

## CHARACTERIZATION OF THE SMALL RUMINANT VALUE CHAIN IN THE MEDITERRANEAN: THE CASE OF THE NORTHERN JORDAN

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### ABSTRACT

The objective of this study was to characterize the small ruminant value chain in the Northern Jordan, map out its stakeholders and their roles, and identify the challenges facing it in order to improve its production efficiency and ensure its sustainability. Data were obtained from a sampling survey of 134 small ruminant holders located in the Northern region of Jordan. The survey focused on the main aspects of small ruminant production as input supplies, husbandry practices, processing, marketing, and consumption. Also, individual semi-structured interviews of 20 animal health care suppliers, 25 dairy processors, 25 butchers, and 20 traders, were used to undertake small ruminant value chain analysis. The results showed that the small ruminant value chain in the study area involved multiple actors with diverse roles represented by input suppliers, producers, traders, processors, and consumers. Present findings indicated that the value chain associated with small ruminants is primarily limited by the spatial constraints posed by the expansion of urban areas into rangeland regions, government policies concerning the management of forested areas, as well as the cultivation and afforestation of privately owned land. Additionally, the high production costs coupled with low milk prices and competition of imported meats, and production management also contributed to the constraints in the value chain. Based on these findings, it can be concluded that the small ruminant value chain is poorly organized and lack strong interconnections among its stakeholders. Therefore, there is a clear necessity to establish effective linkages between all stakeholders involved in the small ruminant value chain within the study area. Furthermore, addressing the weaknesses and threats identified within this sector is first step in order to enhance the production and marketing of small ruminants.

**Keywords:** Small ruminant, Value chain, Mediterranean, The Northern regions, Jordan

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Published first online November 30, 2024

Published final December 22, 2024

### INTRODUCTION

Sheep and goat husbandry is an important and well-established activity in the Mediterranean countries (Arsenos *et al.*, 2021; Al-Araimi *et al.*, 2017). These areas are home to a large number of sheep and goats, characterized by the high proportion of sheep and goats in total ruminant livestock units (Zanoli, 2021). These animals play a crucial role in the local economy and provide diverse opportunities for society to be important in generating income, security, food supplies and rural livelihoods in the Mediterranean, especially in marginal areas (Tzouramani *et al.*, 2016). However, the small ruminant sectors of the Mediterranean region do not always produce and market their products efficiently, as there is an important potential to increase livestock production in terms of quantity, quality and prices; and improve economic margins by organizing more efficient marketing and distribution (Tzouramani *et al.*, 2016).

Small ruminant production has been a prominent activity in Jordan for centuries, providing food security, income generation, and employment opportunities for rural communities (Al-Atiyat *et al.*, 2021). The Northern Jordan, encompassing the regions of Irbid, Ajloun, and Jerash, is an important area for small ruminant rearing due to its geographically diverse landscapes, suitable agro-climatic conditions, and a long history of livestock farming practices. Numbers of sheep and goats raised in the study area at the end of 2021 were around 286,241 and 145,206 heads respectively, distributed among 5,581 farmers, contributed 10.92% of the entire small ruminant flocks in Jordan which were approximately 3.95 million heads (MOA, 2021). However, despite its socio-economic significance (Al-Atiyat, 2014), the small ruminant value chain in The Northern Jordan has received little attention in prior studies. In this context, The Northern Jordan serves as a compelling case study to explore the

dynamics and intricacies of the small ruminant value chain in the Mediterranean regions.

Understanding the complexities of the small ruminant value chain in The Northern Jordan is crucial for policymakers, researchers, and practitioners aiming to strategize interventions, improve livelihoods, and enhance the overall productivity and profitability of small ruminant enterprises. By conducting an in-depth characterization of this value chain, valuable insights can be gained regarding the current production systems, market dynamics, institutional arrangements, and the challenges faced by various actors along the chain.

This study aimed to bridge the knowledge gap by providing a comprehensive characterization of the small ruminant value chain in the Northern Jordan within the Mediterranean context. Analysis of data collected from field surveys, interviews, and existing literature; of this study will shed light on the different actors, their roles, and power dynamics, as well as the critical factors influencing the functionality and performance of the value chain.

## MATERIALS AND METHODS

The study was carried out in three governorates of Jordan, namely Irbid, Jerash, and Ajloun, situated in the northern region of the country (Figure 1). These governorates are characterized by a Mediterranean climate and have respective populations of 2.1, 0.280 and 0.210 million persons respectively,

covering an area of 1,572 km<sup>2</sup>, 410 km<sup>2</sup> and 420 km<sup>2</sup>, respectively (Jordanian General Statistics, 2022). Sheep and goats' populations in different governorates of the study area (Irbid, Jerash, Ajloun) distributed among 3614, 1136, and 831 animal holders respectively are presented in Figure 2.

Differentiation advantage was adapted for small ruminant value chain analysis (MKSP, 2016), where the chain activities were identified and the role of the actors in these activities was described in order to be able to identify potential options for intervention. A survey was taken on (134) out of (5581) small ruminant holders. The small ruminant holders were randomly selected to simple random sampling procedure along the study area (Hosri *et al.*, 2016; Awad *et al.*, 2023b). A structured survey focused on the main aspects of small ruminant's production as input supplies, husbandry practices, processing, marketing and consumption was prepared. Individual interviews with the other potential stakeholders in the chain were used to carry small ruminants value chain analysis which included (20) health care suppliers, (20) of traders, (50) of processors (25 dairy processors and 25 butchers). The data was conducted using IBM SPSS Statistics (Version 27) where it was analyzed using thematic analysis approach. Quantitative data were analyzed using descriptive statistical techniques. SWOT analysis was used for identify the opportunities and threats related to small ruminants' value chain in the study area (Awad *et al.*, 2023a).

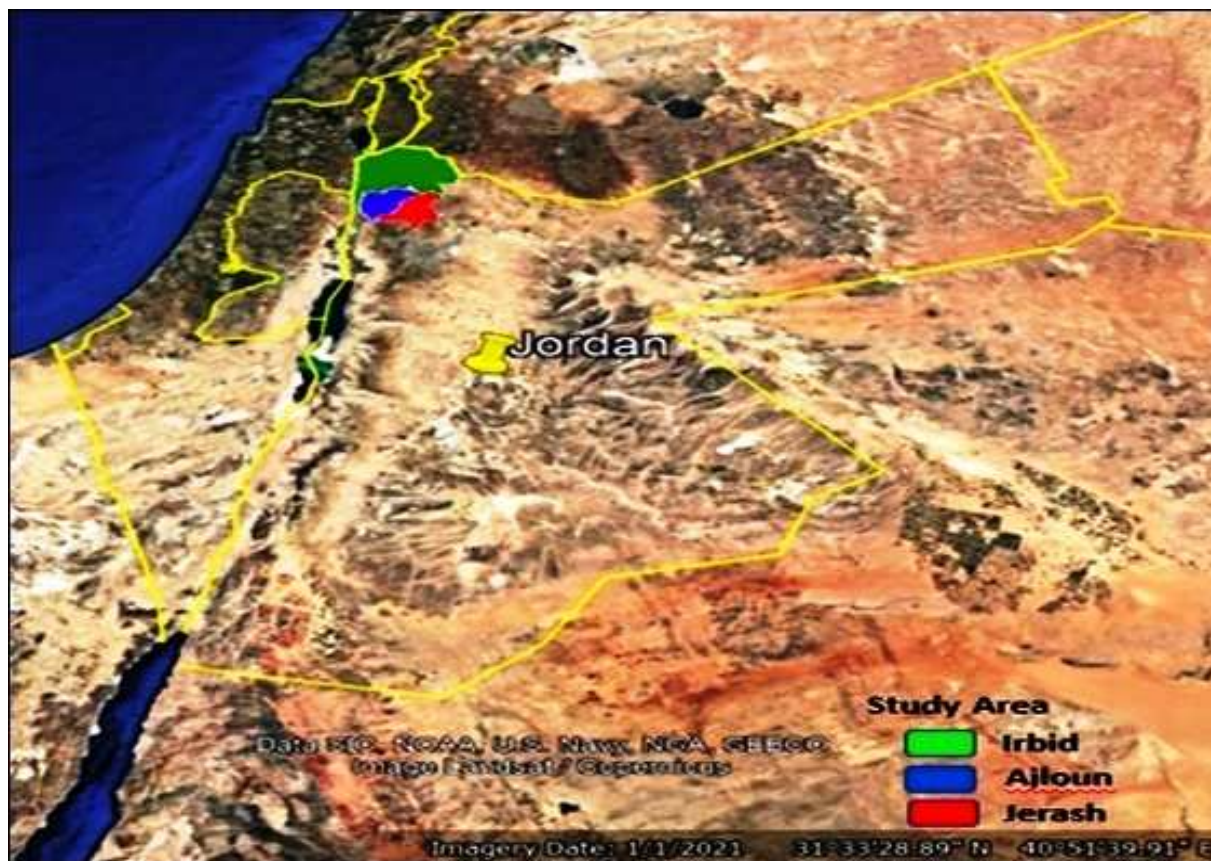


Figure 1. Study area: Irbid, Jerash, and Ajloun governorates

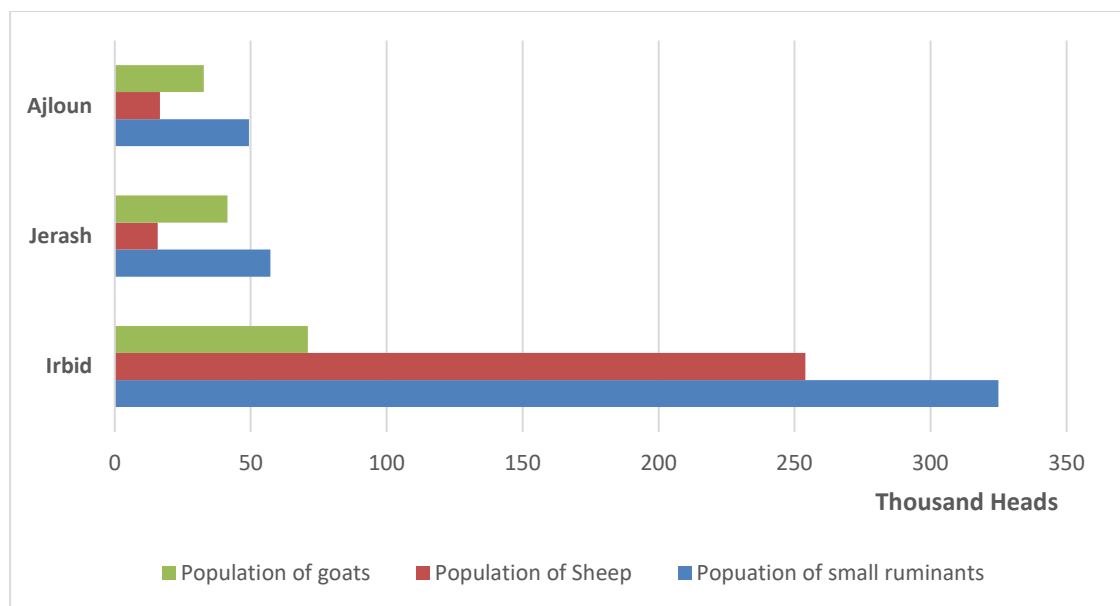


Figure 2. Small ruminants' populations in the Northern Jordan (Irbid, Jerash, Ajloun), year 2021

### RESULTS AND DISCUSSION

The results reported in this study were mostly based on the primary data gathered from different potential stakeholders in the value chain during 2021.

**Mapping core function and actors of sheep and goats value chain:** The small ruminant value chain consists of five key functions: supplying inputs, production, marketing, processing, and selling and consuming products (Ahiagbe *et al.*, 2021). To fully understand this value chain, an analysis was performed on how these functions interconnect. The different functions are shown as a series of connected boxes, with arrows indicating how products and services move

between them (Awad *et al.*, 2024a). Figure 3 illustrates the activities and participants involved in each of the five components of the small ruminant value chain in the studied area.

**Input supply:** The input supply for small ruminant production encompasses both material inputs, such as breeds, feeds, vaccines and medications, as well as service inputs, including credit services, capacity building services, animal health services, and labour, as highlighted by Shah *et al.* (2015) and Awad *et al.* (2023a,b). In the specific study area, the input supply consisted of breed, feed and water supply, veterinary services, credit services, capacity building services and labour.

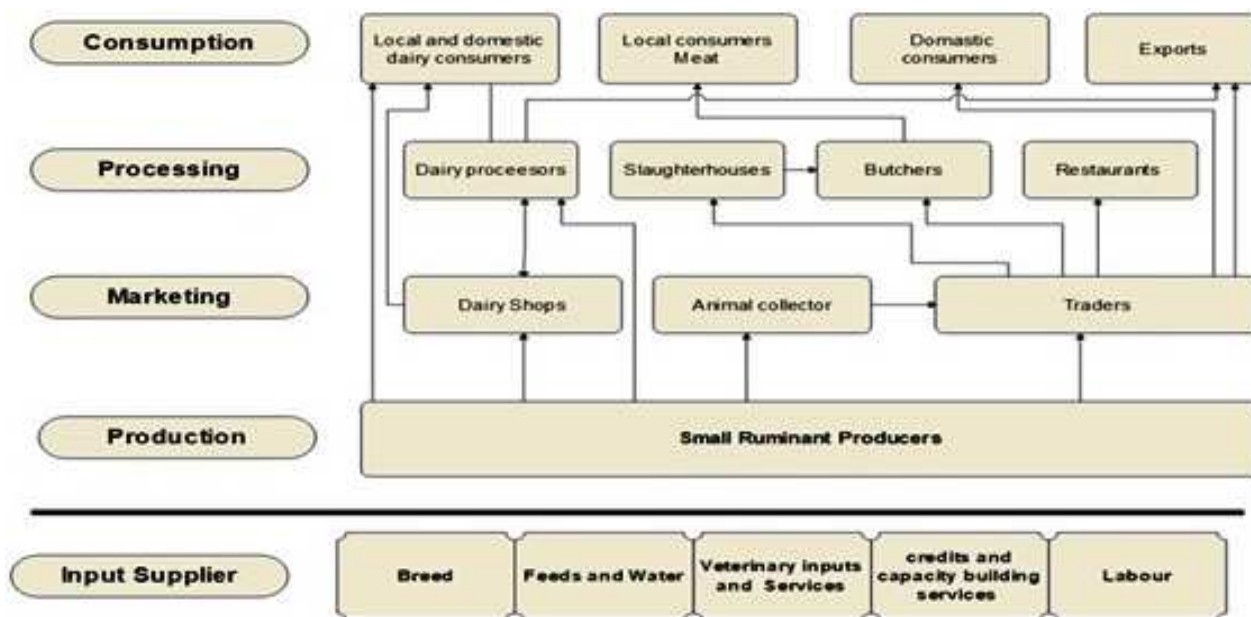


Figure 3. The small ruminant value chain in The Northern Jordan (Irbid, Jerash and Ajloun governorates).

In the study area, sheep exhibit dominance as the primary small ruminant, with a total count of 286,241 heads, surpassing the count of goats which stands at 145,206, a phenomenon that can be ascribed to the prevalent inclination of the Jordanian community towards sheep products over those derived from goats. This preference is affirmed by all the examined butchers, who consistently confirm the higher preference for lamb meat among local consumers as opposed to kid meat. Moreover, ewe milk, having a higher fat content compared to goat milk (Nudda *et al.*, 2020), is particularly coveted due to its suitability for the production of locally required milk-based products. However, the distribution of these species varied with the topography of the region. In mountainous areas such as Jerash and Ajloun Governorate, goats emerge as the predominant species (Figure 2). This might be attributed to the adaptability of goats to challenging topography and severe climatic conditions (Monteiro *et al.*, 2018). In the study area, the Awassi breed, which is prevalent in the eastern Mediterranean region and in the middle east (Al-Atiyat *et al.*, 2014; Meydan *et al.*, 2024), exhibits a significant dominance, constituting over 96.93% of the total sheep population. The Mountain Black (Baladi goat) and the Hybrid (a crossbreed between Baladi and Shami) are the prevailing goat breeds in the study area, accounting for 70.07% and 17.75% respectively. These findings align with the observations made by Al-Dawood *et al.* (2020) and Hosri *et al.* (2016) in their studies conducted in Jordan and Lebanon. Given that there is no program for small ruminant in Jordan which made it hard to assign pure breeds when needed.

The original herds or flocks served as the primary source of small ruminants in the study area. Farmers in this region typically adopt sustainable practices to replace their animals in the herds or flocks, following similar approaches observed in Lebanon (Hosri *et al.*, 2016), and north-eastern Syria (Care International – Syria Office and iMMAP, 2018). In line with these practices, 60.38% of farmers relied on sustainable stock replacement, while the remainder supplemented their herds through both additional purchases and stock sustainability. Additionally, 25% of farmers borrowed male animals from their fellow farmers during the mating season to enhance the quality of their flocks as traditional breeding practice.

When purchasing animals, 76.19% of farmers frequently visited the live sheep and goat sale yard in Irbid and Baqa 'a. The price range for Awassi ewes varied from US \$211.48 to \$493.44, while prices for Baladi goats ranged from US \$155 to \$352.46. The cost of a breeding ram reached as high as US \$634.43. Such prices are usually and annually variable based on factors such as age and animal health, season, feed and grazing availability, personal thought and beliefs.

Farmers in the area under study predominantly provide subsidized feed to their flocks, consisting mainly of barley and wheat bran, in accordance with the established program provided by the Jordanian

Ministry of Agriculture. As per this program, the subsidized feed quantity (grain barley) provided to each farmer covers 90% of their sheep and goat holdings, at a rate of 20 kg per head per month for barley. The quantity of wheat bran provided varies based on the Kingdom's production, ranging from 500 g per head per month during favorable seasons to 250 g per head per month during less productive periods usually 5:1 barley to bran (MOA, 2021). One ton of subsidized barley grain is sold at a price of \$247, compared to \$335 for the non-subsidized in the local market. Likewise, one ton of subsidized wheat bran is sold at \$108.5, whereas the non-subsidized costs \$220. In an effort to eliminate fake or exaggerated livestock holdings, the Ministry of Agriculture has opted to reduce the subsidized feed quantity offered by 20%. According to the farmers, this verification to the MOA poses a financial burden, particularly during the stages of pregnancy and lactation. The issue was similarly experienced by sheep and goat holders residing in the geographic region of Al-Ruwaished in northeast Jordan, as documented by Awad *et al.* (2023b).

The cultivation of crops, specifically barley and wheat, is a prevalent practice among 59.62% of individuals who raise small ruminants in the study area. Furthermore, more than 67.74% of these individuals opt to either lease land for crop cultivation or lease plots that have already been cultivated for grazing their herds. The rental cost of the land is contingent upon the nature and location of the specific area. Notably, the rental price in Jerash and Ajloun governorates amounted to merely \$28.20, in contrast to the substantially higher at \$88.12 in Irbid governorate. The escalated land rental fees in Irbid can be attributed to the influx of Syrian refugees who are vying for the rental of such land in competition with local Jordanian farmers, where the agriculture represents a major livelihood activity for Syrian refugees residing in Irbid governorate (Al Shogoor *et al.*, 2022).

Present findings indicated that a majority of farmers (51.92%) in the designated area using tanks to transport water to water their animals—at an average price of 4.23 USD for each square meter water. The successful development of the livestock sector, particularly for small ruminants, relies heavily on the presence of veterinary extensions (Namonje-Kapembwa *et al.*, 2019). The Ministry of Agriculture holds the responsibility of providing veterinary services through the agriculture directorates. These directorates are supported by private veterinary pharmacies located throughout within the study area. In addition, in Irbid governorate, there is a veterinary hospital that operates under the affiliation of Jordan University of Science and Technology offers a range of medical services in exchange for monetary compensation. Within the agricultural directorates, mandatory vaccines are provided free of charge mainly for foot and mouth disease (FMD), peste des petits ruminant's disease (PPR), sheep and goats' pox, brucellosis, and anthrax

(Braam, 2022). In addition to offering complimentary veterinary services.

Results herein showed that only 71.15% of sheep and goat breeders have actually benefited from these vaccines. Furthermore, 48.65% of breeders were compelled to purchase certain vaccines independently because they were not available through the directorates. A total of 81.49% of the surveyed small ruminant holders exhibited easy access to veterinary services when necessary. Despite the availability of free veterinary services through the Ministry of Agriculture's directorates, many sheep and goat breeders tend to seek assistance from the private sector. This is primarily due to the lack of permanent treatment options and the unsatisfactory services provided by government veterinarians. The private veterinarians are perceived to possess greater competence. Unfortunately, this reliance on the private sector results in additional costs to breeders, particularly given the high prices of pharmaceuticals and veterinary treatments. A similar scenario can be observed in the Chakwal District of Pakistan, where vaccination is the primary service provided by the public sector to farmers (Shah *et al.*, 2015). In the Beitbridge District of Zimbabwe, the supply of veterinary medicines is facilitated by both the State Veterinary Department and private companies, which offer animal health products and services to clients (Dube *et al.*, 2017).

If the necessary guarantees are obtainable, financing services are accessible through the Agricultural Credit Cooperation (a governmental agency), commercial banks, and occasionally NGOs. A minority of farmers surveyed, less than 30%, acquire loans for the purpose of covering expenses or purchasing animals to expand their herds (Table 1). Among these, 5.77% received interest-free loans with a repayment period of two years, secured by a livestock card guarantee approved by the Jordanian Ministry of Agriculture. The remaining farmers obtained loans with either property or land mortgage, which involved a direct deduction from their fixed income in the bank or bank bills with a minimum interest rate of 6.5%. According to Kassahun *et al.* (2021), the utilization of credit services has a significant and positive impact on market participation and the level of involvement in the small ruminant market. It can be argued that farmers with access to formal credit are more likely to participate in the small ruminant market compared to those without such access. In the absence of dedicated credit services specifically for sheep and goat production, funding sources can stem from NGOs that offer credit to small ruminant farmers (Shah *et al.*, 2015), rural microfinance institutions, programs promoting asset building among families, rural savings and credit associations or informal intermediaries who charge excessively high interest rates for upfront financing (Touray, 2017). Generally, surveyed breeders do not access to capacity building services as there is no any such activity from governmental or non-governmental institutions, with the exception of a

specific project aimed at supporting small ruminants and households in transition.

**Table 1: Credit Services in the Northern Jordan (Irbid, Jerash, and Ajloun).**

Credit services	%
No credits	71.16
The Agricultural Credit Cooperation	
with interest rate	19.23
without interest rate	5.77
Commercial banks	1.92
NGOs	1.92

Based on the survey data, it is evident that family employment is prevalent in the study area—constitutes 72.45% of the total labor force in households engaged in small ruminant farming. This phenomenon is consistent with similar situations observed earlier in Jordan (Al-Atiyat, 2014) and in the northeastern region of Syria (Care International – Syria Office and iMMAP, 2018) which heavily rely on family labor. In the study area, local labor contributes to 19.61% of the workforce, whereas foreign workers are employed by 25.0% of the small ruminant holders surveyed. Syrian refugee workers make up most of the paid foreign labor force, accounting for 5.89%, followed by Egyptian workers at 2%.

**Production management:** In the northern region of Jordan, small ruminant farming is considered traditional family breeding used for subsistence (approximately 86.54%). Furthermore, 34.62% of the sampled population engaged in sheep and goat husbandry as an additional source of income, whereas 55.77% relied solely on this activity for generating income. Among these small ruminant producers, the middle age group; ranging from 45 to 65 years old, constituted the largest demographic, comprising 57.69% of the respondents. This finding is consistent with the results obtained by Mohamed-Brahmi *et al.* (2020). Their study on the characterization of sheep production systems in the mountainous and forested areas of The Northern Tunisia also revealed that the middle age group constituted the majority demographic group, accounting for 56% of the participants. Moreover, it was noted that over 90% of small ruminant producers in the study area possessed no educational qualifications beyond high school level (12-year grade), a finding corroborated by Awad *et al.* (2024b). Based on the primary data obtained from the Ministry of Agriculture, it has been determined that the percentage of large ruminant holder producers (have 500 heads and above) in the study area is a mere 0.83% of the total. In contrast, medium ruminant holder producers (have more than 100 and less than 500 heads) make up a substantial portion of 29.72%, while small ruminant holder producers (have less than 100 heads) dominate the majority with a significant representation of 69.44%.

The study area exhibits a semi-extensive production system, accounting for 59.62% of agricultural practices, while only 3.85% are attributed to an intensive production system. Merely 9.62% of individuals move regularly outside the study area. These findings parallel previous research conducted on the districts surrounding Irbid Governorate in Jordan, which also highlighted the dominance of a semi-extensive production system (Aw-Hassan *et al.*, 2018). However, these results differ from studies conducted on the Jordanian desert (Badia), particularly the steppe lands of Jordan, and on Al-Ruwaished District of



Jordan where an extensive production system prevails (Awad *et al.*, 2023b).

The provision of a suitable housing system is considered to be the most efficient approach for safeguarding small ruminants from unfavorable weather conditions (Wadhvani *et al.*, 2016). According to Shah *et al.* (2015), adequate housing plays a crucial role in ensuring better care and enhanced productivity. The common prevailing housing for small ruminants in this study area are barns with a run (Figure 3a), utilized by approximately 55.77% of small ruminant holders, and temporary structures (Figure 3b), employed by about 30.77% of them.



**Figure. 2. Small ruminant management in The Northern Jordan. (a), barns with a run used for keeping small ruminants; (b), temporary structures used for keeping small ruminants.**

Mating is entirely natural in the study area. Superior outcomes have been attained in conventional systems with unregulated reproduction. The fertility rate reached 85%. Nevertheless, a subset of 20.41% of surveyed small ruminant holders used sponges to enhance productivity and to expedite the time of birth, albeit experiencing diminished fertility rates. This finding aligns with the assertion made by Wilson (1989) that improved performance is observed in traditional systems without reproductive control.

More than 80% of the surveyed small ruminant holders adhered to a vaccination schedule and regularly vaccinated their herds. The study area revealed the presence of various diseases affecting small ruminants, with Mastitis and Foot and Mouth Disease (FMD) being the primary reported illnesses. Additional diseases such as Enterotoxemia, sheep and goats' pox, pneumonia, brucellosis, new born diarrhea, and *Taenia multiceps* were also documented, mirroring findings from Al-Assaf's research in the Northern Jordan (Al-Assaf, 2012). Animal health service providers concurred with farmers in acknowledging that veterinary services for small ruminants impose a financial burden on breeders and that government services are insufficient. Moreover, they stressed the lack of health awareness among farmers, who erroneously believe that their experience is adequate and only consult the veterinarian when necessary.

The primary factor considered when selecting breeding females in the study area is the milk yield. More than 40% of the sheep and goat breeders prioritized milk production, while 32.70% of them also took into account the number of births/ gestations, and only 25% focused solely on the number of births/gestation. A significant number of sheep and goat breeders, over 90%, do not maintain records or directly measure production quantities. Instead, they estimate milk production by calculating the quantities supplied to dairy processors. The estimated daily milk production for sheep is approximately 350 g/head. These estimates are in line with the findings of Talafha and Ababneh (2011), who reported that an Awassi ewe produces 40-60 kg of milk during a 150-day lactation period in traditional production systems. However, it was not possible to estimate milk production quantities for goats due to the variety of breeds present on the same farms and the commingling of milk supplied to milk processors. Zaitoun *et al.* (2004) stated that average daily milk production in goats is influenced by breed, region, and lactation number. These factors account for 50% of the total variability in average daily milk production among goats in Jordan. Only a small percentage, 11.53%, of breeders focused on fattening lambs. Wool production is uncommon in the study area with no one buying wool there.

**Marketing:** Marketing includes all the activities necessary to move the products from producers to consumers (Hussen *et al.*, 2013). Most small ruminants within the study area engage in selling their animals in order to meet their cash needs. Irbids' live animal market and Baqaa's live animal market are the main destination source for the small ruminant trade in the study area. These markets often meet the requirements of butchers inside and outside the study area. The lambs are typically sold at two months of age, with prices ranging from \$140 to \$170. However, the kids sold at the same age for prices that do not exceed \$140, with an average price of \$112. According to feedback from stakeholders, it is the traders who heavily influence the market prices. These prices tend to fluctuate depending on the season, with an increase during the spring period (from March to May). Additionally, government decisions regarding the importation of live meat also impact the market. Animal collectors and some merchants have the advantage of directly obtaining lambs indoor, often securing better prices compared to what farms can achieve within the market. Farmers who sell their animals at the live animal markets and indoor transactions have reported better prices, typically exceeding \$28 per head.

The majority of milk producers surveyed, specifically 80.77%, engaged in the sale of sheep and goats' milk to dairy enterprises, at an average rate of 1 USD per liter for sheep's milk and an average rate of 0.7 USD per liter for goat's milk. Among small ruminant dairy processors, approximately 66.67% collected milk indoors twice daily and transported it via an unrefrigerated pickup truck to predominantly local dairy stores, with some deliveries also being made to dairy stores in the capital governorate. Aw-Hassan *et al.* (2018) have asserted that the majority sheep milk production in the Irbid governorate is predominantly marketed through both formal and informal markets. Their study identified a significant hurdle wherein the dairy industry lacks access to refrigeration infrastructure, compelling processors to collect milk bi-daily without the use of cooled vehicles, and this match the results of the study.

**Processing:** Processing is one of the main functions of the small ruminant value chain (Shah *et al.*, 2015). The majority (93.88%) produce dairy products either by themselves (20.40%) for home consumption and for dairy shop, or by dairy processors. In the context of small ruminant dairy processors, the collection of milk from sheep and goats occurs during the milk production season, which spans from mid-November in limited quantities, gradually increasing until the end of April the following year. This collected milk serves as the primary ingredient for the production of various dairy products, including yogurt, butter, Shanina (a fermented homemade yogurt beverage), soft and salted Labneh (a flavourful Middle Eastern cheese derived from strained yogurt), white cheese, Baladi ghee (Samen Baladi, the traditional ghee in Jordan, which is

an anhydrous dairy product produced from bovine, goat, sheep milk, or a combination of these), as well as Jameed (a Middle Eastern food crafted from hard, dried yogurt made from ewe's or goat's milk, serving as the fundamental ingredient for Mansaf, Jordan's national cuisine ). According to the consensus among the majority of dairy processors, prices for these dairy products are elevated at the onset of the season due to lower milk supply. The most productive items during the milk season are primarily yogurt and Shanina, followed by soft and salty Labneh (Thickened yogurt). These products fetch average prices of \$1.76, \$0.85, \$4.23, and \$8.46 per kilogram, respectively. The highest demand for these products is seen at the district and community levels, with consumption extending to the capital city. White cheese, Jameed, butter, and Ghee, on the other hand, are produced during the spring season, particularly after mid-March, when sheep milk is abundant. These products are sold at average prices of \$8.46 per kilogram for white cheese and butter, and \$16.92 per kilogram for Jameed and Ghee. The sales of these items primarily rely on the trust placed in their quality by both producers and consumers, meeting the demand across the entire Kingdom, especially in the capital city.

Meat processing is carried out mainly by Municipal slaughterhouses, local butchers, restaurants located in that area, and/or consumers themselves. The butchers sell raw meat as whole carcass or as cuts at a price of (14.10) USD/Kg, while the edible internal organs are sold at (8.46) USD/Kg. The restaurants, slaughterhouses and the butchers are subject to the supervision of the Jordanian Ministry of Health to ensure food safety. A similar example was noticed in Chakwal district of Pakistan, the processing and slaughtering of the small ruminants is carried out in recognized slaughterhouses at the level district then the carcasses were transported to the retail shops without any proper hygienic and safety protocols which concurs with what was reported by Shah *et al.* (2015).

**Consumption:** The local community primarily relies on homemade dairy products or those available at nearby dairy shops. A significant proportion (up to 90%) of the study sample expressed a preference for sheep dairy products. The majority of dairy products are consumed domestically, with dairy processors marketing their products mainly in the capital. Notably, certain products such as Jameed and white cheese are also exported out of Jordan. According to stakeholder responses, consumers in the study area exhibit a preference for imported meat over local meat, with a majority (65.7%) favouring imported options. The demand for local sheep experiences a surge during Ramadan (the Muslim fasting month) This surge can be attributed to the cultural significance associated with this month, as Ramadan feasts increase and the diversity of Al-Iftar table dishes is ensured during this month, and prior to significant religious events like Eid Al-Adha. Similar increases in demand for sheep have been observed before such occasions in countries

likewise Pakistan and Indonesia (Shah *et al.*, 2015; Ibrahim *et al.*, 2019).

**Impact of climate change on small ruminant value chain in The Northern Jordan:** According to Seijen *et al.* (2013), climate change seriously affects the availability of pastures during the period of recurrent droughts. Besides, severe climatic changes may impose various pressures on animals, which will negatively affect their production and reproduction (Sahoo *et al.*, 2013). The prevailing climatic conditions in the study area, such as delayed rainy seasons and fluctuating precipitation rates, were considered by the participants to be crucial factors contributing to the deterioration of the rangelands.

Despite only 55.77% of small ruminant holders included in this study area acknowledging the significant severity of climate changes at present, and 61.54% expressing concerns about the effects of climate change on the small ruminant sector, a majority of them (more than 90%) reported long-term increases in temperatures, observed a negative variation in rainfall rates, and confirmed the adverse impact on available rangelands. While these findings are based on verbal reports from farmers, trend analysis conducted by Abdulla (2020) indicates clear decreasing trends in precipitation at most Jordanian monitoring stations, with this decline initiated in the 1960s. Furthermore, an increase in temperatures has been documented, with minimum temperatures rising more significantly than maximum temperatures. These observed climatic shifts are associated with reported negative variations in rainfall rates and confirmed adverse impacts on

available rangelands, corroborating the data provided by the breeders.

**Impact of Syrian asylum on small ruminant value chain in The Northern Jordan:** The presence of refugees has resulted in heightened competition for resources among host communities, leading to various negative economic, social, and environmental consequences (Ilukor *et al.*, 2020). Specifically, the influx of Syrian refugees in The Northern Jordan has created additional pressure on agricultural resources, potentially impacting the sector's contribution to overall development (Thiombiano *et al.*, 2017).

According to Thiombiano *et al.* (2017), over 95% of Syrian refugees in the Irbid governorate are engaged in agricultural activities, particularly vegetable production. This explains that 53.84% of the surveyed farmers reported the presence of Syrian refugees in their respective areas, with the Ajloun governorate being the sole exception where no farmers mentioned such presence. Only 42.86% reported being impacted by the refugees' presence. While the presence of Syrian refugees has increased the demand for small ruminant dairy products, it has had a significant adverse effect on the rental prices of agricultural land used for crop cultivation. Consequently, this has escalated production costs for sheep and goat holders in the study area.

**SWOT analysis of small ruminant value chain in The Northern Jordan:** SWOT framework to determine the key strengths, weaknesses, opportunities, and threats within the small ruminant value chain in the specified study area can be observed in Table 2.

**Table 2. SWOT analysis for small ruminant value chain in Northern Jordan (Irbid, Jerash and Ajloun governorates).**

SWOT category	SWOT factor
<b>Strengths</b>	<b>S1:</b> Cultural significance: small ruminants possess a profound cultural and traditional importance within the region. Their utilization during religious festivities and social gatherings establishes a deep-rooted connection between these animals and the local culture.
	<b>S2:</b> Livelihood generation: Small ruminant production serves as a pivotal means of livelihood generation for a sizable portion of the regional population, particularly among small-scale farmers and herders. It substantiates rural employment and income generation, thus ameliorating poverty levels.
	<b>S3:</b> Genetic diversity: The region exemplifies a multitude of indigenous small ruminant breeds, particularly goats, adept at adapting to the local environment. This genetic diversity holds immense value for future breeding programs and conservation endeavors.
	<b>S4:</b> Government support: The government of Jordan acknowledges the significance of the small ruminant sector, thereby providing support through subsidies, veterinary services, and infrastructural advancements. This support helps improve breeding practices, healthcare services, and productivity in the sector, provided that all necessary requirements are met.
	<b>S5:</b> Access to veterinary services: This ensures that individuals who rear small ruminants can readily avail themselves of timely and efficacious healthcare services for their animals.
<b>Weaknesses</b>	<b>W1:</b> Narrow rangelands due to urban sprawl on rangeland areas, government policies for managing forest areas, cultivate and afforest privately owned land, and the exorbitant cost of renting crop land, which cause limited biodiversity, increased vulnerability to climate change, and reduce economic opportunities
	<b>W2:</b> Inefficiencies in the production managements which can affect the competitive of small

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	ruminant products in the market and hinder the sector's ability to meet consumer demand efficiently.
	<b>W3:</b> Lack of value addition and processing capabilities: Inadequate facilities and knowledge for value addition, processing, and marketing of small ruminant products can limit the income potential of small-scale farmers in the value chain.
	<b>W4:</b> Limited access to finance and credit: Lack of access to financial resources and credit can hinder investments in infrastructure, technology upgrading, and other improvements along the value chain.
	<b>W5:</b> Lack of awareness and technical knowledge: Limited awareness and understanding of best management practices, including animal nutrition, health, and reproduction, can negatively affect the productivity and profitability of the value chain.
<b>Opportunities</b>	<b>O1:</b> Local Surge in Demand: The increasing demand for dairy products derived from small ruminants is driven by the high prices of manufactured dairy products.
	<b>O2:</b> Demand Driven by Tourism: The popularity of The Northern Jordan as a tourist destination creates a demand for locally produced small ruminant products in restaurants and other tourism-related establishments.
	<b>O3:</b> Export Opportunities: Jordan has been actively exploring prospects for exporting small ruminant products to neighboring countries.
	<b>O4:</b> Potential for Value-Added Small Ruminant Products: There exists potential for the development of value-added products derived from small ruminants.
	<b>O5:</b> Favorable Climatic Conditions for Small Ruminant Production: The sheep and goat production benefits from the presence of optimal temperature conditions.
<b>Threats</b>	<b>T1:</b> Reduced grazing capacity, loss of open space, and pollution due to urban sprawl, further impacting the health and productivity of small ruminants.
	<b>T2:</b> Increased production costs, encompassing expenditures related to feed, veterinary care, and employment, culminate in reduced profit margins in the face of declining milk prices, specifically in the case of goat milk, alongside the competitive pressure from imported meat.
	<b>T3:</b> Unexpected rise in input costs, this can include increases in the price of the feed, veterinary medicines, and other essential inputs. These cost increases can squeeze profit margins further, making it difficult for producers to break even or make a profit. Fluctuating and rising input costs can cause uncertainty within the industry, affecting long-term planning and investment decisions.
	<b>T4:</b> Government policy: Policies related to agricultural subsidies, import/export regulations, grazing rights, and land use can directly influence the profitability and long-term sustainability of small ruminant operations.
	<b>T5:</b> Political situation of neighboring countries.

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It is well known that SWOT analysis is a methodological approach employed to identify the optimal alignment between internal resources and core competencies in order to establish competitive advantages and recognize the constraints encountered by a particular sector. This process aids in the identification of external opportunities and threats, while taking into account internal strengths and weaknesses (Istaitih and Yelboğa, 2018). The potential interventions along the value chain as solutions to those challenges are as follows:

- 1- Strengthen farmer organizations and cooperatives: Promoting the establishment and empowerment of small ruminant holders' organizations and cooperatives has the potential to enable small-scale farmers to effectively access resources, information, and markets. These organizational structures can serve as a means of facilitating group decision-making processes, sharing valuable knowledge, procuring inputs in bulk, and effectively marketing small ruminant products.
- 2- Enhance marketing and value addition: Enhancing market connectivity and enhancing the value of small ruminant commodities possess the potential

to expand economic prospects for farmers. Measures aimed at achieving this objective encompass the implementation of capacity-enhancement initiatives focused on elevating product quality, facilitating market accessibility, providing assistance in establishing processing facilities, and advocating for the branding and packaging of small ruminant commodities.

- 3- Strengthen extension services: Improving the efficacy of extension services holds paramount importance in the transmission of technical expertise and skills to small-scale farmers engaged in small ruminant farming. Allocating resources towards the training of extension workers in the latest advancements in small ruminant management, equipping them with essential materials and equipment, and implementing mechanisms for regular visits to farmers can effectively tackle diverse obstacles encountered in production.
- 4- Monitoring and assessment efforts: Establish strong monitoring and assessment frameworks to consistently evaluate the effects of urban sprawl and existing interventions on rangelands. The

obtained data will offer insights for adaptive management strategies, guaranteeing the efficiency of interventions, and pinpointing potential areas for enhancement to tackle the weaknesses and vulnerabilities linked to urban sprawl.

- 5- Engage in collaborative partnerships with governmental entities accountable for forest management to reevaluate forest area management policies that forbid grazing activities in forested territories. The formulation of grazing plans and strategies, which concurrently prioritize the protection of forest ecosystems and permit controlled grazing, holds the potential to enhance biodiversity and ameliorate the adverse consequences of urban sprawl.

**Conclusions:** This study aimed to characterize the small ruminant value chain in Northern Jordan, delineate its stakeholders and their respective roles, and identify the challenges impeding its efficiency and sustainability. The findings reveal that the small ruminant value chain in this region is poorly organized and lacks robust interconnections among stakeholders. Significant spatial constraints arise from urban encroachment into rangeland areas, which has been exacerbated by government policies related to forest management, as well as the cultivation and afforestation of privately owned lands.

Moreover, the high production costs, coupled with declining milk prices and stiff competition from imported meats, further undermine the viability of small ruminant production. As reported, a notable proportion of small ruminant holders have expressed concerns about these issues, emphasizing the detrimental impact of climate change on production systems.

In light of these challenges, it is critical to address the identified weaknesses and threats that small ruminant producers face. Effective interventions need to be designed and implemented across the entire value chain, targeting areas such as resource allocation, marketing strategies, and stakeholder collaboration. Strengthening cooperative structures among farmers, enhancing extension services, and promoting value-added processing and marketing of products are potential avenues for improvement. By adopting such measures, it is possible to foster resilience within the small ruminant sector, ultimately leading to enhanced production efficiency and sustainability in Northern Jordan.

**Authors' Contributions:** Rula Awad: conceptualization, data collection, formal analysis, and writing - original draft; Aziza Mohamed-Brahmi: conceptualization, formal analysis, and writing and editing original draft; Hosam Titi: formal analysis, writing and editing original draft; Mohamed Jaouad: analysis and review; Aziza Gasmi-Boubaker: conceptualization and editing.

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