193.
8. Awad, R., Titi, H., Mohamed-Brahmi, A., Jaouad, M., and Gasmi-Boubaker, A. (2023). Small ruminant value chain in Al-Ruwaished district, Jordan. Regional Sustainability, 4(4): 416-424. https://doi.org/10.1016/j.regsus.2023.11.006.
9. Barua, P., Rahman, S. H., and Barua, M. (2021). Sustainable value chain approach for livestock-based livelihood strategies for communities of the southeastern coast of Bangladesh. Modern Supply Chain Research and Applications, 3(3): 191-225. https://doi.org/10.1108/MSCRA-08-2020-0021.
10. Belanche, A., Martín-Collado, D., Rose, G., and Yáñez-Ruiz, D. R. (2021). A multi-stakeholder participatory study identifies the priorities for the sustainability of the small ruminants farming sector in Europe. Animal, 15(2): 100131. https://doi.org/10.1016/j.animal.2020.100131.
11. Bellemare, M. F., Bloem, J. R., and Lim, S. (2022). Producers, consumers, and value chains in low-and middle-income countries. In Handbook of Agricultural Economics, 6: 4933-4996. https://doi.org/10.1016/bs.hesagr.2022.03.005.
12. Bosenu, A., kefelegn, K., and Solomon, G. (2014). Indigenous breeding practices and selection criteria of sheep breed in Selale area, central Ethiopia. International journal of livestock research, 4(7): 50-56. http://dx.doi.org/10.5455/ijlr.20140423043726.
13. Braam, D. H. (2022). Excluding livestock livelihoods in refugee responses: A risk to public health. Journal of Refugee Studies, 35(2): 910-928. https://doi.org/10.1093/jrs/feac006.
14. Care International – Syria Office, iMMAP. (2018). Mapping of wheat and small ruminants market systems in Al-Hasakeh Governorate.
15. Chakraborty, M., and Gupta, D. (2017). Small ruminant value chain in India: opportunities and constraints. Indian Journal of Economics and Development, 5(7): 1-5.
16. De Haan, C., and Umali, D. L. (1992). Public and private sector roles in the supply of veterinary services. In Public and Private Roles in Agricultural Development, Proceedings of 12th Agricultural Sector symposium (pp. 125-137). Washington DC: The World Bank.
17. Department of Statistic Government of Jordan. (2021). Jordan Statistical Yearbook 2021.
18. Derner, J. D., Wilmer, H., Stackhouse-Lawson, K., Place, S., and Boggess, M. (2023). Practical considerations for adaptive strategies by US grazing land

managers with a changing climate. Agrosystems, Geosciences and Environment, 6(1): e20356. https://doi.org/10.1002/agg2.20356.

19. Espinosa, R., Tago, D., and Treich, N. (2020). Infectious diseases and meat production. Environmental and Resource Economics, 76(4): 1019-1044. https://doi.org/10.1007/s10640-020-00484-3.
20. Fahmy, M. H. (2022). Sheep Breeds. Encyclopedia of Dairy Sciences (Third Edition), 131-153.
21. Gadekar, B. B. (2021). Livestock and Agricultural Development. Lulu Publication, p: 305.
22. Gebregziabhear, E. Y. O. B. (2018). Analysis of sheep value chain: the case of Adama District, East Shoa Zone of Oromia Regional State Ethiopia. CoreAcUk, 8(3): 66-78.
23. Giri, S. (2023). Advancements in Crop and Pasture Management: Enhancing Agricultural Sustainability and Productivity. Journal of Advanced Research in Agriculture Science and Technology, 6(1): 7-11.
24. Golla, B. (2021). Agricultural production system in arid and semi-arid regions. International Journal of Agricultural Science and Food Technology, 7(2): 234-244.
25. Haddad, F. F., Ariza, C., and Malmer, A. (2021). Building climate-resilient dryland forests and agrosilvopastoral production systems.
26. Haile, D., Gizaw, S., and Kefelegn, K. (2015). Selection criteria and breeding practice of sheep in mixed crop-livestock farming system of North Shoa, Ethiopia. Journal of Biology, Agriculture and Healthcare, 5(21): 168-174.
27. Höhler, J., and Kühl, R. (2018). Dimensions of member heterogeneity in cooperatives and their impact on organization–a literature review. Annals of public and cooperative economics, 89(4): 697-712. https://doi.org/10.1111/apce.12177.
28. Ibrahim, A., Artama, W.T., Widayanti, R., Yulianto, M.D.E., Faqar, D. and Budisatria, I.G.S. (2019). November. Sheep traders' preferences on marketing place and their satisfaction during Eid Al-Adha period in Yogyakarta, Indonesia. In IOP Conference Series: Earth and Environmental Science, 372(1): p. 012071. DOI: 10.1088/1755-1315/372/1/012071.
29. Ilukor, J., Mudiope, J., Desire, H., and Mwololo, H. (2020). Market and Value Chain Analysis to Support Develoment Response to Displacement Impacts Project Investments in Adjumani District in Uganda. Technical Report. World Bank Group. Uganda. 154p.
30. Istaıtıh, Y., and Yelboğa, M. N. M. (2018). SWOT analysis of small ruminants production in West Bank-Palestine. Mediterranean Agricultural Sciences, 31(3): 255-259. https://doi.org/10.29136/mediterranean.434272.
31. Jordanian Department of Statistics. (2024). Crop Statistics. Jordan, Amman.
32. Khader, A. (2013). Preparing research and scientific theses from idea to conclusion. Faculty of Education, Al-Azhar University, Cairo (in Arabic).
33. Kidanu, E., Regassa, M., Rischkowsky, B. A., and Legese, G. (2013). Analysis of sheep value chains in Atsbi Woreda, Tigray Region, Ethiopia.

34. Kumar, Y., Soni, A., and Sahoo, A. (2022). Dietary intervention and feeding regime for enhanced production in sheep and rabbit. Processing and Quality Evaluation of Postharvest products of Sheep and Rabbits [E-book], 24.
35. Lolemtum, J. T. (2023). Impacts of Climate Change on Sustainable Pastoralist Livelihoodsof Pokot Community in West Pokot County, Kenya (Doctoral dissertation, University of Nairobi).
36. Magesa, M. M., Michael, K., and Ko, J. (2020). Access and use of agricultural market information by smallholder farmers: Measuring informational capabilities. The Electronic Journal of Information Systems in Developing Countries, 86(6): e12134. https://doi.org/10.1002/isd2.12134.
37. Maryono, M., Killoes, A. M., Adhikari, R., and Aziz, A. A. (2024). Agriculture development through multi-stakeholder partnerships in developing countries: A systematic literature review. Agricultural Systems, 213: 103792. https://doi.org/10.1016/j.agsy.2023.103792.
38. Maulu, S., Hasimuna, O. J., Mutale, B., Mphande, J., and Siankwilimba, E. (2021). Enhancing the role of rural agricultural extension programs in poverty alleviation: A review. Cogent Food and Agriculture, 7(1): 1886663. https://doi.org/10.1080/23311932.2021.1886663.
39. Ministry of Agriculture. (2022). Annual Report, Jordan.
40. MKSP. (2016). Study on small ruminant and poultry birds in MKSP area in Pottangi and Semiliguda Blocks of Odisha. Lavosdisha. org. India. Technical Report.
41. Nayyef, A., I. (2024). Effect Of Polymorphisms For Paired Like Homeodomain 2 Gene On Some Reproductive Traits In Goat. Anbar Journal Of Agricultural Sciences, 22(1), 16–27. https://doi.org/10.32649/ajas.2024.183692.
42. Pappa, E. C., Kondyli, E., Sotirakoglou, K., Bosnea, L., Mataragas, M., Allouche, L., ... and Pappas, A. C. (2021). Farmers profile and characterization of sheep and goat dairy chain in northwestern Greece. Sustainability, 13(2): 833. https://doi.org/10.3390/su13020833.
43. Purchase, S., and Volery, T. (2020). Marketing innovation: a systematic review. Journal of Marketing Management, 36(9-10): 763-793. https://doi.org/10.1080/0267257X.2020.1774631.
44. Rahman, H., Happy, F. A., Efan, A. H., and Hera, M. H. R. (2019). The small-scale dairy value chain analysis: challenges and opportunities for dairy development in Mymensingh district of Bangladesh. SAARC Journal of Agriculture, 213.
45. Raji, E., Ijomah, T. I., and Eyieyien, O. G. (2024). Improving agricultural practices and productivity through extension services and innovative training programs. International Journal of Applied Research in Social Sciences, 6(7): 1297-1309. DOI: 10.51594/ijarss.v6i7.1267.
46. Raji, E., Ijomah, T. I., and Eyieyien, O. G. (2024). Strategic management and market analysis in business and agriculture: A comparative study. International Journal of Management and Entrepreneurship Research, 6(7): 2125-2138.

47. Rathore, V. S., Tanwar, S. P. S., and Yadav, O. P. (2019). Integrated farming system: Key to sustainability in arid and semi-arid regions. The Indian Journal of Agricultural Sciences, 89(2): 181-192. https://doi.org/10.56093/ijas.v89i2.86982.
48. Rob, V. O. S., and Cattaneo, A. (2021). Poverty reduction through the development of inclusive food value chains. Journal of Integrative Agriculture, 20(4): 964-978. https://doi.org/10.1016/S2095-3119(20)63398-6.
49. Shah, H., Akhtar, W., Akmal, N., Hassan, T., Farooq, W., Islam, M., Kassie, G. T., Rischkowsky, B., and Razzaq, A. (2015). Rapid assessment of the small ruminant value chain in Chakwal District, Pakistan. [online]. Islamabad (Pakistan): ICARDA, 48 p.
50. Silong, A. K. F., and Gadanakis, Y. (2020). Credit sources, access and factors influencing credit demand among rural livestock farmers in Nigeria. Agricultural Finance Review, 80(1): 68-90. https://doi.org/10.1108/AFR-10-2018-0090.
51. Simões, J., Abecia, J. A., Cannas, A., Delgadillo, J. A., Lacasta, D., Voigt, K., and Chemineau, P. (2021). Managing sheep and goats for sustainable high yield production. Animal, 15: 100293. https://doi.org/10.1016/j.animal.2021.100293.
52. Wanjala, G., Astuti, P. K., Bagi, Z., Kichamu, N., Strausz, P., and Kusza, S. (2023). A review on the potential effects of environmental and economic factors on sheep genetic diversity: Consequences of climate change. Saudi Journal of Biological Sciences, 30(1): 103505. https://doi.org/10.1016/j.sjbs.2022.103505.
53. Wodajo, H. D., Gemeda, B. A., Kinati, W., Mulem, A. A., van Eerdewijk, A., and Wieland, B. (2020). Contribution of small ruminants to food security for Ethiopian smallholder farmers. Small Ruminant Research, 184: 106064. https://doi.org/10.1016/j.smallrumres.2020.106064.
54. Wu, W., Zhang, A., van Klinken, R. D., Schrobback, P., and Muller, J. M. (2021). Consumer trust in food and the food system: a critical review. Foods, 10(10): 2490. https://doi.org/10.3390/foods10102490.