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Assessment of Socio-Demographic Characteristics of Dairy Cattle Farms and Management Practices in The Northern Region of Iraq

Irak'ın Kuzey Bölgesinde Süt Sığırcılığı İşletmelerinin Sosyo-demografik Özelliklerinin ve Yönetim Uygulamalarının Değerlendirilmesi

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Abstract

Dairy farming plays a significant role in the socio-economic development of the northern region of Iraq, constituting a crucial segment of the rural economy. The primary aim of this study is to investigate the sociodemographic characteristics of dairy farms and management practices in the Northern Region of Iraq. Data were gathered from 280 dairy farmers in the Erbil, Sulaymaniyah, Dohuk, and Halep provinces and analyzed using frequency tables and descriptive statistics. The findings revealed that the average number of cows per farm stood at 28.2, with an estimated average milk yield of 10.1 liters per cow. Additionally, 53.2% of farms in the surveyed area reported the utilization of artificial insemination techniques. Despite these achievements, several challenges confront milk producers in the region, such as a lack of digital skills, the burden of high feeding costs, inadequate feeding, challenges related to hygiene and disease control within dairy herds, uncertainties regarding market access, and limited veterinary services.

Keywords: Dairy farm, Milk production, Marketing, Technology, Extension

Irak'ın Kuzey Bölgesinde Süt Sığırcılığı İşletmelerinin Sosyo-demografik Özelliklerinin ve Yönetim Uygulamalarının Değerlendirilmesi

Öz

Süt hayvancılığı, kırsal ekonominin önemli bir bölümünü oluşturan Irak'ın kuzey bölgesinin sosyo-ekonomik kalkınmasında önemli bir rol oynamaktadır. Bu çalışmanın temel amacı Kuzey Irak bölgesinde süt sığırcılığı işletmelerinin sosyodemografik özellikleri ve hayvancılık uygulamalarını araştırmaktır. Veriler Erbil, Süleymaniye, Dohuk ve Halep illerindeki 280 süt sığırcılığı işletmesinden toplanmış ve frekans tabloları ve tanımlayıcı istatistikler kullanılarak analiz edilmiştir. Bulgular, işletme başına ortalama inek sayısının 28.2 ve tahmini ortalama süt veriminin inek başına 10.1 litre olduğunu ortaya çıkarmıştır. Anket yapılan bölgedeki işletmelerin %53.2'si suni tohumlama tekniklerini kullanıldıklarını bildirmişlerdir. Bu başarılara rağmen, dijital beceri eksikliği, yüksek yem maliyetleri, yetersiz besleme, süt sığırlarında hijyen ve hastalık kontrolü ile ilgili zorluklar, pazara erişimle ilgili belirsizlikler ve sınırlı veterinerlik hizmetleri gibi bölgedeki süt üreticilerinin karşı karşıya olduğu çeşitli zorluklar bulunmaktadır.

Anahtar kelimeler: Süt sığırcılığı, Süt üretimi, Pazarlama, Teknoloji, Yayım

1. INTRODUCTION

Dairy farming remains the economic backbone of high-potential livestock farming. Globally, there are approximately 1.5 billion dairy cattle, with over 70% of herds located in developing countries. Despite this, these nations contribute only 30% of total world milk production. Over one-fourth of the 570 million farm holdings worldwide keep at least one milk animal, including cows, buffaloes, sheep, goats, and camels. There were an estimated 202.4 million buffaloes, 38.1 million camels, and 1.5 billion holdings keeping dairy cattle in 2020. On a per capita basis, consumption of milk and dairy products averages 245 kg in developed countries, 66.2 kg in developing nations, and 103 kg globally (FAO, 2020). The global dairy industry stands as one of the most fiercely protected sectors in the agro-food landscape. Leading exporters of milk products include the EU, the US, New Zealand, and Australia, while major importers comprise the European Union, the United States, Mexico, Japan, and Russia (Meilke et al., 2001; FAO, 2020).

Agricultural development is critical in developing countries because it has a specific and direct impact on eradicating extreme poverty and ensuring environmental sustainability (Guadu and Abebaw, 2016). Dairy farming is an activity that has an important and irreplaceable effect. The close relationship between livestock and the livelihoods of a significant portion of the population, as well as the issues of food security and public health, adds to its importance. Despite the prominent economic role of animal husbandry, there is ample evidence that it has been negatively affected by the recession in northern Iraq over the last decade.

In the northern region of Iraq, dairy farming could be well developed as an industry, especially in the hills and high hills where a suitable climate, pastureland, fodder, and an unemployed labor force are available. However, farmers are not encouraged to go in this direction. With the rising population in recent decades, the region has faced problems such as unemployment and a lack of agricultural land. Farmers are generally engaged in crop farming that exceeds the land's carrying capacity. Marginal land has been occupied. Farmers practice traditional methods of agriculture, so production and productivity have not changed significantly. In such a case, developing dairy and crop farming would provide an alternative to the oil industry. It would benefit both individual farmers and the country as a whole. Dairy farming not only supplements rural farmers' income but also helps to increase agricultural productivity.

The northern region of Iraq was rapidly developed, and several sectors, such as the oil industry and construction, saw significant improvements, attracting labor from all over the country. However, in comparison to other sectors, the agricultural sector received less attention from the government and investors. As a result of this development, there has been significant rural-to-urban migration, which has had severe negative consequences, if not ruin, for agricultural projects. Farmers have complained to the government about issues that were making them fearful. A group of them accused the government of failing to meet their basic needs, while another group demanded better job opportunities. Furthermore, farmers stated that they could not sell the milk and milk products they produced at an affordable price and that they incurred losses. This has caused many people to leave agriculture (Nanakali, 2021). In addition to this, the former destruction of the villages' entire infrastructure has continued to have a negative impact on people's lives to this day. Recent policies to solve these challenges were not adequately formulated and implemented (Nanakali, 2021). In addition to the agricultural production of many crops, livestock plays an important role in the economy of Iraq's northern region, providing meat, wool, and milk. Several rural people specialize in livestock raising, either in addition to farming or solely for livestock breeding. The people of the region practice transhumance, which involves moving their flocks of goats and sheep to higher mountain pastures in the summer and down to the plains in the winter. The total number of livestock in Iraq's northern region is estimated to be around 4 million. In

addition, there were 2.4 million sheep, 1.2 million goats, and 257000 cows raised in villages, pastures, and animal-raising farms. Red meat production stands at 78000 tons, accounting for 86.7% of the estimated need of 90000 tons. In addition to production, the region has several livestock projects for a variety of purposes, such as sheep and goat breeding farms, dairy farms (cow and buffalo), and fattening farms (calves and sheep). Over the last few years, the purchase of cow milk has increased significantly in Iraq's northern region (Ministry of Agricultural and Water Resources, 2019).

International organizations such as the World Bank Group emphasize that Iraq's agriculture and food sectors, particularly in the northern region, can significantly contribute to rural job creation and income generation. This, in turn, enhances political and economic stability at both regional and national levels (World Bank, 2018). Traditionally, the dairy sector in the region, particularly in northern Iraq, has been characterized by smallholder-integrated production systems, with most producers owning one to thirty cows. Although there has been widespread scaling up throughout the region in recent years, as well as the emergence of corporate-style mega-farms in Erbil, Sulaymania, Dohuk, and Halep, traditional smallholder systems remain dominant. According to the Ministry of Agriculture, some significant differences between member provinces account for the majority of Iraq's northern region dairy cows and herds where production is concentrated. Sulaymania is notable for having most of the total dairy herd. It should be noted that Sulaymania province accounts for roughly half of all milk production in Iraq's northern region. Furthermore, the northern region of Iraq has seen population growth and an increase in demand for milk and dairy products over the last few decades. This has encouraged dairy farmers to increase output by importing high-yielding dairy cows to replace low-yielding local breeds (Al-Rawashdeh, 1999).

To date, there have been few academic studies and no comprehensive studies of the structural analysis of dairy farming in the northern region of Iraq. Hadad (2021) studied an economic study of the cost of dairy milk production in the Erbil governorate. The average daily milk yield was 12.2, 9.2, and 6.7 liters for large, medium, and small farmers. Akbay and Akdogan (2020) investigated the structure of dairy cattle holdings and the market supply of milk in Izmir province, Turkey. According to the results, 52.9% of producers stated that the most inconvenient issues for dairy cattle farmers are the high cost of feed and diesel oil, as well as the constantly changing prices of feed and milk. It is also found that 39.4% of producers sell milk to collectors. Okello et al. (2019) attempted to identify the institutional factors influencing smallholder farmers' adoption of zero-grazing dairy farming technology in Bondo sub-county, Kenya, and found that access to extension services, frequency of extension officer visits, group membership, and distance to the nearest marked had a significant influence on the adoption of zero-grazing dairy technology. Muradi and Akbay (2018) studied the structure and marketing opportunities on dairy farms in Konya province, Turkey and found that the average number of dairy cows per dairy cattle farm was 33.56, the daily milk yield per cow was 21.13 kg/day and the average lactation period was 260 days. Therefore, this investigation will add to existing information, as the findings will help other academics conduct additional research on the factors influencing the development of dairy farming ventures in Iraq's northern region.

The main objective of this study is to analyze the sociodemographic characteristics of dairy farms and management practices in the northern region of Iraq. The study is intended to be of importance in exposing the factors affecting the production of dairy products in the northern region of Iraq and helping the country realize how these problems can be minimized to improve the dairy farming sector. For the government of the northern region of Iraq, the study is valuable in that it provides general information on the state of the dairy sector and the financial constraints that influence it in the region. It will show the effect of government policy and recommendations for improvement. As policymakers, the government will find this study

important in formulating policies in the dairy sector.

2. MATERIALS AND METHODS

The northern region of Iraq covers an area of about 40000 km^2, and borders Syria in the northwest, Turkey in the north, and Iran in the northeast. The northern parts of Iraq are mountainous, with peaks reaching 3600 meters above mean sea level, whereas the southern parts are flat and suitable for grain production. The average annual precipitation ranges between 300 and 1000 mm, with inter-annual variations between 100 and 1300 mm (Eklund et al., 2017). Iraq's northern region is between latitude 34-37 and longitude 41-46 (Khoshnaw, 2013). The total area of arable land suitable for agriculture is 1535794 hectares (6143176 dunams). The climate of the northern region of Iraq is semi-arid continental, with very hot and dry summers from June to September, and cold and wet winters (Ministry of Agricultural and Water Resources, 2019).

A survey was conducted to assess the present status of dairy farming in the northern region of Iraq. Four provinces, namely Erbil, Sulaymaniyah, Dohuk, and Halep, were selected. The survey was based on face-to-face meetings with farmers. The sample size was estimated using the following formula within the limits of a 5% error and 95% confidence limits (Newbold, 1995):

$$n = \frac{Np(1-p)}{(N-1)\sigma^2_{\hat{p}_x} + p(1-p)}$$

Where n denotes the sample size, N is the population size, p is the probability of examiningsituations occurring (0.5), and $\sigma^2_{p_x}$ is the variance ratio. According to the used method, the sample size was calculated as 280. Data were analyzed using frequency tables and descriptive statistics.

This research was approved by Science and Enginnering Research Ethics Committee of Kahramanmaraş Sutçu Imam University (date: 25.03.2024, decision no: 2024_7)

3. RESULTS AND DISCUSSIONS

3.1. Socio-demographic Characteristics of Dairy Farmers

This section discusses the socio-demographic characteristics of dairy farmers, such as age, gender, marital status, education level, farmers' experience, working status, and household size (Table 1). According to the survey results, the average age of farmers was 47.3 and 31.4% were under 30. Although the total male population in dairy farms is high (81.1%), women are primarily responsible for the animals on the farm. They are in charge of milking the cows and preparing the milk for sale or home use in the production of cheese or other products. Considering the overall sample, the study revealed that 65% of dairy farmers were married. For economic reasons or rural-to-urban migration, the proportion of single dairy farmers was about 35%.

Education is one of the most important factors in a farmer's ability to secure, process, and use agricultural information (Ritter et al., 2021; Sundaram et al., 2014). The northern region of Iraq is characterized by a low level of education and a high rate of illiteracy. Farmers' education level is assumed to improve their ability to use agricultural-related information. As illustrated in Table 1, 17.5% of the farmers were illiterate, 24.3% had elementary school education, and only 19.3% had a bachelor’s degree. Indeed, education is thought to improve farmer readiness to accept new ideas and innovations, as well as to obtain up-to-date demand and supply information (Brown and Roper, 2017). The findings also revealed that the majority of dairy farmers, approximately 69.3%, had a family size of five or more family members per household. Additionally, 76.4% had been practicing dairy farming for more than six years.

Multiple job-holding might be seen as a temporary phenomenon in response to financial pressures in agriculture, but it has consistently been present in the region (Mumba et al., 2011). About 53.6% of farmers surveyed engaged in agriculture as a secondary activity and undertook an additional wage-earning activity.

The results show that 46.4% of the dairy farming respondents are also engaged in the business sector. Many farmers initiated dairy farming as a secondary occupation, typically while one spouse, often the husband, pursued another regular job in town (Rangnekar and Thorpe, 2001).

Table 1. Socio-demographic characteristics of farmers

Variable		Number of farms	%
Age (Mean = 47.3; Std. dev.: 17.1)	≤ 30 years old	88	31.4
	31-40 years old	101	36.1
	≥ 41years old	91	32.5
Gender	Male	227	81.1
	Female	53	18.9
Marital status	Married	182	65.0
	Single	98	35.0
Education levels	Illiterate	49	17.5
	Elementary	68	24.3
	High School	109	38.9
	Bachelor	54	19.3
Household size	Small size ≤4	86	30.7
	Large size ≥5	194	69.3
Experience (Mean = 16.8; Std. dev.: 11.8)	≤5	66	23.6
	≥ 6	214	76.4
Occupation	Farmer and/or business	130	46.4
	Public service and farmer	93	33.2
	Army and farmer	57	20.4
Total		280	100.0

3.2. The Structural Characteristics of Dairy Farms

Most dairy farms in northern Iraq have been established through farmers' own funds, supplemented by government loans, primarily directed towards breeding and supplying heifers to farmers. Dairy farming is categorized into three types based on factors such as the primary use of cows, farm size, and dairy product utilization: small-scale dairy farming (dairy farming for household consumption), medium-scale commercial dairy farming, and large-scale commercial dairy farming. For the purpose of this study, dairy farms are further classified into three groups based on herd size: less than 30 head of cattle, between 31-60 head, and more than 61(Table 2). Small-scale dairy farms are common in Iraq's northern region, whereas medium and large-scale operations are diminishing rapidly. Survey results indicate that half the small and medium-scale farmers keep cattle in a small, closed barn with other animals. Some of the barns do not have windows, cooling systems or electricity. The survey results also show that half of the farmers keep their animals in small and medium-sized open barns with other animals, which have similar conditions to those in closed barns. Cows are kept separate from other farm animals in 50% of cases, but this does not meet animal welfare or food safety standards.

Milk yield is one of the most important factors influencing the economic profitability of dairy farms (Ndambi et al., 2008). Increasing milk yield, while decreasing feed and other expenses, can result in financial gains for farms. Dairy cattle milk yields vary by region of the world due to a variety of factors such as nutrition, the genetic makeup of animals, the environment, and season (Reijs et al., 2013). This study estimated the average milk yield (Table 2). One cow's milk production changed from 1 kg to more than 15 kg per day. Improved cows with more than 15 liters/day of milk per head are mentioned here, which depends on staying in a barn and grazing outside, but local cows yield 1-7 liters per day, which depends on natural pasture, and grazing

land. However, milk productivity below 8 liters per cow per day is not profitable. The productivity was dictated by the breed type, with farmers preferring relatively expensive and affordable crossbreeds such as Jersey, Friesian, Simmental, Holstein, etc., which have more productivity compared to relatively cheaper local cows, which have low productivity when reared by farmers. The average annual milk yield in the region is below average compared to New Zealand (3343 kg), Australia (5600 kg), the United Kingdom (7101 kg), the United States (9332 kg), and Israel (10214 kg) (Rathod et al., 2017). The constraints on milk production in the study area were the shortage of feed, inadequate feeding system, limited grazing land availability, insufficient land for feed production, less accessibility to agro-industrial by-products, inadequacies in the breeding system, lack of community bull service in the area, low productivity of dairy cattle, lack of close examination of disease outbreaks, and lack of cooperatives (Kebede, 2009; Jongerden et al., 2018).

Table 2. The Structural characteristics of dairy farms in the northern region of Iraq

	Number of farms	%
Farm size (Mean= 67.68; Std. dev. = 71.49)		
Small-scale dairy farms (≤ 30)	98	35.0
Medium-scale dairy farms (31-60)	84	30.0
Large-scale dairy farms (≥ 61)	98	35.0
The type of breed kept by farmers		
Local cow	45	16.1
Culture and Cross cow	76	27.1
Both	92	32.9
No Idea	67	23.9
Average milk yield (liter/day) (Mean = 10.11; Std. dev.: 4.39)		
1-7	108	38.6
8-10	52	18.6
11-1	35	12.4
13-14	42	15.0
Above 15	43	15.4
Land size (in dunam)* (Mean = 1.73; Std. dev.: 0.77)		
≤ 5	132	47.1
6-10	92	32.9
≥ 11	56	20.0
Purpose of keeping livestock		
To increase income	117	41.8
To increase food security	28	10.0
Consumption (meat/milk)	53	18.9
Reproduction	53	18.9
As hobby	29	10.4
Share of income from livestock		
Selling cows	62	22.1
Selling calves	54	19.3
Selling bulls	60	21.4
Selling milk, yogurt, cheese, whey	104	37.2
Total	280	100.0

*: 1 dunam= 2500 m^2

The land is an essential source of livelihood for all farmers. It was expected that the larger the farm, the greater the possibility of combining technological packages (Sheng and Chancellor, 2019). However, landholdings are generally very small. Specifically, 47.1% of respondents own

less than five dunams, 32.9% own 6-10 dunams, and 20.0% own more than 11 dunams. These findings align with national reports indicating prevalent small-scale land ownership in rural areas. The diminutive size of farmers' landholdings can be attributed to unchecked population growth and land fragmentation.

As a cornerstone of the agricultural system, livestock serves a crucial role in household food security. It fulfills immediate financial needs, provides draft power, aids in loan repayment, facilitates transportation, offers fertilizer and fuel, contributes to dowries and gifts, acts as a buffer in the event of crop failure, and fulfills various social and cultural functions (Valk, 2019). In Iraq's northern region, milk producers maintain their livestock for multiple purposes, including draft power, income generation, consumption (both meat and milk), reproduction, ensuring food security, and as a recreational pursuit (Table 2). Slightly less than half of the farmers (41.8%) keep dairy cows for monetary reasons, such as selling milk as a source of additional income. Consequently, the majority of farmers in Iraq's northern region practice dairy farming primarily for financial gain. Approximately 10% of farmers practice dairy farming to improve their food security. Moreover, 18.9% keep dairy cows for meat and milk consumption, while 18.9% are for sale for reproduction. Only 10.4% of those farmers considered dairy farming a tradition or a hobby. As stated above, farmers keep dairy cows for a variety of reasons. Some farmers practice dairy farming for their milk consumption rather than for sale. Table 2 presents the estimated share of income from selling cows, calves, and bulls, as well as milk, cheese, whey, and yogurt. The highest share is from milk production (37.2%), followed by selling cows (22.1%). Farmers also sell the male calves and bulls to buy grass and animal feed. As a result, the income comes from sales of milk, yogurt, cheese, whey, and other products.

Moreover, cows were the most common animal in dairy farms. The average number of cows per farm was 28.22, the number of calves was 13.03, the number of heifers was 12.95, the number of bulls was 12.12, and the number of oxen was 1.35 (Table 3).

The dairy farming sector is intricately linked to milk yield and production (Brito et al., 2021). Farmers have enhanced animal feeding and breeding practices to increase milk productivity (Garrick and Snell, 2005). In certain countries, dairy farming involves two distinct types of cows: high-producing, "improved" breeds utilized for commercial purposes, and low-producing breeds managed through traditional methods (Marshall et al., 2020). Table 3 shows that the number of culture-cross cows is larger than that of local cows. Farmers have preferred to choose cross and culture cows because they are higher milk-yielding animals than local cows. This presents a promising outlook for milk production in the near future. Additionally, it is noteworthy to highlight that local cows have adapted effectively to the country's environment.

The first 100 days of lactation are commonly referred to as "early lactation." Cows will reach their peak milk production at the start of this phase (during the second month of lactation). Feed intake is low, and cows typically lose weight. Peak dry matter will be reached at the end of early lactation, and no weight loss will occur (Biçoku and Uruçi, 2013). Cattle breeds like local cows and culture-cross cows were found on typical farms. Lactation averages 265.22 days for crossbred and cultured cow farms and 198.94 days for local dairy farms (Table 3). The result indicates that the mean is greater for crossbred cows than for local cows.

3.3. Technologies Utilized by Dairy Farmers for Cattle Management

Precision dairy farming technologies serve several purposes for dairy farmers, researchers, and producers. These technologies help farmers care for their animals without the need for skilled labor. It should ensure that technologies in this area meet the needs of dairy farmers as a whole (Shelley, 2016). Modern livestock building systems provide increasingly advanced methods of improving operational economics and efficiency (Wojdalski et al., 2008). Housing technology adoption entails

improving recommended housing conditions, such as the use of a feeding trough, gutter, floor, sidewalls, and roofing (Funk et al., 2018). For instance, dairy farming aims to achieve the highest milk yield of cows while maintaining the welfare of the animals by keeping a suitable climate in barns (Samer, 2010).

Table 3. The average number of animal types and lactation length

	Mean	Std. deviation
The number of animals (head)		
Cows	28.22	37.08
Calves	13.03	15.78
Heifers	12.95	13.52
Bulls	12.12	13.39
Oxen	1.35	1.34
Lactation length (days)		
Cross and culture cows	265.22	33.37
Local cows	198.94	32.37

In the research area, small and medium-sized farmers put cattle in small and closed barns with other animals. Sometimes the barn is not equipped with windows and a cooling system. Other problems touched on in the interviews with farmers include a lack of electric ventilation and water. Inadequate water access for livestock during the dry season has emerged as a critical priority in the region. In addition, the mixing of sewage with rivers is a major problem. Moreover, 60% of the farmers do not have electric ventilation and complained about the lack of electricity provided by the government.

Table 4. Implementation of Cooling and Barn Ventilation Systems on Dairy Farms

Variables	Yes	%	No	%	Total	%
Have cooling systems	168	60.0	112	40.0	280	100.0
Have refrigerators for cooling milk	280	100.0	0	0,0	280	100.0
Have enough water for animals throughout the day	257	91.8	23	8,2	280	100.0
Have an electric barn ventilation system	206	73.6	74	26,4	280	100.0

The findings revealed that the majority of farmers (75%) rely on hand milking (Table 5). For most, the adoption of milking machines is unfeasible primarily due to their cost and the lack of training provided by the government on their usage. However, hand milking poses significant challenges in rural areas. In the research area, a majority of farmers neglect to disinfect their hands prior to commencing milking activities. Additionally, farmers residing in rural areas continue to produce cheese, yogurt, whey, butter, and other dairy products at home without oversight, subsequently vending them informally. Consequently, this practice undermines food safety and hygiene standards significantly. Additionally, because production on these farms is still simple, they do not use any milking equipment. Furthermore, the fresh milk was not tested to ensure it was microbes-free. It is also susceptible to contamination from sources unrelated to the cow's feed, the quality of the water supply, or its health status.

Water sources for dairy farmers are related to a management pattern within water supply systems (Castells et al., 2018). In the research area, the majority of farmers (56.8%) rely on river water, 21.8% on surface water (ponds/fountains/dams), 16.4% on water piped by an electric motor, and about 5% use both ground and surface water.

The challenge facing ecological engineering lies in developing cost-effective technologies capable of treating manure as a waste source and, ideally, transforming it into a valuable resource (Joshi and

Wang, 2018). Cleaning and disinfecting are critical to the well-being and health of high-producing animals like dairy cows. This is especially true in dense modern housing, where the infection pressure is increased by high density and productivity. Thorough cleaning and appropriate disinfection reduce pathogen levels and help to prevent or break the disease cycle. In addition, each day, the cow barn is scraped and cleaned. Results indicated that 98.2% of farms used the manual method to drain manure (Table 5).

Dairy cattle productivity is influenced by grass intake and the nutritive value of the grass (Van Vuuren and Pol, 2006). Feed intake is influenced by the cow's behavior, which includes where, when, and how she consumes the provided diet (Büchel and Sundrum, 2014). Many studies in Kenya have found that a variety of improved feeding, animal health, breeding, and calf management practices can boost milk yields (Richards, 2017). A maximum of 300 to 700 kg body weight for crossbred cows can be expected. This will satisfy the energy and protein needs for maintenance, along with producing 15 to 25 kg of milk. In addition, supplemental feeding of maize silage or carbohydrate-rich concentrates can alleviate the stress of grassland management (Albantov, 2019). Dairy cows housed in barns are tethered continuously or for part of the day. Some farmers were willing to support a stay in a barn all day for dairy cattle. However, local breeds primarily rely on grazing in the surrounding pastures as their main feed source. Concentrate mixed feeds, crop residues, and recommended ration feeds were predominantly utilized for crossbreeds. Approximately 48.6% of participants indicated they graze freely (in the pasture) between March and September, have no grazing between October and February, and would support staying in a barn. On the other hand, 51.4% of dairy farmers stated they would support depending on grazing land and staying in the barn. However, support for a stay in the barn and dependent grazing increased as expected, resulting in a larger-than-expected decrease in the cost of feeding. Cattle are primarily fed on non-arable land in natural pastures. Throughout the day, they are permitted to graze on communal village grazing land. Non-arable land provides the majority of green fodder for ruminant animals due to the absence of available arable land for dairy farm feed production. This non-arable land is typically found outside of farms as public wasteland near rivers and roads. Farmers with many cows try to secure enough food from grass in the summer and flour, barley, alfalfa, and straw in the cold season, despite the high prices of these materials, in an effort by small farmers to improve the quality of dairy products, care for their animals, and keep up with animal welfare regulations. Furthermore, fodder is traditionally made in villages from tree leaves, as well as tender shoots and twigs. Tree fodder has recently gained popularity as livestock feed.

The primary challenges associated with enhancing forage availability are a lack of animal feed policy (38.6%), high feed costs (33.2%), and inadequate feeding (28.2%). Farmers face numerous challenges, livestock farmers who have difficulty feeding their livestock due to drought and pasture poverty, as well as insufficient forage and the difficulty of preparing food from the open market, have made it more difficult for the livestock and livestock industry to survive. Natural pasture feeds, barley, alfalfa, flour, grass, mixed feed, and other purchased serve as the main sources of livestock feed in this area. Consequently, the majority of livestock feed is derived from planted forages, cropped land, and imported feed. Weeds and fodder crops cultivated on soil conservation terraces emerge as significant contributors to livestock feed on numerous farms, especially those reliant on grazing land and staying in the barn (Çetinkaya et al., 2023; Rangnekar and Thorpe, 2001). According to the results, more than half of the barley in the research area comes from the west of Iraq.

Animal breeding programs have been developed to improve dairy productivity and herd fertility by reducing breeding diseases and removing the cost of keeping a bull (Mohammed, 2018). Artificial insemination (AI) improves genetic quality for the next generation, thereby contributing to milk

production. Shortening calving intervals, on the other hand, is regarded as an easier method of conceiving than natural mating, with one successful pregnancy out of every four artificial inseminations (Al-Sobayil, 2006). The borders are open for importing different types of cattle to the north of Iraq. While local breeds produce between 1 and 7 liters of milk per cow, crossbred or graded dairy cattle in northern Iraq produce more than 15 kg per day. A few crossbreed owners practiced natural breeding, which could be attributed to their aversion to AI. Moreover, a few farmers replace local cows with a few high-yielding genotypes by upgrading them with exotic breeds. Two breeding methods, namely natural mating using bulls and AI, were reported in the study area. Specifically, 53.2% of respondents utilize artificial insemination, 21.8% opt for bull service, and 25% employ both artificial insemination and bull service for dairy cattle breeding. In the study area, the three most critical constraints hindering access were identified as the distance to the AI station, a shortage of skilled AI technicians, and inadequate availability of liquid nitrogen and semen (Table 5).

Table 5. Modern Agricultural Technologies Utilized by Farmers

	Number of farms	%
Type of milking		
Milk by Machine	56	20.0
Milk by Hand	210	75.0
Both	14	5.0
Sources of water supply		
Pond/fountain/dam	61	21.8
Piped water by an electric motor	46	16.4
River	159	56.8
Combined Source	14	5.0
Cleaning type		
Manual method	275	98.2
Falls in a channel (hole)	5	1.8
Feeding system		
Free graze (in the pasture) between March and September and no grazing between October and February	136	48.6
Keep in the barn	144	51.4
Major constraints fort feeding		
Lack of animal feed policy	108	38.6
High cost of feed	93	33.2
Inadequate feeding	79	28.2
Involvement in main dairy farming activities		
Self-employed or unpaid workers (family member)	169	60.4
Paid workers	49	17.5
Both	62	22.1
Mating type		
Bull (controlled)	149	53.2
AI	61	21.8
Bull (uncontrolled)	70	25.0
Major constraints for access to artificial insemination		
Lack of access	52	18.6
Shortage of liquid nitrogen and semen	69	24.6
Lack of skilled AI technician	79	28.2
Distance to AI station	80	28.6
Total	280	100.0

3.4. Extension and Advisory Services

Many developing countries have recently reaffirmed the critical role of agricultural extension in agricultural development (Walker and Sarkar, 1996). Negative extension experiences in the past have sparked considerable debate around the world about the best way to provide agricultural extension (Oladele, 2004). The scale of dairy farming units in Iraq's northern region is very small. A large-scale expansion of the economy is required for the sector's improvement. The government is the main provider of extension and advisory services in the dairy industry but is underfunded. To identify strategies for making agricultural extension demand-driven, a range of institutional options for providing and financing these services must be considered, keeping in mind that the government, private, and third-sector organizations such as NGOs can collaborate in various combinations.

Farmers' prior knowledge of the standards to follow during milk production was assessed, based on their responses to survey questions, as high (50.0%), medium (36.4%), or low (13.6%). This means that the percentage of farmers who had more prior knowledge is higher than the percentage of farmers who had a low level of prior knowledge (Table 6). Dairy farming information and in-depth knowledge are vital for profitable dairy farming. To design and develop an effective information system to provide farmers with relevant and authoritative information, it is essential to understand their information needs and seeking behavior (Boz et al., 2011). Dairy farms have become a livelihood for some farmers in the northern region of Iraq. Most dairy farmers are not registered with the Ministry of Agriculture (namely the Department of Animals). The main factor that decreases farmers' membership in dairy farming groups is that contact between farmers and government centers is weak. Many farmers have switched to becoming agricultural laborers or construction workers, or are trying to find other active jobs. It is evident from the respondents that farmers join social media groups to exchange information, instead of the animal department.

Table 6 shows dairy farmers access information about milk production not only from other farmers and friends (48.9%), but also from other sources such as the animal market and farmer representatives (17.9%), newspapers, radio, and TV (10.4%), and the internet such as Facebook and other and social media (16.4%). The majority of farmers interviewed complained about television and radio programs, claiming there are not enough programs about dairy production.

According to Table 6, the majority of farms shared information with others to a medium degree. The percentages of respondents who shared information with others were 20.0%, 59.3%, and 20.7% for the low, medium, and high-extent categories, respectively. According to the results, informal knowledge flow is very important in sharing experiences among milk producers. Most of the farmers prefer self-owned indigenous information. This emphasizes the importance of incorporating indigenous knowledge into each farm's development intervention.

Training needs were assessed against a ranking from 1 to 10. Table 6 indicates that to run a dairy on a domestic, semi-commercial, or commercial scale, farmers gave top priority to marketing and processing. For domestic and semi-commercial purposes, the priority was feed management, because feed accounts for most of the total cost of dairy farming. Likewise, housing and general farm management were ranked 3rd and 4th after marketing and feed management. This was probably due to the poor feeding and management conditions followed by the farmers. Additionally, milk production was ranked 5th by all the categories of farmers, which indicated that getting more income was the sole criterion. Reproduction, animal disease, pregnant animals, artificial insemination, herd care, and farm accounts/record-keeping were given less consideration by all the farmers. Thus, training in this aspect is required at all levels. To summarize, analyzing the training needs of each category is essential to make training and demonstrations more effective in technology transfer. Otherwise, the total effort made by extension staff engaged in the dairy sector will be futile.

Table 6. Extension and advisory services

	Number of farms	%
Prior knowledge level		
High	140	50.0
Medium	102	36.4
Low	38	13.6
Major sources of information for milk production		
From other farmers and friends	137	48.9
Animal market and farmer representative	50	17.9
Media (Radio, TV, newspapers, etc.)	29	10.4
Workshops, seminars, and meetings	18	6.4
Internet services and social media	46	16.4
Sharing of available information with others		
Share to a low extent	56	20.0
Share to a medium extent	166	59.3
Share to a high extent	58	20.7
Training needs		
General farm management	32	11.4
Herd care	15	5.4
Feed management	47	16.8
Animal disease	18	6.4
Housing management	34	12.1
Marketing and processing	49	17.5
Milk production	29	10.4
Reproductive management	19	6.8
Pregnant animals and artificial insemination	18	6.4
Farm accounts/record keeping	19	6.8
Animal health problems		
Insufficient availability of veterinary drugs	56	20.0
Distance to the animal health center	71	25.4
Shortage of skilled animal health technicians	47	16.8
Limited access to laboratory services	49	17.5
Lack of timely vaccination	57	20.3
Sources of veterinary services		
Government agencies	39	13.9
Private veterinarian	201	71.8
Government and Private	40	14.3
Practices		
Vitamins and other supplements given	196	70.0
Isolation of sick cows from healthy cows	108	38.6
Periodic health check	208	74.3
Have vaccinations given	262	93.6
Used antibiotics for other purposes than mastitis treatment	155	55.4
Total	280	100.0

The main objectives for farms differ considerably between farmers: whereas some focus mainly on milk production, others prefer a healthy herd or few problems (Derks et al., 2013). It was impossible to investigate the specific and unique relationship between veterinarians and farmers for this study because measuring the strength of this relationship requires more research (Firth et al.,

2019). Improving veterinary service delivery to combat and control emerging and reemerging animal diseases is an important step toward addressing the benefits of increased global demand for livestock products (Leyland and Catley, 2002).

The most commonly reported problems with access to animal health service delivery were distance to animal health centers (25.4%), lack of timely vaccination of animals (20.3%), insufficient availability of veterinary drugs (20.0%), limited access to laboratory services (17.5%), and a shortage of skilled animal health technicians (16.8%).

Regarding the primary sources of veterinary services, the private sector accounted for 71.8%, followed by government services at 13.9%. Additionally, a small percentage accessed services from both the government and the private sector, totaling 14.3%. Farmers use healthcare practices to a reasonable extent. Most of the farmers followed practices like giving vitamins and other supplements, isolating sick cows from healthy cows, periodic health checks, vaccinations, and antibiotics. However, maintaining good dairy records such as breeding dates, date of birth, the treatment given, previous health problems, daily milk yield, and other relevant data is critical for scientific and improved dairy farming. Nevertheless, only a few dairy farmers in the study area kept dairy animal records. Low literacy rates, lack of time, and lack of training may have contributed to farmers' failure to adopt and maintain proper dairy management records.

3.5. Marketing of Dairy Products

Market conditions, supply and demand balance, milk quantity, seasonal fluctuations in milk quantity, and geographical location are effective factors in marketing dairy products (Upton et al., 2013). The raw milk reference price in the region is determined by bargaining between buyers/industrialists and farmers (Madau et al., 2016). The supply and demand balance strongly influences the milk price (Basagaoglu, 2020). The cost of producing milk, particularly the assessment of cash and economic costs, is an important indicator for long-term dairy farming. Moreover, both factors and product markets, both locally and globally, are used to estimate overall economic competitiveness. Furthermore, to remain competitive, dairy organizations and farmers must strive to reduce farm-level costs (Hemme et al., 2014).

According to the study, most dairy farmers were nervous about selling their products because of the low buying price. In the research area, the researcher found out that some local bazaars buy milk from Northern Iraqi farmers for 500–1750 IQD per liter. A difference in relative prices, suggesting increased demand for convenience milk and dairy products, plays an important role in explaining dairy product patterns. As consumers substitute processed imported milk for locally produced milk, they move to imported pasteurized milk due to expected volatility in local prices.

In the research area, milk can be purchased from street vendors. Following each milking, the milk is cooled and delivered in various containers. In the collecting system, milk is transferred to local shops, families, friends, middlemen, processors, and confectionery-buying firms. To a large extent, the majority of raw milk produced is unregistered and sold publicly on the streets. However, to increase the efficiency of production facilities, improvements must be made in the milk market in the northern region of Iraq.

In addition, milk collection centers were not available in Northern Iraq, and farmers sold milk directly to consumers and milk/sweet shops in the city by vehicle. This deters some farmers from improving their production potential.

The survey results highlight the significant challenges many farmers encounter when attempting to sell the milk they produce, primarily due to their limited control over the milk market. Consequently, they must explore alternative channels for marketing their products. According to Table 7, the majority of farmers (around 30%) opt to sell their milk to neighbors, family, and friends. Approximately 17.1% rely on small

supermarkets, while 17.5% attempt to sell to middlemen who collect milk from farmers. Furthermore, 18.6% of farmers sell their milk to processors, while 16.8% supply it to confectionery producers.

The distances that dairy farmers travel to sell their dairy products were of interest to show the transportation costs associated with operating a dairy farm. Table 7 shows that 20.0% of farmers travel less than 5 kilometers, 30.4% travel 6-10 kilometers, and 12.4% travel more than 21 kilometers to sell their dairy products. Most farmers do not incur transportation costs when selling dairy products because they sell dairy products at the farm gate, incurring only input-related costs. In addition, most dairy farmers suggested that dairy feed should be sold not only in rural and urban areas but also at sub-regional levels and that the government should support the use of dairy inputs.

Table 7. The sale price of a liter of milk on dairy farms

	Number of farms	Percent
The sale price of milk (IQD) (Mean = 1173.0; Std.: 230.7)		
500-1000	105	37.5
1000-1500	121	43.2
1500-1750	54	19.3
Marketing Channels		
Sales to neighbors/ family/ friends	84	30.0
Small supermarkets	48	17.1
Middlemen	49	17.5
Processors	52	18.6
Confectionery	47	16.8
Distance (KM) (Mean = 13.3; Std.: 8.9)		
Less than 5	56	20.0
6-10	85	30.4
11-15	68	24.3
16-20	36	12.9
More than 20	35	12.4
Problems and constraints of milk marketing		
Poor quality of milk/sour milk	22	7.9
No market	105	37.5
Low price	37	13.2
High import of milk	85	30.3
Other	31	11.1
Totals	280	100.0

Dairy farmers face many milk marketing problems and constraints in the study area. There is no special market for selling milk. If farmers want to sell milk, they have to go to the local bazaar. The price of milk is determined by the seller, and it is not stable. The government does not intervene. In this situation, farmers can make heavy losses and are obliged to consume their surplus milk production, though they want to sell it. Milk going sour is also a problem for dairy, which is the cost that farmers bear. Other problems include a lack of scientific testing centers, vehicles, and well-maintained roads for transporting milk. Farmers' technical knowledge in the region is very low.

The main issue in milk marketing is the absence of a milk market in the region. Thus, 30.3% of farmers were dissatisfied with open borders and import smuggling. Moreover, 13.2% of farmers stated that the main issue with milk marketing is low prices, while 7.9% faced poor milk quality. More than 11% of households cited other problems with milk marketing, such as lack of

good transportation, lack of a milk product industry, lack of processing and acidification, etc.

4. CONCLUSION AND RECOMMENDATIONS

The global production and trade of milk and dairy products have witnessed a steady rise, owing to their vital role in promoting human health and nutrition. Globally, there has been a consistent increase in herd size and milk production over the years. However, despite this trend, Iraq remains heavily reliant on imported dairy products as it struggles with self-sufficiency in dairy production. The dairy sector in northern Iraq is characterized by small-scale, unorganized milk animal holders, alongside challenges such as scattered and inadequate animal feeding practices and insufficient healthcare provisions. Farmers are forced to accept low animal production for economic reasons due to a scarcity of good forage and the high cost of concentrates. Crossbred cows that produce more than 15 liters of milk per day require more feeding in proportion to their body weight. However, such feed is not available at affordable prices. One of the most important problems in the research area is the need for milk collection centers that are not in this region. An increase in the current daily milk production level can be achieved if there is an investment in market infrastructure as well as an improvement in the economy as a whole.

The results of the study indicate that most of the farmers, due to poor agricultural education, have used only the experience and knowledge of other traditional cattle breeders and do not have enough training in this field. It is suggested that agricultural extension and universities try to control or significantly reduce risk from the start by improving farmer skills and providing appropriate training programs for farmers. Due to the lack of knowledge about the training classes held in some areas, it is suggested that more information be provided in this regard through the extension and with the universities. In addition, it is necessary to raise farmers' awareness and change their attitudes towards the benefits of new systems through appropriate training in familiarity with technological factors. Furthermore, due to the high cost of advanced livestock technologies, farmers should be given more credit and government assistance in this area so that they can use these factors to implement better risk management in their livestock. Additionally, examining the research findings, most traditional farmers are not familiar with veterinary centers. It is suggested that measures be taken by holding training classes for ranchers to increase their awareness of the use of new health methods. Drought seasons have had a negative impact on water resources; Both the drinking water of the animals and the pastures were affected. The government should make it easier for dairy farmers to get enough water, especially during dry periods.

To quantitatively and qualitatively develop the dairy industry in the northern region of Iraq, it is recommended that large-scale dairy farms be allowed to applicants whose field of study is directly related to the profession and who are not employed by any governmental or non-governmental organization. The government should provide continuous training for dairy farmers in the country on the management of the use of institutions, control of livestock health, and fight against livestock diseases, and every year dairy farmers should be encouraged and provided facilities to visit the country's exemplary farms.

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